Society of Open Innovation Technology, Market & Complexity

DGIST

WORLD CAPITAL INSTITUTE

PROGRAMME OF

SOItmC & KCWS 2015

Society of Open Innovation :

Technology, Market, and Complexity (SOItmC) &

Knowledge Cities World Summit (KCWS) 2015

June 14 ~ 18, DGIST, Daegu, Korea

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Welcoming Remarks by the President of DGIST

- SOItmC and KCWS 2015 -

Distinguished invited speakers, Honorable guests, Ladies and Gentleman,

It is my pleasure and privilege for me to welcome all of you on the Society of Open Innovation: Technology, Market, and Complexity (SOItmC) and the Knowledge City World Summit (KCWS) 2015 Conference to be held on June 14~18 at DGIST.

DGIST is a research-oriented university founded by the Korean government. DGIST started as a research institute in 2004 and grew dramatically into a research-oriented university by opening graduate program in 2011 and undergraduate program in 2014. The vision of DGIST is to become a 'world-leading convergence research university' by nurturing the global leaders of knowledge creation and creating future convergence technology. As mentioned in the vision, 'Convergence' is the key word of DGIST. We believe that a breakthrough and innovation could be made more effectively though convergence research among various fields.

Considering that DGIST pursues academic excellence through knowledge creation and convergence, it is appropriate for DGIST to host SOItmC and KCWS 2015 to be held under the themes of Open Innovation, Knowledge City, and Creative Economy. Various topics such as Entrepreneurship, Start-ups, Smart Technology, City of Future, Smart Mobility, and Creative City will also be covered in the conference.

Among the seven strategic plans I suggested in my inaugural speech in March this year when I began my second term as DGIST President, four are 'strengthening and completing our innovative undergraduate program,' 'serving as a vanguard of the Creative Economy Model,' 'development of Innovation & Entrepreneurship (I&E) Zone,' and 'development of our unique spirits and advanced culture.' I believe that this SOItmC and KCWS 2015 will contribute for us to carry forward our plans.

I take this opportunity to express sincere appreciation to distinguished scholars who take time to share their ideas and knowledge at this conference, and members of the Organizing Committee, as well as Dr. JinHyo Joseph Yun, Chair of the committee.

I believe that this conference will serve a forum for all experts from all over the world to share their experiences and knowledge, and hope all participants truly enjoy the academic excellence of the conference. Thank you.

June 15, 2015

Shin Sung-chul
President of DGIST

Congratulatory Speech by the Mayor of Daegu Metropolitan City

Hello, I am Kwon Young-jin, Mayor of Daegu Metropolitan City Government.

I welcome all of you, professors, researchers, students, businessmen, and start-up entrepreneurs from 20 countries, who have come to Daegu to participate in the Society of Open Innovation: Technology, Market, and Complexity (SOItmC) and the Knowledge City World Summit (KCWS) 2015 Conference. First, I would like to express my deep gratitude to Shin Sung-chul, President of DGIST; Yun Jin-hyo, President of SOItmC; and Javier Carrillo, President of the World Capital Institute, for their efforts to hold this academic conference in Daegu today.

I do agree with and share the three themes of this conference: Open Innovation, Knowledge City, and Creative Economy. As it was “Happy People, Creative Daegu” that I suggested as a vision for Daegu when I took office as the 33rd mayor of Daegu, I expect that this conference will serve as a driving force that makes the industrial city of Daegu develop into a knowledge-based information city by proposing specific tools and methods for the realization of “Happy People, Creative Daegu” through diverse discussions on the themes of this occasion.

I proposed six strategies when I was inaugurated as the mayor of Daegu. One of them was to make Daegu a leader of the creative economy of Korea. I am paying close attention to the fact that this conference is preparing sessions and presentations according to the themes of Knowledge City, Start-ups, and Creative Economy. I anticipate various ideas and policies necessary for making Daegu as a creative economy leader.

Another strategy for future Daegu was to transform it into a prosperous culture city. I believe that diverse and open cultures will provide the main impetus for a sustainable development, so I would like for novel ideas to be generated from sessions and presentations on this occasion so that Daegu will be able to play a role as a melting pot. It is Daegu that produced Lee In-sung, who is called an “Asian van Gogh” and formed a cultural hub of modern Korean art history. Moreover, Daegu was where Great Master Wonhyo and Master Ilyeon established the roots of a creative spirit, and where the egalitarian spirit of the Donghak Revolution stemmed from. What is our alternative for constructing the innovative and future city Daegu where culture is still alive? I hope that this conference will give us an answer to this question.

I also pledged that I would do my best to make Daegu a city of communication and good governance. Communication and governance are top priorities for Daegu to grow as a creative city through open innovation. To this end, I expect that this academic conference will lay out different ideas based on an open innovation culture.

Again, I would like to welcome all of you today here in this SOItmC and KCWS 2015 Conference. I sincerely hope that you will take time out of your busy schedule to enjoy the picturesque nature and night view of Daegu. Thank you.

June 15, 2015

Kwon Young-jin
Mayor of Daegu Metropolitan City Government

Welcome Speech by the President of World Capital Institute

Professor Sung-Chul Shin, President of DGIST
Young-Jin Kwon (Mayor of Daegu Metropolitan City)
Professor JinHyo Joseph Yun, President of SOItmC and Co-hoster of SOItmC and KCWS 2015
Colleagues and friends associated to the World Capital Institute,
Faculty and students of DGIST
Participants from Korea and the City of Daegu

On behalf of the World Capital Institute, I celebrate the occasion of the 8th Knowledge Cities World Summit being hosted by the City of Daegu and the prestigious Daegu Gyeongbuk Institute of Science and Technology, as a joint conference with the 1st Society of Open Innovation: Technology, Market, and Complexity. After a substantial effort by all parts, we are able to meet for enjoying a most appealing scientific program. This program might be just the starting point of new or renewed collaboration amongst those interested in furthering the Open Innovation and Knowledge-based Development agenda.

Regarding innovation and the Knowledge Economy, South Korea has set an international example by the way in which it focused its development policies in a systematic strengthening of education and the institutional base for science and technology. No doubt, South Korea has accomplished a major upgrade of its industrial platform by consistently moving towards technology-intensive production. My Korean friends, you may feel proud of these achievements as these are well documented and admired throughout the world.

But that might be just a starting point. The transition from the Industrial to the Knowledge Society involves a deeper transformation of the social value base, a disruption of the entire economic culture. The understanding and mobilization of the intangible capital that makes the distinctive base of knowledge-based production and life, calls for a major transformation of institutions, practices, roles and underlying values. It also calls for a redefinition of socio-economic agents and the way they engage in value creation, distribution and consumption.

The future of South Korea is now open to the possibility of an upgrade in human life, one where collective capitals such as national and regional identity, sense of belonging, social cohesion, economic equality, human rights, gender balance, political transparency, citizen engagement, public accountancy, etc., become the focus of policy and accountability. A society centered not only on economic growth, but also on sustainability, quality of life, subjective well-being and the discretionary use of time. One where getting what one wants is balanced by choosing what one does.

I wish you all a most productive conference. I also take the opportunity to thank our gracious hosts the city of Daegu and the DGIST. I am particularly grateful to Professor JinHyo Joseph Yun, President of SOItmC and Co-hoster of SOItmC and KCWS 2015, for his leadership in making this event happen. I am also grateful to his entire team, as well as to all the faculty who co-sponsored the keynote speakers participation. I regret the absence this year of the WCI Executive Director for Events, Prof. Tan Yigitcanlar and look forward to see him back at KCWS 2016. Finally, I welcome Profs. Tommi Inkinen and Katri-Liis Lepik as WCI representatives, as well as Dr. Blanca García, WCI Executive Director for the MAKCi Awards.

Thank you and congratulations to you all.

June 15, 2015

Dr. Francisco Javier Carrillo Gamboa
President
World Capital Institute

Welcome Speech by the President of SOItmC

Hello! I am Yun Jin-hyo, President of the Society of Open Innovation: Technology, Market, and Complexity (SOItmC).

I would like to express my heartfelt gratitude to Shin Sung-chul, President of DGIST, and Kwon Young-jin, Mayor of Daegu Metropolitan City Government, for their full financial and emotional support to make the SOItmC and KCWS 2015 Conference successful. I would also like to thank Javier Carrillo, President of the World Capital Institute, for his efforts to hold the joint international academic conference with SOItmC in spite of difficult circumstances.

Beginning with the publication of "Capital in the 21st Century" written by Thomas Piketty, academic and economic circles have suggested a variety of methods to grapple with the limits of capitalism without growth. Against this backdrop, the global academic organization Society of Open Innovation: Technology, Market, and Complexity (SOItmC) was founded in DGIST on October 27, 2014 (http://www.openinnovationtmc.org). This organization is designed to establish a new growth paradigm for the modern capitalist economy, featuring complex systems by researching on creative and open innovation relationships between technologies and markets and by developing business models on the creative combinations of technologies and markets.

SOItmC is based on the engagement of professors, researchers, businessmen, and start-up entrepreneurs from diverse fields ranging from economic management to ICT and robot engineering. Approximately 300 people participate in SOItmC. Specifically, they are renowned scholars from 25 countries, including the United States, China, Japan, the United Kingdom, Australia, and Finland; domestic professors of major universities, such as KAIST, POSTECH, Seoul National University, Korea University, Yonsei University, and Sungkyunkwan University, and major local universities, such as Keimyung University and Kyungpook National University; DGIST professors and researchers; and creative businessmen from all over the world.

Under the themes of Open Innovation, Knowledge City, and Creative Economy, SOItmC is going to co-host the SOItmC and KCWS 2015 Conference with the World Capital Institute in DGIST from June 14 to 18 this year. The SOItmC and KCWS 2015 Conference will provide a momentum to explore theoretical and practical alternatives for building creative relationships and combinations between technologies and markets to construct a creative economy not only for the knowledge-based city Daegu but also for Korea.

On June 15, under the theme of Open Innovation, this conference is composed of three keynote speeches delivered by Philip Cooke, Taeho Park, and yours truly; three special sessions led by KeeHeon Cho, MinHwa Lee, DongKyu Won, ChoongJae Im, and SanChul Park; and two general sessions. Moreover, there will be nine Open Innovation and Business Models contests where Wanjong Joo, Avvari Mohan, KyunbBae Park, and ChoongJae Im will participate as reviewers.

On June 16, under the theme of Knowledge City, it will begin with keynote speeches delivered by Francisco Javier Carrillo, Tan Yigitcanlar, Tommi Inkinen, Katri-Liis Lepik, and Keun Lee. Then, there will be five sessions with Jaehoon Rhee, Eunnyeong Heo, WooSung Jung, SangHo Lee, KwangHo Jung, and SangOk Choi..

On June 17, under the theme of Creative Economy, Fumio Kodama, Blanca Garcia, Venni Krishna, and KongRae Lee will deliver keynote speeches first. Then, there will be 3 sessions with KyunbBae Park, YoHan Kim, and KwangHo Jung.

This academic conference has already achieved a big success, with 100 theses or OI and BM cases received and 150 applicants registered.

I hope that this SOItmC and KCWS 2015 Conference will serve as a new motive for conquering the growth limits of capitalism through open networks between technologies and markets and creative combinations of technologies and markets. To end my speech, I would like to quote Robert Schuller:

“Winning starts with beginning.”

“Failure doesn’t mean you are a failure; it just means you haven’t succeeded yet.”

June 15, 2015

Jin-hyo Joseph Yun
President of the Society of Open Innovation: Technology, Market, and Complexity
Co-host of the SOItmC and KCWS 2015 Conference

Conference Schedule (Updated on 06. 14, 2015)

Sunday, 14th June 2015 ※ Presider: Prof. KyungBae Park (SangJi University) Director: Prof. DooSeok Lee (DGIST)	
16:00 ~ 19:00 Venue: Lobby on the 2nd floor	Registration
17:00 ~ 18:00 Venue: Lobby & R#: 203 on the 2nd floor in B/D. R1	Welcome Reception ※ Appendix 4. Transportations to DGIST ※ Appendix 6. Campus Map
18:10 ~ 19:00 Venue: Lobby & R#: 203 on the 2nd floor in B/D. R1	Meeting with Keynote Speakers, Special Session Chairs, and World Capital Institute Members
Monday, 15th June 2015 (Open Innovation Day) ※ Presider: Prof. KiSeok Kwon (Hanbat National University) Director: Prof. DooSeok Lee (DGIST)	
08:00 – 14:00 Venue: Lobby on the 2nd floor	Registration
09:00 – 09:15 Venue: Auditorium (B/D: R1, R#: 204)	Welcome Speech by the President of SOItmC Welcome Speech by the President of KCWS

09:15 – 10:15 Venue: Auditorium (B/D: R1, R#: 204)	**Keynote Speech** · Philip Cooke (Bergen University College, Norway) Presentation Theme: "The Future of Innovation: Challenges, Complexity & Crossovers" · Taeho Park (San Jose State University, USA) Presentation Theme: "Open Innovation in Supply Chain Management for Creative Economy" · JinHyo Joseph Yun (DGIST, Korea) Presentation Theme: "How do we conquer the growth limit of capitalism: Schumpeterian Dynamics of Open Innovation Economy System"	
10:15 – 10:45 Venue: Auditorium (B/D: R1, R#: 204)	**Welcoming Remarks by the President of DGIST** **Congratulatory Speech by the Mayor of Daegu Metropolitan City**	
10:45 – 11:00 Venue: Lobby on the 2nd floor	**Coffee Break**	
11:00 – 12:30	Venue: R# 202 (Conference Room) **Special Session 1:** "The Importance of Valuation and Big Data as a Source of Technology Commercialization in Open Innovation Era" · Session Chair: KeeHeon Cho (Korea Valuation Association) · Honorary Discussant: Keun Lee (Seoul National University) ✓ Paper 1: "Valuation using royalty data in Life Science area–Focused on Anticancer and cardiovascular therapies" by JeongHee Lee(Digital Science Co., Ltd.), Youngyong In(Digital Science Co., Ltd.), Il–Hyung Lee(KISTI), JoonWoo Lee(KISTI)	Venue: R#: 203 (International Conference Hall) **General Session 1:** "Creative Economy & Open Innovation" · Session Chair: MinHwa Lee(KAIST) · Discussant: TBD ✓ Paper 1: "The Platform Business Model and Business Ecosystem: Quality Management and

<table>
<tr>
<td></td>
<td>✓ Paper 2: “Review of the New Product Development Strategy and Corporate's Competition” by JaeMan Joo (Duksung Women's University)
✓ Paper 3: “Open Innovation of Knowledge Cities” by JinHyo Joseph Yun(DGIST), EuiSeob Jeong(KISTI), SangChul Lee(DGIST), JeongHo Yang(DGIST)
✓ Paper 4: “Technology Valuation by Collective Intelligence” by YoungGi Kim(Gisang Co., Ltd.), Taehoon Kwon(KISTI), TaeJong Jang(KISTI)
✓ Paper 5: “The Economic Value of Brands and Patents in Manufacturing Firms of South Korea” by SoJin Lim(Korea Institute of Intellectual Property)
✓ Paper 6: "Schumpeterian Analysis of Catch-up and Catch-up cycles" by Keun Lee(Seoul National University) and Franco Malerba(Bocconi University)</td>
<td>Revenue Structures” by Junic Kim(University of Manchester, UK)
✓ Paper 2: “A Case Study on the Motivational Effects of Platform Systems based Hardware Startup on Open Innovation” by So-Young Lee, Ph.D.(KCERN), MinHwa Lee(KAIST)
✓ Paper 3: “Fintech, the Open Innovation to Unbundling Financial Industry and the Next” by Myungho Lee(KCERN)
✓ Paper 4: “A Study on the Direction of Korea’s Open Innovation Technology Market” by Ae-Sun Kim(KCERN), MinHwa Lee(KAIST)
✓ Paper 5: “O2O Convergence trend and Gamification that stimulates open innovation: Focused on crowd souring” by Kyungju Choi(KCERN), MinHwa Lee(KAIST)</td>
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<td>12:30 - 14:00</td>
<td colspan="2">Lunch Break

Venue 1 (Cafeteria) : B/D R1, 1st floor
Venue 2 (Family Restaurant, “Okon”) : B/D E7, Lobby
Venue 3 (Cafeteria) : B/D E7, 2nd floor</td>
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<td>13:30 - 16:00</td>
<td colspan="2">Venue: International Conference Hall (B/D: R1, R#: 203)

The Contest for Global Innovative Cases of Open Innovation and Business Model
Reviewers: WanJong Joo(Lawyer of TAEBAEK, Inc.), Avvari V. Mohan(Prof. of University of Nottingham, Malaysia), KyungBae Park (Prof. of SangJi University), ChoongJae Im (Prof. of KeiMyung University), ChangHwan Shin (Prof. of Kyungpook National University)

✓ “Parking lot information sending on real time system and their method” by Jaeho Yoon (Senior Researcher at BOKJU CO., LTD.)
✓ “Story Make A City” by SangGoo Kwon (Institute of Time & Space)
✓ “Smart Social Library System Business Plan” by SangHyun Lee (CEO of Sntec, LTD.)
✓ "Smart phone Photo based Smart Length Measuring System and Method" by JinHyoung Kim (L-Line)
✓ "Feedback public-relations server and method of manufacturing homepage using thereof" by Ki-dong Baek
✓ "Lumicrew, Smart Group Lamp System" by SuYeon Cho(KAI Spring Co.,Ltd.)
✓ "Smart panel system construction and management method for mobile and online survey" by Kyounghun Kim(Neo Economy Society Institute)
✓ "A business model about an online based real estate brokerage service" by SeokHyun Moon
✓ "Adjustable Walker“ by Shalini Kumari Shalu (National Innovation Foundation, India)
※ Presider: Prof. ChangHwan Shin (Kyungpook National University)</td>
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15:30 – 16:00 Venue: Lobby on the 2nd floor	**Coffee Break**		
16:00 – 17:30	Venue: R# 202 (Conference Room) **Special Session 2** "Complexity, Open Innovation & Knowledge City" · Session Chair: DongKyu Won(KISTI) · Honorary Discussant: JinHyo Joseph Yun(DGIST) ✓ Paper 1: "How do we conquer the growth limit of capitalism: Schumpeterian Dynamics of Open Innovation Economy System" by JinHyo Joseph Yun(DGIST) ✓ Paper 2: "How Do Academics Engage in Technology Transfer Activity? An Exploratory Study of the San Diego Biotechnology Community" by SangTae Kim(Small & Medium Business Administration of Korea), YongIl Jeong(KISTI) ✓ Paper 3: "Measuring the easiness of diffusion in social networks through the agent-based modeling" by HyoungSun Yoo(KISTI), TaeEung Sung(KISTI), SunHi Yoo(KISTI), DongKyu Won(KISTI) ✓ Paper 4: "Simulation of Weak Signals of Technology Innovation in Complexity" by SunHi Yoo(KISTI), DongKyu Won(KISTI) ✓ Paper 5: "Complex Adaptive Systems Approach to Sewol Ferry Disaster in Korea" by DongKyu Won(KISTI), HyungSun	Venue: R#: 203 (International Conference Hall) **Special Session 3** "Start-ups, Open Innovation, and Knowledge City" · Session Chair: ChoongJae Im (Keimyung University) · Honorary Discussant: Taeho Park (San Jose State University, USA) ✓ Paper 1: "Open Innovation in Supply Chain Management for Creative Economy" by Taeho Park (San Jose State University, USA) ✓ Paper 2: "The Study on the Innovation of SMEs Affecting on Corporate" by HyeMi Oh (ChungAng University), WooJin Lee(Kookmin University), ChoongJae Im(Keimyung University) ✓ Paper 3: "Study on the effects of open innovation ability to the growth of the company" by WooJin Lee(Kookmin University), ChoongJae Im(Keimyung University) ✓ Paper 4: "Study on the establishment of start-up marketing strategy through social network analysis" by Byoung-Kug Kim(Keimyung University), ChoongJae Im(Keimyung University) ✓ Paper 5: "The cases of open innovation in the Roman era" by Jeong-Hwan Jeon(Gyeongsang National University) and Sung-Kyu Kim(Gyeongsang National University)	Venue: R#: 201 (Conference Room) **General Session 2** · Session Chair: SangChul Park (Korea Polytechnic University) · Honorary Discussant: Philip Cooke (Bergen University College, Norway) ✓ Paper 1: "The Future of Innovation: Challenges, Complexity & Crossovers" by Philip Cooke (Bergen University College, Norway) ✓ Paper 2: "Growth Strategy for Finnish Science Parks under External Economic Crises" by SangChul Park (Korea Polytechnic University) ✓ Paper 3: "Promotion of university students' skills and behaviours topical for open innovators" by Karine Oganisjana(Riga Technical University, Latvia) ✓ Paper 4: "The scope of coaching in the context of organizational change" by Angelina Rosha(Riga Technical University, Latvia), Natalja Lace(Riga Technical University, Latvia) ✓ Paper 5: "Research Ethics Education for Overcoming Differences in Culture and Value System" by Hwan-jin NHO(DGIST)

	Yoo(KISTI), SunHi Yoo(KISTI), JongYeon Lim(KISTI) ✓ Paper 6: "Developing a Conceptual framework for Knowledge-based Urban Development in Isfahan, Iran" by Marjaneh Farhangi(University of Tehran, Iran)		
17:30 – 18:30	Venue: International Conference Hall (B/D: R1, R#: 203) **Editor Board Meeting of *Journal of Open Innovation: Technology, Market, and Complexity*** (JOItmC) with Springer Publisher (Springer Booth to be prepared on the 2nd floor in B/D R1 from 15 to 17, June) (※ Appendix 5)		
18:30 – 19:30	**General Meeting of SOItmC** (※ Appendix 1)		
19:30 – 21:30 Venue: Convention Hall (E1), DGIST	**Gala Dinner** Welcome Speech with Cheers by Jeon Il Moon (Vice President of DGIST for Convergence Research Institute) Welcome Speech with Cheers by Sukjoon Hong (General Director of Medical Industry Division, Daegu Metropolitan City) (※ Appendix 2)		
Tuesday, 16th June 2015 (Knowledge City Day) ※ Presider: Ph.D JinWon Kang (KISTEP) Director: Prof. HeungJoo Ahn (DGIST)			
08:00 – 14:00 Venue: Lobby on the 2nd floor	**Registration**		
09:00 – 10:50	**Keynote Speech**		

<table>
<tr><td>Venue:
Auditorium
(B/D: R1, R#: 204)</td><td colspan="2">· Francisco Javier Carrillo (Monterrey University of Technology, Mexico)
Presentation Theme: “Knowledge-Based Development as Cultural Disruption”
· Tan Yigitcanlar (Queensland University of Technology, Australia)
Presentation Theme: “Incentivising innovation: insights from Australian and Brazilian incentive schemes”
· Tommi Inkinen (University of Helsinki, Finland)
Presentation Theme: “Reflections on the innovative city: examining three innovative locations in a knowledge bases framework”
· Katri-Liis Lepik (Tallinn University, Estonia)
Presentation Theme: “Strategic management for public sector innovation in knowledge societies”
· Keun Lee (Seoul National University, Korea)
Presentation Theme: “Schumpeterian Analysis of Catch-up and Catch-up cycles”</td></tr>
<tr><td>10:50 - 11:00
Venue:
Lobby on the 2nd floor</td><td colspan="2">Coffee Break</td></tr>
<tr><td>11:00 - 12:30</td><td>Venue: R# 202 (Conference Room)
Special Session 4 “Open Innovation and Creative Entrepreneurship from Gyeongbuk TP and University Entrepreneurship Center”
· Session Chair: Jaehoon Rhee (Yeungnam University)
· Honorary Discussant: Francisco Javier Carrillo (Monterrey University of Technology, Mexico)
✓ Paper 1: “Knowledge-Based Development as Cultural Disruption" by Francisco Javier Carrillo (Monterrey University of Technology, Mexico)
✓ Paper 2: "Organizational Slack and Managerial Practices for Open Innovation: Moderating Effect of Social Capital" by Hoyoung Bae(Woosong</td><td>Venue: R#: 203 (International Conference Hall)
General Session 3: “Open Innovation in Energy”
· Session Chair: Eunnyeong Heo (Seoul National University)
· Discussant: TBD
✓ Paper 1: "Learning Networks for Energy Efficiency in Industry as Open Innovations" by Wolfgang EICHHAMMER (Fraunhofer Institute, Germany)
✓ Paper 2: "Smart Home and Smart Energy - potentials and limits for innovation" by Christoph WEBER (Duisburg University, Germany)
✓ Paper 3: "Global energy trend and KIER's R&D portfolio" by Seongkon Lee(Korea Institute of Energy Research)
✓ Paper 4: “A study on the Accountability of the</td></tr>
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	University), Jaehoon Rhee(Yeungnam University) ✓ Paper 3: "A conceptual framework for coalescent and innovative public services in the context of reducing public sector resources (UK)" by David Parks(The Skill Mill Limited, UK), Paul Brownlee(The Skill Mill Limited, UK) ✓ Paper 4: "Assessment of Knowledge-Based Urban Development Potential of Turkish Provinces" by Sinem Metin(Istanbul Technical University, Turkey), Ferhan Gezici Korten(Istanbul Technical University, Turkey) ✓ Paper 5: "A conceptual approach to the relationships between the social economy, social welfare, and social innovation" by ChangHwan Shin(Kyungpook National University) ✓ Paper 6: "Learning Organization Activities and Innovativeness of Tech-based SMEs in Technopark: The Mediating Role of Learning Transfer" by Junghyun Yoon(POSTECH), Jaehoon Rhee(Yeungnam University), Sunghoon Hwang(Yeungnam University)	Regional R&D Program: The Case of APCTP" by Jinwon Kang(KISTEP), Seongsik Cho(KISTEP) ✓ Paper 5: "A study on the R&D investment and financial performance: Focused on existing and potential competitors" by Dongphil Chun(KRICT), Youngjoo Ko(KRICT), Yanghon Chung(KAIST)
12:30 - 14:00	**Lunch Break** Venue 1 (Cafeteria) : B/D R1, 1st floor Venue 2 (Family Restaurant, "Okon") : B/D E7, Lobby Venue 3 (Cafeteria) : B/D E7, 2nd floor	
14:00 - 15:30	Venue: R# 202 (Conference Room) Special Session 5 "Open Innovation for Smart Mobility & Complexity" · Session Chair: WooSung Jung (POSTECH) · Honorary Discussant: Tommi Inkinen (University of Helsinki, Finland) ✓ Paper 1: "Reflections on the innovative city: examining three innovative locations in a knowledge based framework" by Tommi Inkinen(University of Helsinki, Finland) ✓ Paper 2: "Measuring Thematic Causality for Public Research Institutions" by HyeonChae Yang(POSTECH), WooSung Jung(POSTECH) ✓ Paper 3: "The impact of graduate students on research productivity in Korea" by KiSeok	Venue: R#: 203 (International Conference Hall) Special Session 6 "City of Future, Future of City: Open Innovation and Ubiquitous City" · Session Chair: SangHo Lee (Hanbat National University) · Honorary Discussant: Tan Yigitcanlar (Queensland University of Technology, Australia) ✓Paper 1: "Incentivizing innovation: insights from Brazilian innovation support programs" by Tan Yigitcanlar(Queensland University of Technology, Australia), Eduardo Moreira da Costa(Federal University of Santa Catarina, Brazil), Jamile Sabatini Marques(Queensland University of Technology, Australia) ✓ Paper 2: "Human Interaction and Perceptions to Media Facade" by JungHoon Han(University of New South Wales,

	Kwon(Hanbat National University), SeungHwan Han(National Research Foundation of Korea), Duckhee Jang(Korea Institute of Ocean Science & Technology) ✓ Paper 4: "Predicting Future Issues with the Keyword Network of National Policy Research", by Hyunuk Kim(POSTECH), Taekho You(POSTECH), SangJin Ahn(KISTEP), WooSung Jung(POSTECH) ✓ Paper 5: "Does the knowledge economy growth encourage clustering of knowledge workers in metropolitan cores and subcenters of metropolitan areas? A comparative study of Barcelona and Helsinki" by Juan Eduardo Chica(University of Helsinki, Finland) ✓ Paper 6: "Network analysis for the Korean national R&D development" by MinWoo Ahn(POSTECH), WooSung Jung(POSTECH)	Australia) and SangHo Lee(Hanbat National University) ✓ Paper 3: "Designing ICTs Aided Community Center for Neighborhood Residents" by Fan Qiangqiang(Northeastern University, China), Seyun An, Soyeon Kim, Hannah Ju, Ho Kim(Hanbat National University) ✓ Paper 4: "Smart City as an Urban Innovation Platform: What's next?" by JungHoon Lee(Yonsei University) ✓ Paper 5: "Can ICTs Contribute to Urban Renewal for Deprivated Cites?: Recent ICTs-base Urban Planning and Design Cases of Korea and Japan" by YounTaik Leem(Hanbat National University), Seiji Sato(Oita University, Japan) ✓ Paper 6: "Location Allocation and Use Characteristics of Bounded Carsharing Service for Urban Public Housing Residents" by Jungbeom Lee (Daejeon Development Institute), Wanhee Byun, Hoyoung Kee (Land and Housing Institute), Myungsik Do(Hanbat National University) ✓ Paper 7: "How Does IT(Information Technology) and ET(Environment Technology) makes New Innovative Urban and Architecture Model" by JuHyung Han(Hanbat National University) and SangHo Lee(Hanbat National University) ✓ Paper 8: "Can CSR be a platform for open innovation to support a creative city development?" by Avvari V Mohan(University of Nottingham Malaysia Campus, Malaysia), Naga Lakshmi Chelluri(University of Hyderabad, India)
15:30 - 16:00 Venue: Lobby on the 2nd floor	Coffee Break	
16:00 - 17:30	Venue: R# 202 (Conference Room) Special Session 7 "Smart Technology for Good Governance" · Session Chair: KwangHo Jung (Seoul National University) · Honorary Discussant: Fumio Kodama (University of Tokyo, Japan) ✓ Paper 1: "Corporate and Public Policies for Open Innovation: Demand Articulation in the Open-Innovation Paradigm" by Fumio Kodama (University of Tokyo) ✓ Paper 2: "The Impact of 'Pay-As-You-Throw(PAYT)' on Waste Disposal" by EunHyung Park(Seoul National University), Jonghwan Eun(Seoul National	Venue: R# 203(International Conference Hall) Special Session 8 "Technology Policy for Open Innovation & Knowledge City" · Session Chair: SangOk Choi (Korea University) · Honorary Discussant: Katri-Liis Lepik (Institute of Political Science and Governance, Estonia) ✓ Paper 1: "On the Way Towards a Knowledge City" by Katri-Liis Lepik(Tallinn University, Estonia), Merle Krigul(Brainport Living Lab, Estonia) ✓ Paper 2: "How to interact within science parks in order to improve industrial performance? - comparing research park and industrial park through social network analysis" by Injeong Lee(KAIST), Wonjoon Kim(KAIST)

	University), Kwangho Jung(Seoul National University) ✓ Paper 3: "An Empirical Analysis of Food Waste Disposal Systems: RFID, Pay–as–throw system, and Block–Payment", by Kwangho Jung(Seoul National University), EunHyung Park(Seoul National University), Jonghwan Eun(Seoul National University) ✓ Paper 4: "The influence of need for touch and gender on Internet shopping attitudes" by SeungHee Lee(Southern Illinois University), Jane Workman(Southern Illinois University), Kwangho Jung(Seoul National University) ✓ Paper 5: "Factors influencing consumers' fashion M–Commerce" by Marcella Smith(Southern Illinois University), SeungHee Lee(Southern Illinois University)	✓ Paper 3: "The Factors affecting to 'Basic Research' Performance Funded by Government: 'Creative Research Program' Case in South Korea" by Youngsoo Ryu(KISTEP), Kwangseon Hwang(KISTEP), Sangok Choi(Korea University) ✓ Paper 4: "The Effect of Product Innovation on R&D Activities and Government Support Systems: the Moderating Role of Government Support Systems" by Si–jeoung Kim(KOFST), Eun–mi Kim(GSTEP), Yoon–kyo Suh(Korea University), ZeKun Zheng(Korea University) ✓ Paper 5: "Perceived innovation barriers, open innovation and its performance" by Daehan Jung(Korea University), Youngmi Kim(Korea University), Yoonjung Kim(Korea University), Yoonkyo Suh(Korea University) ✓ Paper 6: "Affecting Structure on the Performances of University–Industry Cooperation : Mediating Effects of the Government & Enterprise Supported R&D Projects" by Hue–kyung Lee(National Research Foundation), Hyun–duk Youm(Korea University), Si–jeoung Kim(KOFST), Yoon–kyo Suh(Korea University) ✓ Paper 7 "An Empirical Study on the Determinants of Innovative Activity in Korean Manufacturing Firms: Focusing on the Firms' Perception of Innovation " by SungChan Yeom(Korea University)
17:30 – 18:30	Venue: International Conference Hall (B/D: R1, R#: 203) MAKCi Awards Ceremony, moderated by Blanca C. Garcia	
18:30 – 19:00	Venue: International Conference Hall (B/D: R1, R#: 203) Declaration of KCWS 2016, moderated by Francisco J. Carrillo	
19:00 – 19:30	Venue: International Conference Hall (B/D: R1, R#: 203) WCI Extended Meeting (Only invited members)	
19:30 – 22:00	Dinner (only invited) hosted by JinHyo Joseph Yun (SOItmC President) & Francisco Javier Carrillo (WCI President)	
Wednesday, 17th June 2015 (Creative Economy Day) ※ Presider: Ph.D. YoungJoo Ko (Korea Research Institute of Chemical Technology) Ph.D. SangCheol Lee (DGIST)		
08:00 – 14:00	Registration	

Venue: Lobby on the 2nd floor	
09:00 - 10:30 Venue: Auditorium (B/D: R1, R#: 204)	**Keynote Speech** · Fumio Kodama (University of Tokyo, Japan) Presentation Theme: "Corporate and Public Policies for Open Innovation: Demand Articulation in the Open–Innovation Paradigm" · Blanca C. Garcia (Northern Borderlands Research College, Mexico) Presentation Theme: "Knowledge Cities Benchmarking: The case of Daegu, Korea" · Venni V. Krishna (Jawaharlal Nehru University, India) Presentation Theme: "Globalization of R&D and Open Innovation: Linkages of Foreign R&D centers in India · KongRae Lee (DGIST, Korea) Presentation: "Sectoral differences in convergence innovation: implications for open innovation"
10:30 - 11:00 Venue: Lobby on the 2nd floor	**Coffee Break**
11:00 - 12:30	Venue: R#: 203(International Conference Hall) Special Session 9 "Open Innovation: Technology, Society & Dynamics" · Session Chair: KyungBae Park (Sangji University) · Honorary Discussant: Venni V. Krishna (Jawaharlal Nehru University, India) ✓ Paper 1: "Globalization of R&D and Open Innovation: Linkages of Foreign R&D centers in India" by Swapan Kumar Patra(Jawaharlal Nehru University, India), Venni V. Krishna(Jawaharlal Nehru University, India) ✓ Paper 2: "Open Innovation Effort, Entrepreneurship Orientation and Their Synergies on Innovation" by JinHyo Joseph Yun(DGIST), KyungBae Park(Sangji University), JangHyun Kim(Sungkyunkwan University) ✓ Paper 3: "The Philosophy of Open Innovation: Historical Development of Philosophy of Open Innovation and Its Reflection from Taoism" by JinHyo Joseph Yun(DGIST), KyungBae Park(Sangji University), JeongHo Yang(DGIST), WooYoung Jung(DGIST) ✓ Paper 4: "How User Entrepreneurs Succeed: The Role of Entrepreneur's Caliber and Networking Ability in Korean User Entrepreneurship" by JinHyo Joseph Yun(DGIST), KyungBae Park(Sangji University) ✓ Paper 5: "A Study on the Dynamics of Platform Business Models" by JinHyo Joseph Yun(DGIST), DongKyu Won(KISTI), KyungBae Park(Sangji University), JeongHo Yang(DGIST)

	✓ Paper 6: “Autonomous learning model in closed and open innovation condition” by DooSeok Lee(DGIST), JinHyo Joseph Yun(DGIST), HeungJu Ahn(DGIST), KyungBae Park(Sangji University), JeongHo Yang(DGIST) ✓ Paper 7: “Analyze Network Property of Patent Based on Citation” by Gabjin Oh(Chosun University), Kyubin Yim(POSTECH), SeokWon Ahn(Chosun University), Ho-Yong Kim(Chosun University), HyoSeon Lee(Chosun University)	
12:30 - 14:00	**Lunch Break** Venue 1 (Cafeteria) : B/D R1, 1st floor Venue 2 (Family Restaurant, “Okon”) : B/D E7, Lobby Venue 3 (Cafeteria) : B/D E7, 2nd floor	
14:00 - 15:30	Venue: R# 202 (Conference Room) **Special Session 10:** “Daegu Techno-Park, Open Innovation and Creative City” · Session Chair: YoHan Kim (Daegu Techno Park) · Honorary Discussant: KongRae Lee (DGIST) ✓ Paper 1: “Sectoral differences in convergence innovation: implications for open innovation” by KongRae Lee(DGIST), Guktae Kim(Kyungpook University) ✓ Paper 2: “Healthcare IT growth strategies for Daegu” by JinWoo Lim (DGIST) ✓ Paper 3: “The Study for Network Structure between intellectuals and urban innovation” by HeeDae Kim(DIP), ChangYong Mun(Daejeon Metropolitan City), DukHee Lee(KAIST) ✓ Paper 4: “The Case of R&D Intermediate Organizations in Daegu Technopark” by YoHan Kim & Hyojin Kwon(Daegu Technopark)	Venue: R#: 203(International Conference Hall) **General Session 4:** · Session Chair: KwangHo Jung (Seoul National University) · Honorary Discussant: Blanca C. Garcia (Northern Borderlands Research College, Mexico) ✓ Paper 1: “Knowledge Cities Benchmarking: The case of Daegu, Korea” by Prof. Blanca C. Garcia (Northern Borderlands Research College, Mexico) ✓ Paper 2: "What Knowledge Activities Promote Creativity?" by Kwangho Jung(Seoul National University), SeungHee Lee(Southern Illinois University), Jane Workman(Southern Illinois University) ✓ Paper 3: “Determinants of RFID Adoption: A Meta-egression Analysis” by Sabinne Lee(Seoul National University), Kwangho Jung(Seoul National University) ✓ Paper 4: "Exploring Reasons for Illegal Use of Software: An Application of Q-Methodology" by ChanWoo Kim(Seoul National University), Kwangho Jung(Seoul National University)
15:30 - 16:00 Venue: Lobby on the 2nd floor	**Coffee Break**	
16:00 - 17:30	**Closing Ceremony of SOItmC & KCWS 2015** · Certificate of Merit of SOItmC & KCWS 2015 · Appreciation Plaque Ceremony of SOItmC & KCWS 2015	

<table>
<tr><td></td><td>· Awards Ceremony of the Contest for Open Innovation Cases and Business Model
· Paper Awards Ceremony
※ There could be no Paper Awards Ceremony if papers are judged not qualified.
· Declaration Speech of the SOItmC 2016
※ By Prof. Taeho Park (San Jose State University, USA)</td></tr>
<tr><td>17:40 - 18:30</td><td>Dinner (Only invited)</td></tr>
<tr><td colspan="2">Thursday, 18th June 2015</td></tr>
<tr><td>10:00 - 16:00

※ Participation Fee: $50

– The price includes: round-trip bus service (Daegu to (from) the site), lunch, guidance, and souvenirs</td><td>Historical & Cultural Tour (※ Appendix 3)
✓ Andong Hahoe Village (UNESCO designated World Heritage Site)

</td></tr>
</table>

June 15 (Monday)

R# : 204 Auditorium

Keynote Speech

Philip Cooke (Bergen University College, Norway)
Presentation Theme: "The Future of Innovation: Challenges, Complexity & Crossovers"

Taeho Park (San Jose State University, USA)
Presentation Theme: "Open Innovation in Supply Chain Management for Creative Economy"

JinHyo Joseph Yun (DGIST, Korea)
Presentation Theme: "How do we conquer the growth limit of capitalism: Schumpeterian Dynamics of Open Innovation Economy System"

The Future of Innovation: Challenges, Complexity & Crossovers

Philip Cooke

Draft Presentation:

14 – 18 June, 2015

Venue: DGIST (Daegu Gyeongbuk Institute of Science & Technology), Daegu, Korea

1st Society of Open Innovation: Technology, Market, and Complexity (SOItmC)
& (8th Knowledge Cities World Summit) 2015

Abstract of Contribution

The Future of Innovation: Challenges, Complexity & Crossovers

Prof Phil Cooke, Center for Innovation, UC Bergen, Norway

Progress has been made of late on understanding that the core process of innovation is 'knowledge recombination'. This implies not a “closed” but an “open” perspective on how innovation occurs. From an economic geography perspective, which is taken in this presentation, this raises interesting issues for the economics of knowledge. First it makes the need to pay serious attention to questions of 'proximity' imperative, suggesting not that knowledge is easily appropriable for ('open') innovation but that it may be excessively difficult to identify because it lies hidden in possibly neighbouring - but different - industries and firms. Thus, second, it makes the notion of 'knowledge spillovers' problematic because the spillovers may come in unrecognisable forms. Hence, third, this means that firms likely need more than usually expected intermediation (including knowledge transfer services) to avoid market failures of innovation. The complexity theory notion of 'transversality' has been advanced to capture the 'emergence' of novelty out of contexts of difference, unifying a solution to the three conceptual problem-issues raised in the paper.

Introduction

This paper is a research-informed contribution to a new kind of regional innovation policy analysis based on evolutionary economic geography principles. It tackles key issues in the ways in which the 'knowledge economy' has been understood by both academics and policy-makers. Furthermore, it suggests that this 'framing' of 'knowledge economy' rhetoric contributed directly to the socio-spatial polarisation of modern economies. At its heart, the dominant 'knowledge economy' practice model is linear, exclusive and 'specialisationalist' – for example, the EU insistence that to receive regional aid, regions must show they propose S&T *innovation* by so-called 'smart specialisation'. A seminal paper by Jensen et al (2007) refers to this hegemonic approach to *innovation*, which itself has also become an almost 'totalising' rhetoric for regional and business improvement, the Science, Technology, Innovation (STI) model of innovation. As we shall see, they contrast STI with a Doing, Using, Interacting (DUI) model that is both more user-friendly than STI to most firms and much truer to Schumpeter's (1939[1]) basic and still relevant definition of innovation as rooted in 'recombinations of knowledge' where novelty may occur, we may add, even if the 'knowledge modules' themselves are not new.

To achieve this, the paper reports original research into a number of, first, DUI regional and, secondarily, DUI-STI hybrid innovation models that give parity if not priority to DUI modes of operation. The contribution shows how a growing selection of regions are responding to economic, financial and sustainability crises by searching for models of business enhancement and development that take innovation seriously but do not confine it to an STI (science, technology, innovation) mode of 'policy framing'. Accordingly, these are not "core, science-based" regions such as Silicon Valley, Greater Boston or Cambridge within the East Anglia region, where Nobel laureates abound and path-breaking scientific discoveries are historically made. In truth, such regions are rare, but such is the allure of their research as well as commercial fecundity that their STI has bedazzled policy 'movers and shakers'. In the non-core science regions that exemplify a more widely-applicable 'framing' of innovation, each is keen to recognise and enhance formerly often-unrecognised, practical DUI innovation styles pursued by firms and other

[1] Schumpeter, J., 1939. Business Cycles: A Theoretical, Historical and Statistical Analysis of the Capitalist Process. McGraw-Hill, New York.

actors usually in the absence of formal science. The findings are interesting because until now there has been no ‘model’ of a DUI regional innovation system (RIS) either theoretically or practically, in any formalised sense.

The paper proceeds to four formalisations of RIS set-ups that formally involve DUI, including a variety of forms in which STI is either ostensibly absent (Nordic model variant), weakly (Algarve) or more strongly (Centro, Skåne[2]) engaged. It begins with clarification of the differences between STI and DUI framings of innovation, after Jensen et al (2007). This leads in the next section to an evolutionary theoretical discussion of typical RIS system failure around knowledge issues. This is followed by a section on the rise of ‘modularity’ as a new mode of policy formulation (although not of industry organisation) whose origins lie in process innovations in the ICT industry dating from the 1990s if not earlier. Following this are brief sections based on ‘deliberative research’ in which the author was both ‘participant observer’ and ‘critical friend’ to the process of learning how to more fully embed DUI support into regional innovation policy processes in northern and southern European regions. This involved analysis of organisational processes from the management of transitions to sustainable development practice, sometimes called ‘strategic niche management’, connecting STI and DUI, while formalising and externalising the resulting innovation processes. There are then sub-sections introducing different regional experiences of involving DUI separate from as well as alongside STI in regional innovation. Finally, there is a Discussion and Conclusions section.

What Is STI Type Innovation and What Is DUI?

The Science-Technology-Innovation (STI) approach might be referred to as the classic, top-down, internal, research and innovation (R&I) model first practised in large corporate laboratories like GE and AT&T *transformed* into an externalised model of university laboratory research translated into technological innovation through “academic entrepreneurship”. It is the source of start-up and spin-out SMEs in high-tech clusters such as Silicon Valley and Cambridge, Massachusetts. As such, it has been an innovation model, pursued with much rhetoric, investment and

[2] Further detail on Skåne can be found in Cooke, P. (2012) *Complex Adaptive Innovation Systems*, London, Routledge

variable results throughout the world of regional and national economic development. It is sometimes characterised in terms of a "patenting - seed/angel/venture fund - incubator" model of new business growth. It thrives in economic boom times when venture capital is abundant but withers in economic downturns when risk capital is scarce. The approach is inclined to be *Linear* with some interactivity among science, finance and entrepreneurship (although the finance element often drives out the scientific founder element due to the perceived weak business management skills of the latter). It is *Technology-push* in inspiration. The approach is highly *Specialist*, taking often extremely advanced scientific findings (single molecule or function), to a hoped-for exit on the relevant market. Accordingly, it is *Exclusive*, being advanced, protected and proprietorial in terms of knowledge. This is even though patenting and publication nevertheless render such knowledge to a large extent *Explicit/Codified* and finally, because of codification it is knowledge that is, in principle, *Global* in its reach and accessibility, i.e. anyone with the right skill-set can, in principle, exploit it.

This contrasts markedly with the Doing-Using-Interacting (DUI) approach to innovation. This is not immediate exploitation of laboratory bench knowledge, although some such knowledge may lie behind the current state-of-the-art or even contribute to its furtherance. DUI involves knowledge recombination among diverse knowledge and practice sets. Accordingly it is fundamentally *Interactive* among firms and/or intermediaries characterised by "related variety" in the first instance. However, research shows that such is the potential of Schumpeterian knowledge recombination that many innovations integrate sectorally very different firm or institutional knowledge-sets. One only has to think of the Wright brothers' first flight, the plane for which embodied boat propellers, kites, bicycle wheels and chains *inter alia*. In this respect, DUI is *Practice-driven*. Accordingly, DUI is *Diversified* in that it thrives on cross-fertilisation or cross-pollination of ideas and practices from different fields, for example the intelligent textiles for stay-clean car seats that inspired the innovation of bacteria-free medical uniforms. This means DUI is *Inclusive* to firms that have the needed information about a shared innovation possibility provided demonstration effort is made (e.g. by a regional innovation & development agency – RIDA) through presentations, roadshows or living laboratory-based "innovation theatre". The entailed knowledge for DUI is thus *Implicit* rather than codified, and

Regional/Local rather than globally available. Later in the paper, designs of evolving DUI regional innovation systems (RIS) are delineated to demonstrate both the specific characteristics these have but also showing how they are open to STI involvement where desirable and appropriate[3].

A peer-reviewer of this paper asks why the distinction is presented as sharply distinct while most innovation systems are a mixture of the two. This belies a rather naive view of scientific method, which is to make clear conjectures then test them against reality. Reality may be messier than conceptual frameworks. However, in this case the distinctions between the two modes are more than justified. They are indeed borne out as separately “framed” types and ways of utilising knowledge by the incumbents represented in Fig. 2. A similar answer attends peer-reviewer question two, namely why is STI specialised but DUI diversified. There is a conceptual ‘system’ and a real ‘system’. Nevertheless, by and large science proceeds by becoming more and more specialised down to the sub-atomic or molecular level, while DUI tends to add value through a kind of “bricolage”. The reviewer goes on to muse that both specialisation and diversification might occur in both with positive effects on innovation performance. This is true but it may likely be as much sequential as simultaneous where a diversified “breakthrough” (e.g. the Wright brothers’ bicycle wheels, chains, box-kites and boat propellers in their workshop eventuating in specialisation in refining and tailoring such parts. But later, other variety gets introduced for innovation such as turbines or “fly-by-wire” from other engineering fields). Finally, it is suggested DUI’s openness lends itself to a ‘spaceless playground’ of global interactivity. However, economic geography teaches us that knowledge often doesn’t travel far due to tacitness or even communities of practice and embeddedness effects. So we retain a notion of “friction-of-distance” in our dualistic – but potentially interactive – conceptual system. Studies of this include Isaksen & Nilsson (2013); Grillitsch & Trippl (2014) and Njøs, Jakobsen, Fosse, & Engelsen (2014).

[3] For further explication of STI/DUI characteristics, see: Jensen, M, Johnson B, Lorenz E. & Lundvall, B. (2007) Forms of knowledge and modes of innovation, *Research Policy*, 36, 680-693

System Failure from Weak Purposive and Communicative Action

We begin here with an analysis of three main kinds of system-failure that occur in typical regional innovation system (RIS) set-ups. The first of these occurs because the "system" is not a system. This means three things: first, the issue of 'nodality', second, the issue of 'connectivity' and third, the issue of 'lock-in'. In the first of these, the set-up lacks "nodality" or the key driver organisation/institutional arrangement to give *purpose* to innovative effort. This is described in complexity theory as being in the presence of the Lego problem. That is, a person may be surrounded with all the different shapes, sizes and functionalities of Lego bricks, but without a definite purpose for such infinite variety, no design idea can exist for implementation as an innovation. Accordingly, the Lego problem, or put differently, the problem of social action, is first to identify its *purpose*, or "purposive action" for innovation. This means injunctions for persons, firms, organisations or regions to "be innovative" are close to meaningless without a clear purpose. This problem is exacerbated when the dominant model underpinning the injunction is STI. The "nodality" is usually expected to be provided by the regional university, which, even if its officers and staff are "on message" usually lacks the capacity or authority to lead regional innovation in the STI-driven way. This may be because it also lacks "innovation assets" meaning its best research knowledge lacks "fit" with the regional economy or the knowledge is not yet exploitable for commercial purposes, or it simply lacks the distinction or purposiveness to attract innovators.

A second absence in regions with innovation system-failure is the result of a failure of communication or, to maintain the action perspective, lack of a theory of communicative action. This is a failure of processes of "discursive rationality" meaning reasoned arguments that may lead to regional policy consensus even where, as is likely, such consensus is "second-best" and loved by no-one but tolerated by everyone. This is often referred to as the "networking" problem and no would-be RIS can be so without the system-connectivity that rests upon modern, open, transparent networking propensities and practices. In parenthesis, 'networks' may exist in a region but they can be exclusive, closed and uncommunicative – especially where "private languages", including STI private languages, prevail. Adopting a DUI model of innovation can mean such exclusivity disappears, especially where "resource conditionality", meaning control of innovation funding processes requires that, for example, STI revenue is earned by meeting business norms of being an efficient and effective contractor to a firm or firms. In RIS contexts, resources should broadly support purposive innovation not basic science.

The third source of system failure in would-be RIS set-ups is also highlighted in complexity theory as the problem of too little variety. Many regions are not only dependent on an "industrial monoculture" they find they are "locked-in" to that monoculture by both acts of omission and commission by higher authorities. Acts of omission occur when central government decision-makers refuse, especially, STI infrastructural investments that could help diversify the regional economy using a "probable white elephant" discourse. Accordingly, locked-in monocultures lose any possibility of implementing STI-type innovation even if a "spinoff in the desert" occurs unless it too reinforces the monoculture. The acts of commission occur when the same central authorities divert attention and possible investment (e.g. FDI), towards the region in precisely the inherited monoculture thus reinforcing the lock-in that regional stakeholders may wish to escape.

Complexity theory sees as the problem of "stasis of low numbers", meaning that where a monoculture has low or no industrial diversity with which to easily interact, no innovation can occur and lock-in retains its deadening grip. By contrast, the more evolutionary insight is that where a region has a number of points of economic energy or "clusters"[4] interaction among them will naturally occur and from the "interaction at interfaces" novel ideas and potential innovations may also occur. It is the increasing richness rather than monocultural isolation of the economic web that gives birth to innovation and growth. Hence "specialisation" ("smart" or otherwise) is not a good recipe for regional growth. So, the extreme opposite scenario – of stasis and decline is summed up in characteristics of low "nodality" or purposelessness, absent or closed networks from which only monocultural (or "stasis of low numbers") reinforcing of lock-in will ensue and insufficient stimulation of regional variety – underlies the basic condition of regional innovation system-failure.

[4] This term is used by Kauffman to specify "complex adaptive systems" in Kauffman, S. (1995) *At Home in the Universe*, Oxford, Oxford University Press

What is New in these DUI Inclined RIS Set-ups: Towards DUI-RIS innovation?

Mention has been made in the relevant research literature of the remarkably consistent RIS and to some extent NIS profiles in Nordic countries whereby "platforms" of innovation seem to have replaced earlier "industrial district" or cluster morphologies (Isaksen, 1997). This is accompanied by an apparently focused innovation effort that is based on DUI innovativeness more than STI, although STI elements may be present in certain sub-contracts to technical research centres of excellence.

The effect of this is much of Norway's innovation may, hypothetically, go unregistered because it is DUI with relatively little direct STI input. This would be because of knowledge absorption from multiple modes and a variety of sources orchestrated by LEs (Fagerberg et al., 2009). Such LEs may also be substantial innovation funders through their own sub-contracts that may, nevertheless, be recorded as "business costs", "investments" or "write-offs" rather than innovation. This would, again hypothetically, differentiate Norway from DUI-inclined Denmark, where SMEs are more direct or final innovators (of DUI or STI knowledge) and where innovation is, accordingly, registered as such. The simpler, alternative hypothesis is that Norwegian firms are – as statistical interpretations by the likes of the EU aver – "moderate innovators" comparable to Estonia, Czechia, Slovenia and Cyprus. But given Norway's challenging industrial context and mix that judgement is hard to credit.

This doubt opens a possibly extremely fruitful line of research inquiry in Norway and, by comparison, nearly everywhere else in the developed and developing world regarding the extent of under-recording of innovativeness due to the statistical bias towards STI measurement in the official statistics. Greater emphasis and weighting would be given to fast-changing, post recession but existing EU Regional Innovation Scoreboard indicators such as: SMEs innovating in-house; innovating SMEs collaborating with others; technological (product & process) and non-technological (marketing & organisational) innovators, and sales of products new to firm & market. To these can be added measures of "regional skills enhancements," which measured in computer skills intensity of national populations is remarkable in Nordic countries, with Norway in the lead. Some of these begin to address characteristics of “new innovation” discussed earlier in this paper. Thus “SMEs collaborating” opens up further lines of inquiry about “related variety” regarding “innovation on what, with whom?”; “non-technological innovators” may be adopting an idea utilised in a different industry to innovate their internal or external interaction systems; while “sales new to firm and market” may, on further inspection, signify departure from “path dependence” towards “new path creation.” Regional skills enhancements help capture both innovative skills upgrading of the existing workforce and in-migration of more skilled labour consistent with entrepreneurship, “absorptive capacity” and “revealed related variety” effects (Neffke, Svensson-Henning & Boschma, 2011; Neffke & Svensson-Henning, 2013).

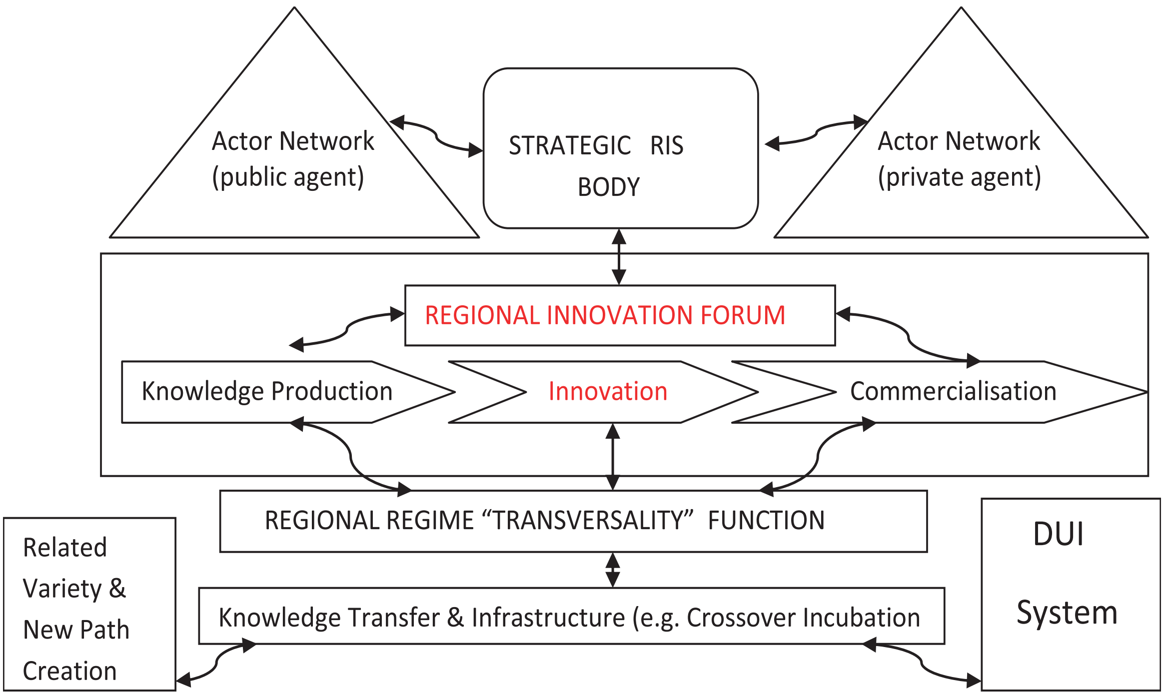

Fig. 1. A Conceptual Model of a DUI Innovation System
Source: Author

This leads to an effort to specify in graphic form the key elements of a DUI-inclined RIS and this is done in Fig. 1. Of key importance in this original organisational flowchart are the following. First, a Strategic RIS Body is centrally located at the interface of the internal system and the external world. In this instance it is flanked by the Public Actor Networks (skills training agencies, national link organisations, etc.) of consequence to the DUI regional system and the Private Actor Networks that exist in civil society but with a primarily economic brief (business associations, chambers of commerce, etc.). Thus it is already an open system with certain ECT features of "self-organisation" albeit animated by the RIS and any regional democratic institution embracing it. Second, within the RIS purview is facilitation of the innovation process from DUI knowledge production, mindfully brought out of stimulating crossover and other inter-firm, inter-agency interactions, to commercialisation. Third, and supporting this is the RIS "Transversality" function of animating "innovation theatre", attracting participants through "storytelling" events and interacting with the Knowledge Transfer and Incubation Functions. These may be civil society or market initiatives (e.g. incubation) but to flow along with the transversality ethos, incubators too may include "crossover" intentions and capabilities (see below, and next section). Thereafter, fourth, out in the market or institutional service transaction space (e.g. healthcare) are found the regional and inter-regional industry mix that constitutes the regional paradigm (technological and socio-cultural) with its related and unrelated variety, path dependencies and prospects for new path creation. Finally, the integrated expression of these functions is the operational DUI RIS. As noted, certain complementary facilities in a transversal set-up of this kind may be assisted by internally or externally managed support facilities adhering to a similar "crossover" innovation philosophy. Two examples of such facilities from a country where such boundary-crossing is practised, in this case Portugal, are summarised in the next section.

Existing DUI & STI Hybrid RIS Policy Models

Here, we drill down into some emergent exemplars of DUI-friendly RIS-building, starting with the climatically agreeable but monoculturally locked-in Portuguese Algarve region[5]. As a case in point of 'specialisation syndrome' some coastal or mountain regions suffer from too much specialisation – in tourism, particularly for coastal regions like Algarve, the "sun and beach" specialism - as perceived by national government. Having said that, such regions are often highly entrepreneurial

[5] J. Guerrero & H. Pinto et al. (2013) *'RIS3 – Algarve 2014-2020: Research & Innovation Strategy for Smart Specialisation'* (Version 0.2 – 30/4/2013), Faro, Algarve CCRD

where entrepreneurs are capable of swift adaptation. So, if a niche opportunity presents itself, entrepreneurs are not slow in coming forward to make money. Notice also that local licensing can facilitate this process. There are municipal licenses and licenses for economic activity, so some advantage may accrue from regions being decentralized in terms of authority. This may even be advantageous in attracting 'prestigious' FDI (foreign direct investment) projects complementary to national priorities. But national governments may steer specialized FDI to the appropriately specialized region, too. Accordingly, specialized regions may suffer from 'lock-in' meaning the region is specialized, adaptable, but not particularly "smart" because of

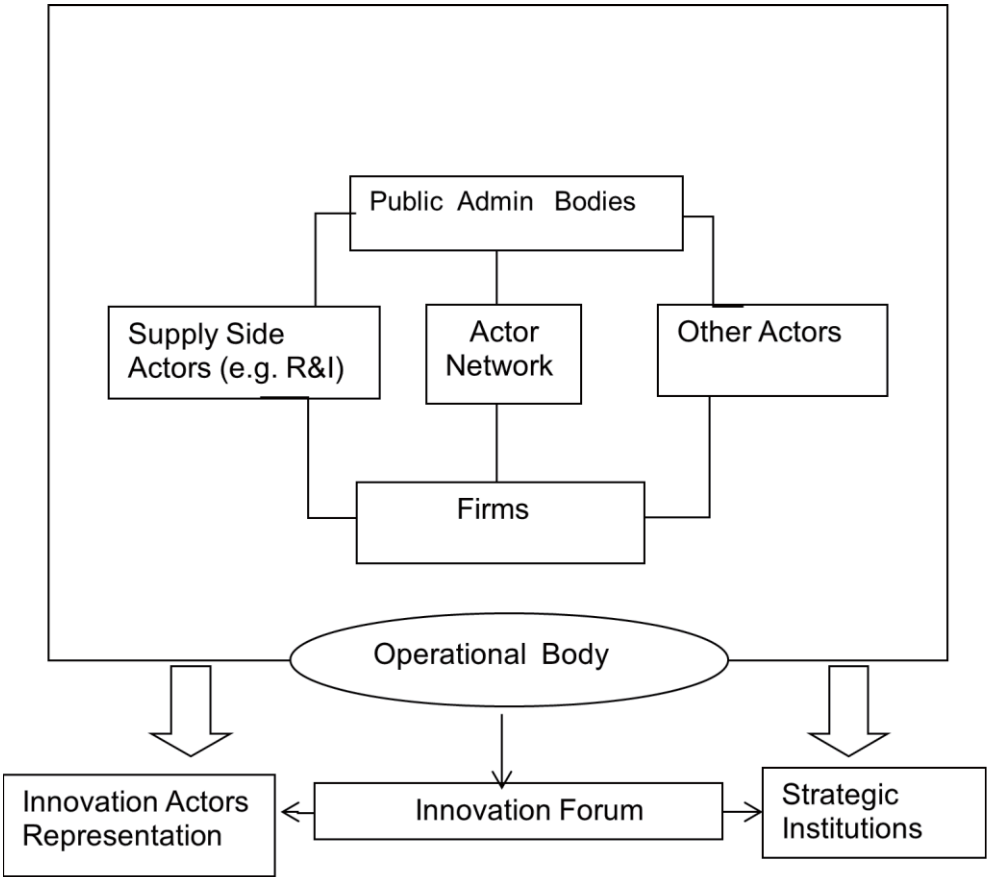

Fig. 2: Regional Innovation Governance Model for Algarve, 2007.
Source: Guerrero & Pinto, 2013

old perceptions of its 'role' in the national economy. What the specialized region needs, in consequence of this character, is "Smart Diversification". Regions' past achievements will have moved them up the learning curve and may include: experience in managing EU Structural Funds Operational Programmes; specific record of managing MLG (multi-level governance) innovation initiatives;

achievement of (DUI) results in raising innovative behaviour of indigenous firms; assisting traditional firms learn about ICT and adaptations; and experience with policy decentralisation to municipalities. Now the challenge is to raise the learning and monitoring practice in the region under, for example the EU's RIS3 programme. An example of this is found in the Algarve region's evolving effort to establish a DUI innovation system model for that over-specialised touristic region. Part of the vision is to establish a framework for undertaking DUI innovation support governance, to be translated into clear strategic goals and objectives. The region's governance and

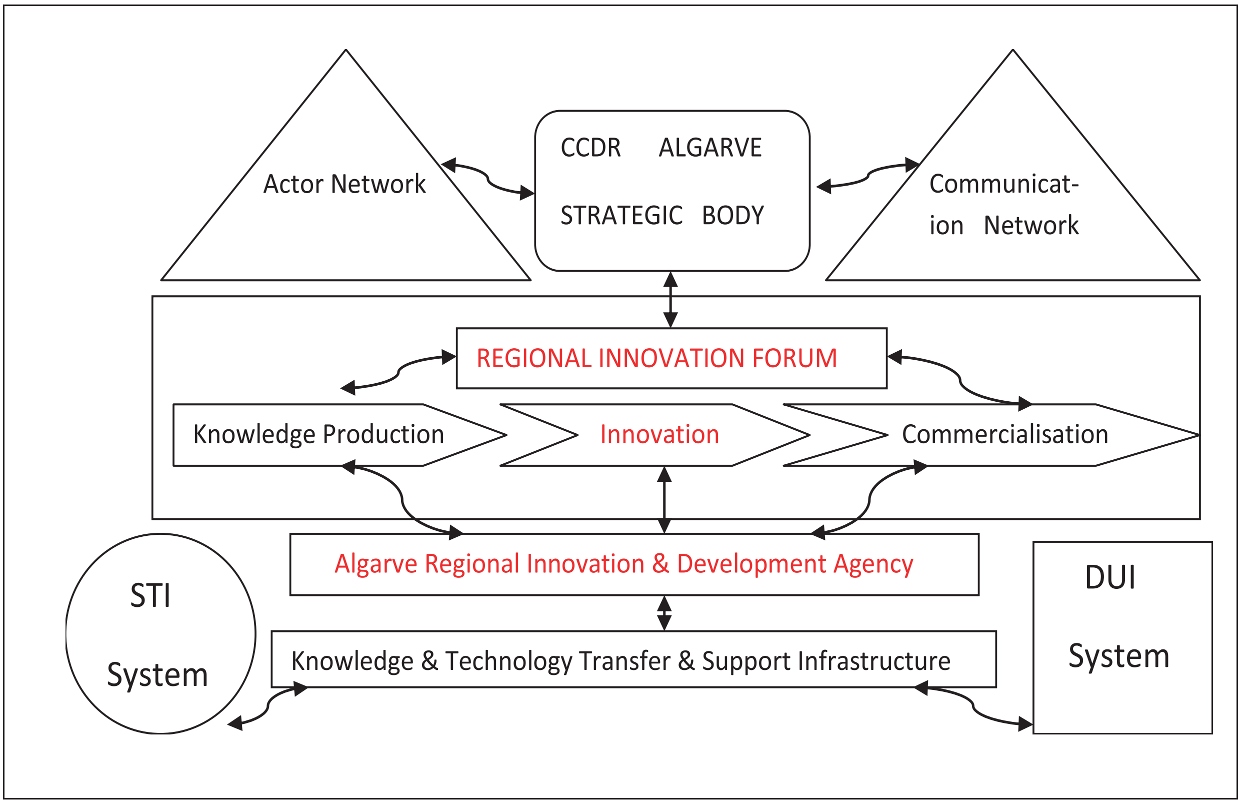

Fig. 3: RIS3 Phase Conceptual Model of DUI/STI Regional Innovation System (2013)
Source: Author's Interpretation of Algarve CCDR's RIS Model

monitoring system is the subject of analytical design in the Guerrero/Pinto report[6]. This early attempt at a DUI innovation governance model for the Algarve region

[6] Where STI benchmarking stresses R&D expenditures (especially private), employment in medium to high-tech activities (manufacturing and services), EPO patents and public-private co-publications, DUI indicators may show increasingly technical product and process improvements, regional skills enhancements, SME endogenous innovation and innovation sales new to firm and market.

revealed (Fig. 2) an actor-centred governance model with good stakeholder engagement mechanisms which was to be further augmented with a Communication Strategy. By 2013 the demands from EU DGs for European regions to evolve *Regional Innovation Strategies* to be eligible for regional development (ERDF/FEDER) funds would cause a *rapid* evolution in thinking, for Algarve and elsewhere, about the appropriate governance and delivery model. In this, as can be seen (Fig. 3), the emphasis on *innovation* as the primary mechanism for securing regional economic development meant the regional support function for , in particular, DUI innovation became of equivalence to the STI approach. In parenthesis, it would be expected that highlighting DUI would produce more measurable innovation success than an exclusive reliance upon a thin infrastructure of STI institutions and assets had in the past. That is not to say that STI was to be downgraded in support or policies but rather DUI was to be introduced and stimulated as a more down-to-earth, but nevertheless valuable, mode of securing regional innovation. The newer, evolved regional innovation governance model with functional spaces for both DUI and STI approaches to innovation is shown in Fig. 2.

This demonstrates three key 'innovation governance discoveries'. First *innovation* is now both highlighted and placed at centre stage in the governance model. It is further supported by a Regional Innovation & Development Agency (RIDA) to manage the DUI/STI project assessment and overall management function, to facilitate the 'learning from your industry' process annually, and to arrange 'innovation theatre' opportunities in living lab-type settings. Previously, as Fig.2 shows, all of this was outside the main ambit of the policy development arena. Second, the innovation support infrastructure is bi-directional, linking to the STI knowledge base where appropriate and available but also aligning with the more ubiquitous DUI knowledge base in the quest for more practical innovation opportunities. Third, the strategic governance body has taken on responsibility for ensuring openness and transparency towards the public by installing a Communication network function, complementing the previously included Actor network policy input function.

Centro Region's STI/DUI Hybrid RIS Model

The new EU regional economic development measure that embeds funding in the successful submission of a Regional Innovation Strategy (RIS3) to qualify for EU regional aid (ERDF/FEDER) has released highly DUI-dependent, over-specialised and 'locked-in' regions like Algarve to think innovatively in policy terms. As we have seen this has meant evolving mechanisms to enhance 'transversality' across industry boundaries and bring regional innovation from the edge to the heart of the regional economic development process by proposing a regional innovation agency (ARIDA) to lead policy governance. But what happens in regions where, while DUI has been something of a policy 'orphan', it has long been practised in a context where STI has been highlighted as the key regional economic and innovation development need? To that end, Portugal's Centro region exemplifies some of the opportunities for hybrid regional innovation system evolution by virtue of its RIS3 process.

Space does not allow for more than a sketch of how transversality among STI and DUI across the boundaries of a biotechnology, a construction and a forestry cluster are planned to facilitate such hybrid innovation strategy. In an emergent Centro field, biotechnology, BIOCANT has been a successful and fast-growing research entity (including businesses among them FDI, a 24 firm incubator, and venture capital) that now 'translates' its findings into commercial innovations in healthcare and other biotechnology-related fields. Thus stem cells, microbial biotechnology and computational biology are BIOCANT research strengths being applied experimentally to biomaterials and agro-forestry (biofungicides; oenobiotechnology) as well as ICT diagnostics in human healthcare. One of BIOCANT's fields of expertise is in the analysis of the DNA of biofungicides, work that began in relation to biofungicidal issues in human healthcare. However, innovation opportunities arose in relation to the transfer of such biotechnological knowledge from human to agro-food and, particularly, agro-arboreal applications.

A specific development project in Centro's RIS3 programme funding bids involves the two other Centro clusters, mentioned earlier, one of which, HABITAT, is the 115-member house construction cluster within which are many timber-utilising firms. One success of this cluster has been the production of low-cost dwellings for less-developed countries, including refugee camps and slum-upgrading schemes (e.g. in

Angola, Mozambique and Kurdish Iraq). In such countries high humidity causes rot to occur in native softwoods commonly used in the Centro cluster. Biotechnology knowledge from BIOCANT shows this can be controlled by the application of biofungicides to the growing tree/live timber. However, a delivery mechanism is necessary and this can be supplied from nanotechnology, or more specifically, bionanotechnology. Such a knowledge centre, capable of delivering the requisite molecule to the living tree organism exists at Bragancia in neighbouring Norte region. Such a partnership, crossing regional boundaries from laboratory bench biotechnology and nanotechnology (STI) to the wooden dwelling construction and furniture industries (DUI) utilising Centro regional forest products clearly captures platform/hub integration of diverse knowledge and innovation modes at knowledge and industry interfaces.

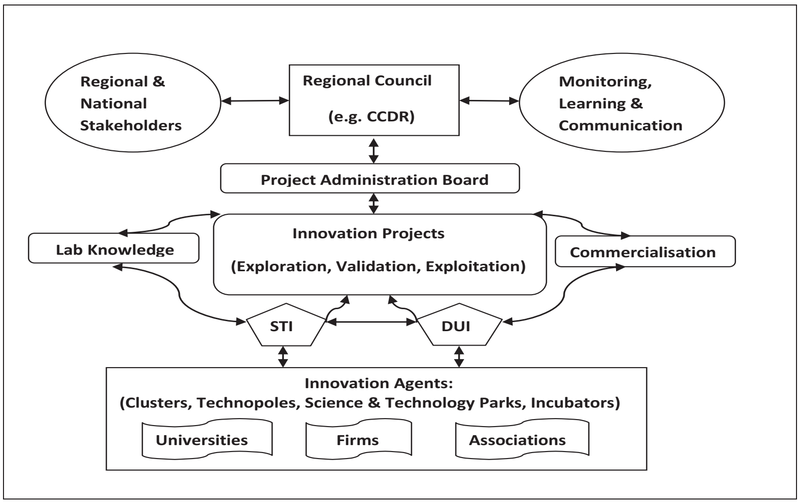

Fig. 4. Centro's STI/DUI Hybrid Regional Innovation System
Source: Author's Interpretation of Centro CCDR's RIS Model

Instead of an external regional innovation agency Centro's RIS model builds on its past (EU & central government) match-funded investments in STI infrastructures, including new universities, Technopoles and clusters, to lead programme bids for funding its regional innovation strategy (Fig. 4). This occurs under the regional council's (CCDR) leadership but, as with Portugal's other regions, eventually subsumed in the national RIS3 strategy. Frequently, such asymmetric power relations would be expected to lead to conflict or stasis as local versus national developmental tensions would be worked through or become blockages to progress.

However, Centro's intelligent solution to this has been consciously to engage large numbers of stakeholder interests (some 300 at least) in a process of 'socio-economic challenge' identification. Four of these: sustainable industrial solutions; endogenous resource efficiency; quality of life; and territorial (especially rural) innovation, have been adopted. Unlike the national institutional proclivity for prioritising sectors, Centro's model is deliberately issue-focused and cross-sectoral, as we have seen. Accordingly, tensions such as those arising from national insensitivity to local concerns seem potentially to be defused in large measure. Inspection of Fig. 3 also shows STI and DUI to be more closely integrated in the strategising process than in Algarve, but a project-based approach to be equally favoured and with firms, universities and business associations in the same policy-box for progressing projects to fruition.

Skåne: a Further Example of DUI-friendly regional innovation system architecture

Skåne region in Sweden has DUI and STI as conscious regional innovation development mechanisms. Its system consists (Fig. 5) of a regional innovation forum (regime) known as the 'Sounding Board' bringing together key regional and national representative stakeholders and their priorities for developing the regional economy (paradigm). The Sounding Board searches for innovation opportunities in the 'White Spaces'. Here, different sectoral or institutional interests come together to explore new innovation opportunities and means for focusing these. In Fig. 3, this regional innovation 'regime' interacts with the regional 'paradigm' of industry, mostly SMEs, some clusters, large firms e.g. (formerly) Astra Zeneca in life sciences or Ericsson in ICT and public bodies (e.g. healthcare). Such interactions led to the identification of two cross-sector/cluster strategic innovation platforms that are pursuing, with project subsidy support, innovations in White Space fields of 'Sustainable Cities' on the one hand, and 'Personal Healthcare', on the other. Feedback from 'paradigm' to 'regime' then informs further refinement of policies.

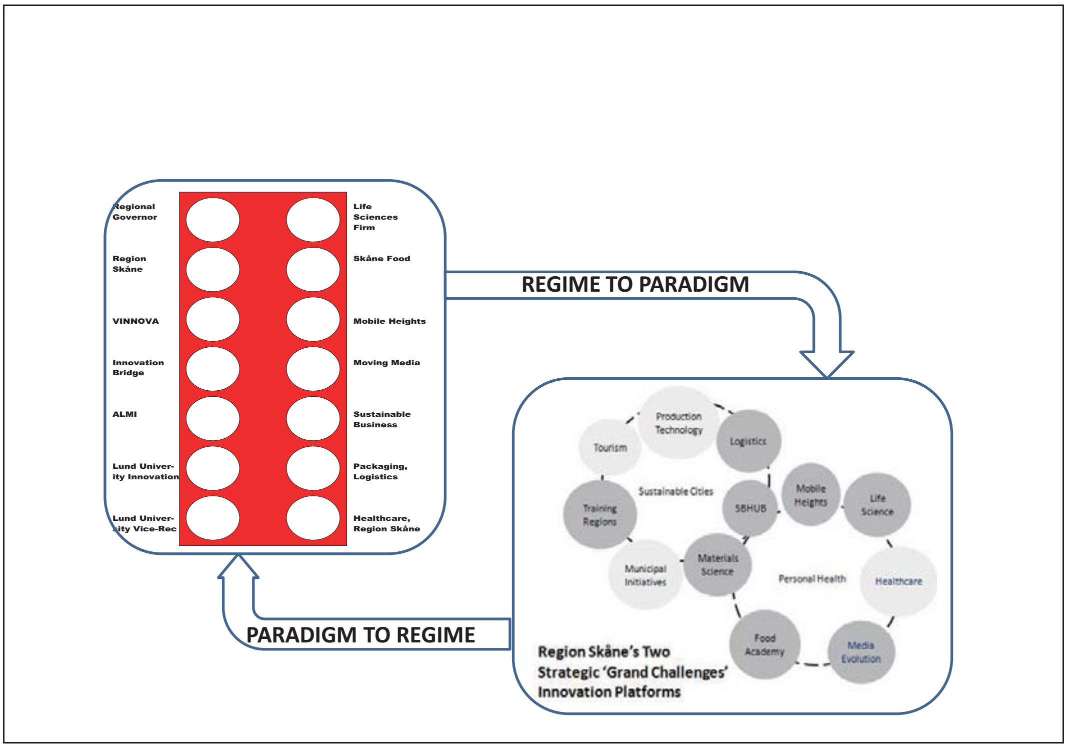

Fig. 5: Regional Innovation: DUI/STI 'Sounding Board' Regime & 'Transversality' Paradigm (Skåne)
Source: Region Skåne - Author's Adaptation

Although STI-inflected innovation efforts are clearly part of this process, much of the rest is DUI such as the packaging cluster (Packbridge) working with the digital media cluster (Media Evolution) to evolve supermarket product-finding apps on smartphones. Similarly, Packbridge works on sustainability with the Food Academy cluster both to customise organic SME retail packaging and to prevent bioplastic liquid seepage in containers produced from regionally-grown potato starch. Clearly each innovation quest uses knowledge derived ultimately from STI but the innovation ideas can equally be seen to be quite practical in a DUI sense.

New Modular Vision of Regional Innovation

This is a section that problematises 'knowledge spillovers', which tend to be treated as a feature of normally functioning markets rather than occasional triumphs by firms over market failure. Much of the argument about recombinant innovation in this paper has pointed to the importance of open discourse in preference to cognitive dissonance. There is a huge literature on the failure of firms to innovate because of dissonance within their own corporate walls. In the externalised world of the RIS, which will have inter-regional and international connectivity too, the problem is magnified. However RIS set-ups offer possibilities, explored below, for significantly minimising such 'failures to innovate'. The core issue is how to stimulate knowledge spillovers in a facilitative, non-imposing, hierarchical way. A strong candidate solution that involves recognition that innovation involves Schumpeterian re-combination of knowledge, was described by CEO Andy Grove for *Intel* the pioneer ICT firm that systematically realised it as "modular assembly."[7] This model of "purposive action" was since copied in most manufacturing and services industries but it has made effectively no entry on to the radar of any policy community in the world – with the exception of a tiny minority involved in regional innovation, some of which feature in the following section. In the policy sphere, this means thinking of sectors as embodying modules that must be integrated to accelerate regional innovation. This modular approach is increasingly perceived to be the way forward for regional innovation policy. It overcomes the development blockage of sectoral specialisation in 'silos' by rotating recombinative interactions from the vertical into the horizontal (interaction at industry interfaces) to enhance Schumpeterian 'recombinative' innovation.

Translating *Intel* practice into policy practice might be thought simplistic and it has to be said the model is not without its faults. One of these, which *appears* to be corrective of the evolutionary economic geography advocacy of *proximity* as perhaps the key locational advantage for firms, whether SMEs in clusters or MNCs to appropriately talented labour pools, is that *Intel* was criticised for being slow in delivering chips to customers. Both *Apple* and *Google*, located on *Intel*'s doorstep in Cupertino and Palo Alto respectively experienced this. So much so that although *Apple* continued to source from *Intel* for desktop PCs, it was Taiwanese suppliers that met its exacting standards for smartphone chip delivery. *Google* had to wake *Intel* up by getting it to optimise its chip architecture to meet Android platform requirements. Interestingly, now *Google* entered the smartphone market under its own name, its products are badge-engineered by Taiwanese firm *Asus*. Finally, the reason this cautionary tale about the possibly unrealised advantage of *spatial* proximity strengthens the evolutionary perspective is that it has a sophisticated

[7] Grove, A. (1996) *Only the Paranoid Survive*, New York, Doubleday. Other writers on modularisation include Henderson, R. & Clark, K. (1990) Architectural innovation: the reconfiguration of existing systems and the failure of established firms, *Administrative Science Quarterly*, 35, 9-30: Sturgeon, T. (2002) Modular production networks: a new American model of industrial production, *Industrial & Corporate Change*, 11, 3 451-496

analysis of proximity of the *relational* or non-spatially constrained kind. Thus good inter-firm, even if inter-continental, relations such as those found in successful global innovation networks (GINs) can clearly trump geographical propinquity[8].

Accordingly the emergent DUI vision for the region involves the following:

- Evolving a more dynamic, sustainable and innovative region – an admirably concise 'key vision statement' - by
- Increasing openness to innovation at interfaces between innovation and entrepreneurship, by
- Implementation of new innovative content activities, e.g. a diverse food, construction or tourism offer (not simply 'mass consumption', 'mass housing' or 'sun & beach'), by
- Integration of, for example, healthcare, renewable energy, "connectivity" and new "creativity" (innovation by interactions among culture, heritage, ICT and performance resources) with economic processes

This approach receives some stimulation from the EU's regional economic development instrument - Regional Innovation Strategy: version 3 (RIS3) by which member regions access regional aid (FEDER/ERDF). However the EU emphasis on 'smart specialisation' is typically backgrounded to allow regional innovation strategies to evolve a more thoroughgoing methodology, based on demonstration, learning, exploring, modularising and creating innovative products, processes and methodological/organisational forms. Accordingly, the preferred approach means absorbing suitable S&T knowledge to facilitate working out and working through a new DUI system model for regional innovation. Hence DUI by no means 'substitutes for' STI, the two are, as far as possible complementary; but as we shall see, certain status concessions and modes of discourse have to occur for this compatibility between knowledges to be found[9].

In the policy context, learning from the weaknesses as well as strengths of innovation by modularisation involves a broad stakeholder engagement that allows preferences to be boiled down and prioritised. While 'specialisationist' STI in pursuit of, for

[8] The *Google*, *Intel*, *Apple* interface issues are discussed in Cooke, P. (2013) Qualitative analysis and comparison of firm and system incumbents in the new ICT global innovation network, *European Planning Studies*, 21, 9, 1323-1340

[9] This is valuably explored in Nooteboom, B., Van Haverbeke, W., Duysters, G., Gilsing, V. and van den Oord, A. (2007) Optimal Cognitive Distance and Absorptive Capacity, *Research Policy*, 36, 1016–34

example, a single molecule is by definition somewhat exclusive knowledge, in an innovation context – especially a RIS – can legitimately require that its likely relevance and applicability in DUI practice be discussed purposively. One of the unmentioned weaknesses of STI is a tendency for its knowledge approach to be privileged, if not reified, by its practitioners and audience in equal measure. However, a more hard-headed knowledge appreciation process is needed where the purpose is to achieve innovation by means of open and transparent interaction within a functioning RIS. Accordingly, deliberation upon the possible interfaces between STI and DUI is important, as is inter-industry DUI interaction, both with a view to reducing cognitive dissonance. Modules of knowledge (and artifacts) may subsequently be assembled and thereafter be in a position to be explored, validated (examined), or exploited commercially as 'new combinations' (or recombinations) of knowledge that constitute innovation. Clearly, modularisation goes hand-in-hand with a project focus for the facilitation of such 'innovation at interfaces'. Accordingly, the important, unifying 'vision statement' for a regional innovation strategy will likely occur at the end of the deliberative process rather than at the beginning, where it can be myopic, constraining and excluding, as much as giving focus to a strategic exercise.

Discussion & Conclusions

In the preamble, this contribution spoke of certain problems of knowledge transfer and knowledge spillovers implied in the standard model of how this tends to occur in contemporary business, particularly among firms and between them and knowledge sources, notably universities. Research now shows that direct, comprehensible transfer from laboratory bench to production line across the university-to-firm interface is a rarity indeed. An exception for the majority of firms might be where the firm founder is also the discovering scientist. But even there, if venture capital is involved in fuelling the start-up it is often the case that the financier replaces the scientist with a proper business manager. In passing, this is a perfect illustration of Schumpeter's differentiation of the inventor/innovator, on the one hand, and the entrepreneur, with its separate commerce and finance business skills-set, on the other.[10] Thus knowledge spillovers may, in theory, be open because composed of codified knowledge in STI fields but it is actually very far from problematic.

Accordingly, this paper opened up the debate, initiated by Jensen et al., (2007) regarding the importance of other kinds of knowledge for innovation than STI, namely DUI. It now seems that was a very prescient argument whereby most innovation (in any case mostly incremental[11]) is not directly STI in nature but rather DUI. However, those founders of the DUI perspective rather left it at that, having come up with the concept. The challenge, now being picked up, is to conceptualise, research and formalise the system modes by which, if true, DUI is actually operationalised in its practice. Hence the interest in this paper in exploring extant DUI regional innovation systems. Regional, because knowledge transfer in this case being tacit rather than codified in patents or journals, the likelihood is that much knowledge transfer and even spillovers would be local rather than global. The missing link in conceptual terms is supplied by evolutionary complexity theory (ECT) with its core innovation concepts of preadaptivity and adjacency as moves firms (and, conceivably, researchers) actually make in the creative step to reaching Schumpeterian knowledge recombinations that are at the heart of innovation. Innovation, here, being understood in terms of *commercialisation* of the knowledge newly recombined.

The contribution showed how, amongst other things, *modularisation* captures the way in which firms innovate when they bring in elements from outside, including across industry interfaces, to piece together with pre-existing and other extant elements from elsewhere the knowledge and artifactual components of the innovation to be commercialised. Some of this involves what may not start out as but may become 'general purpose technologies' (GPT[12]). The paper also showed how because of the dark side of knowledge transfer – namely, when spillover opportunities are obscured or invisible – certain regional innovation agencies exemplified in the paper establish mechanisms to facilitate key "let there be light" moments of revelation. It was shown that these may occur when strategies in support

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[10] This is explored carefully by Andersen, E.S. (2011) Schumpeter and regional innovation, in P. Cooke et al. (eds.) *The Handbook of Regional Innovation & Growth*, Cheltenham, Edward Elgar.
[11] Lundvall, B. (ed.) (1992) *National Systems of Innovation*, London, Frances Pinter
[12] Jovanovic, B. & Rousseau, P. 'General Purpose Technologies' in P. Aghion & S. Durlauf (eds.), 2005. *Handbook of Economic Growth*, Amsterdam, Elsevier

of regional innovation are being established by setting up 'thematic issues' groups tasked with the responsibility of identifying future "Grand Challenges", opportunities for "strange attractors" (as they are known in ECT) to engage across sectoral boundaries, or to seek such opportunities as ways of breaking out of the "lock in" associated with past regional economic path dependence.

The contribution also demonstrated how innovation policy makers may stimulate 'modularisation' among clusters, single firms or other key innovation actors or users to facilitate 'emergence' if innovation platforms based on renewed exploitation of regional assets across industry interfaces. In the few cases thus far researched there appears to be no sense of opposition between STI and DUI modes of innovation interaction. Rather, in regions disadvantaged from an endogenous STI infrastructure, DUI may be a default position from which to start, if indeed promotion of innovation is understood to be the imperative it is according to numerous innovation-support incentive schemes. Some such regions are best described as operating a hybrid regional innovation system with engagement from both STI and DUI in variable quantities. The pure STI region is, however, almost certainly a rarity. This paper has sought, using an evolutionary economic geography perspective, to open up further opportunities for research into the ways most firms (which, of course, are not large corporations) actually conduct research and innovation (R&I) as distinct from presuming they all more or less conform to some variant of an often not very appropriate STI model of innovation alone.

So the main conclusions of this article are, first that, guided by our evidence from innovation-system friendly yet systemically distinctive Nordic countries, partly because among the Nordic countries, oil wealth has made Norway one of the richest countries per capita in the world DUI systems actually function. We showed also how in southern Europe, which is far less affluent and crisis-prone, nevertheless strong elements of DUI innovation exist in combination with a by no means dominant STI input to create a hybrid DUI-STI model of regional innovation. While wealth bestows certain advantages in being able to invest in infrastructure that was hitherto unthinkable, like highways down the extremely rugged west coast, an opera house in Oslo and generous personal incomes to facilitate high grade consumption, not least of the indigenous culinary arts that were previously less gastronomic than can now be found. Elsewhere, a country like Sweden has slipped from fourth wealthiest in the world in the 1970s to fourteenth in the 1990s and seventeenth nowadays as its socio-economy changed with the rise of global competition and its population aged. But in their traditional niche markets where quality is the guide to competitive success, Norway and the other Nordic countries continue to prosper. Moreover, looking to a future of many uncertainties, Nordic labour markets, especially Norway's are superbly positioned to take advantage of the "ICT revolution". This is all testimony to a high grade capability in reaching consensus and ensuring different parts of the socio-economy evolve in harmony. In this, a favourable attitude towards regional and national innovation systems thinking will continue to be highly complementary to the aspiration to keep these small but innovative economies high in international benchmarking exercises and perhaps to pioneer better ways of measuring innovation itself. This act would likely be such as to ensure that certain of Norway's apparent past innovation deficits emerge into the daylight they may hitherto have been denied as the world became smitten with STI rather than DUI indicators as measures of global innovation excellence.

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Open Innovation in SCM for Creative Economy

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Abstract

Since the concept and terms were introduced by Henry Chesbrough, open innovation has been widely spread out in a variety of industries. Open innovation has received increasingly attention by companies which aim for launching innovative products, reducing R&D cost and product introduction cycle, and improving product quality. It has been evolved throughout a supply chain in a company beyond just R&D for product development innovation. This study discusses activities in the supply chain which can be innovated/improved through open innovation, and stakeholders involved in the supply chain who can participate in the open innovation.
iding products and services in open innovation.

How do we conquer the growth limits of Capitalism?

- Schumpeterian dynamics of open innovation economy system

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Abstract

The purpose of this study is to answer the research question, "How do we conquer the growth limits of capitalism?" Based on existing studies on growth limits of capitalism by Marx and Schumpeter as well as the recent discussions of Drucker, Rifkin, and Piketty, the Schumpeterian dynamic model of an open innovation economy system (OIES) is proposed as an answer to this research question.

OIES consists of an open innovation economy, closed innovation economy, and social innovation economy. The Schumpeterian dynamics of OIES occurs from the positive interaction among the open innovation economy, closed innovation economy, and social innovation economy. The Schumpeterian dynamics of the OIES circle are from an open innovation economy, through a closed innovation economy and social innovation economy, and back to an open innovation economy again. In addition, the validation of the model for the Schumpeterian dynamics of OIES is improved by simulating the life cycle of the dynamics of OIES, low-level OIES dynamics, and high-level OIES dynamics, and by inquiring about a practical economic system corresponding to each simulation situation. Next through a comparative discussion between the linear steps of Schumpeter 1 and 2, and Socialist Democracy, and the Schumpeterian dynamics of an open Innovation economic system, the practical and theoretical characteristics of the Schumpeterian dynamics of OIES are clearly defined. Finally, the limits of this study and a follow-up research project are presented in addition to a summary of the discussion.

Keywords: open innovation economy system, Schumpeterian dynamics, open innovation, closed innovation, social innovation

1. Introduction

1.1. Capitalism at its growth limits

As of March 2015, the growth of the global capitalistic economy has halted. Specifically, the base rate of each nation's capital investment, which is the standard for capital income that serves as the key of capitalism, is near 0.00%. With this, the base rate of the capital investment of advanced nations in the area of capitalism has reached almost 0%. The fact that the federal funds rate of the Federal Reserve Bank of United States is 0.00-0.25%, the rate of the European Central Bank is 0.05%, and the rate of the Bank of Japan is 0.1% serves as evidence for this standstill.

Korea is not an exception in this case because its base rate is only 1.75%. Interest rates indicate that the expected income from capital investment is zero considering the population growth rate and inflation; thus, zero income, which is expected from capital investment, serves as an indicator for the ending of the growth of capitalism.

However, the base rate of China and India is relatively high, which is at 7.4 % and 5%, respectively. In proportion to the high interest rate, their national capital income records the annual average economic growth rate which is close to the interest rate. These exceptional cases should not be used to cover the fact that the growth of capitalism has already reached its limits. First, these nations do not thoroughly pursue the principle of a capitalist economy. They block capital investment in land because private ownership of land is prohibited, and their annual economic plan is formulated by a central government. Because of these facts, they have a market- and nation-led economic system rather than a market-driven economy. Second, in their cases, the history of introducing the market economy of capitalism is not that long, and they have not grown sufficiently to reach their growth limits. The latter case can be the basis of understanding the growth rate of a new capitalist nation with high growth in South America, Southeast Asia, and Africa.

In particular, if the contribution of inflation and population growth is subtracted from economic growth, it is observed that the economic growth rate of major capitalistic nations is reaching 0%. Before the capitalistic economic system was introduced, a very low economic growth rate was recorded in the past. After the Industrial Revolution, early capitalistic markets recorded high economic growth rates (Piketty, 2014, p. 25). However, after the 1980s, the US, EU, and Japan recorded a low economic growth rate which was less than half of their respective rates over the past 20 years. Even though the quantity and distribution of technology and knowledge increased globally, and the world became flat because of global networks, the economic growth rate of major capitalistic nations decreased by more than half.

Since the mid-1990s, the global growth engine of capitalism has remained stagnant for the past 20 years. The stagnation of economic growth is sometimes interpreted as a continuation of the aftermath of the global real estate bubble caused by the subprime mortgage crisis. However, the real estate bubble itself was caused by the structural distortion of capitalism, coming from the growth stagnation of capitalism for which the expected income rate of capital investment is very low. Thus, it is not proper to interpret that the current stagnant growth of capitalism is the aftermath of the subprime mortgage crisis. A theoretical and practical discussion to define and interpret the growth stagnation of capitalism around the world is necessary to guarantee an alternative in handling the problem.

1.2. Research Question

This study starts from the recognition that capitalism has reached its growth limits. Indeed, it is considered as part of the business cycle, and it can be seen that the growth of global capitalism has not reached its limits but has been on its decline in the business cycle. Global capitalism has reached the stagnation of its growth. To overcome it, Piketty said that the structure of distribution should be improved as a new alternative, and as part of it, he suggested a capital tax. His discussion corresponds to the growth limits of capitalism (Piketty, 2014). Meanwhile, Ha-Sung Chang mentioned that as capitalism in Korea moves away from its original characteristics, its soundness should be recovered through the political intervention of the government. His logic handles the limits of capitalism at a national level (Ha-Sung Chang, 2014). He also talked about the growth limits of capitalism by pointing out 23 things not told to anyone about capitalism (Chang, 2002, p. 14; 2010, p. 11).

Since the financial crisis in the 1990s, the gross domestic product (GDP) per capita of Korea has still been around USD 20,000s for the past 20 years. However, the sales and profits of the top 10 or 30 companies that are listed have been at their highest level since the foundation of the country, and the current account surplus has also continued to rise, reaching its highest level in March 2015. Even in the good records, the Korean economy has shown its growth with a lower rate of new job creation. The US has achieved a relatively high economic growth of 3 – 4% and new job creation based on quantitative easing. In most European countries and in Japan, slow economic growth has continued to happen for a long time now.

The purpose of this study is to answer the research question, "How do we conquer the growth limits of capitalism?" In other words, the question of whether the growth of capitalism has reached its limits is not the subject of this study. However, to clearly identify this, the theory on the growth limits of capitalism is summarized. A discussion is given to secure the perceptual basis of a theory model on development to overcome the growth limits of capitalism, which is the key element of this study.

The research scope and method start from the analysis of existing studies on the growth limits of capitalism. The review of the preceding studies covers classic discussions on the growth limits of capitalism like that from Marx and Schumpeter as well as the recent discussions of Drucker, Rifkin, and Piketty. Second, the economy system model to overcome the growth limits of capitalism is set. During the establishment of the model, I joined the corporate business model innovation program of the Center for Executive Education at UC Berkeley on Nov. 17–19, 2014 and the India Innovation Festival held in the Indian Presidential Palace on March 6–13, 2015 wherein I applied the results of the participant observation to this study. In addition, this study is based on Schumpeter 1 and 2, Socialist Democracy, Ostrom's Comedy of Commons, Chesbrough's Open Innovation and Open Business Model, Corporate Social Responsibility (CSR), and Creating Shared Value (CSV). Third, various situations of the Dynamics of Open Innovation Economic system (OIES) based on thinking experiments are simulated. The theoretical validation of the model of the dynamics of OIES is improved by simulating the life cycle of the dynamics of OIES, low-level OIES dynamics, and high-level OIES dynamics, and by inquiring about the practical economic system corresponding to each simulation situation. Fourth, through a comparative discussion between the linear steps of Schumpeter 1 and 2 and Socialist Democracy, and the Dynamics of Open Innovation Economic system, the practical and theoretical characteristics of the dynamics of OIES are clearly defined. Fifth, the limits of this study and the follow-up research project are presented in addition to a summary of the discussion.

2. Growth Limits of Capitalism, a Literature Review

The discussion on the growth limits of capitalism is mainly rooted in the Decreasing Law of Surplus Value of Capital of Marx, Big Business and Socialist Democracy of Schumpeter, and General Theory of Employment, Interest, and Money of Keynes (Keynes, 1935; Marx, 1867; Schumpeter, 1934; 1939; 1942). Adam Smith introduced the concept of equilibrium to the capitalist economy and completed the self-purified market balance based on the price mechanism corresponding to the physical order of nature in theory. He formed the theoretical basis of the objection of growth limits of capitalism on the Neoclassical School of thought (Marx, 1867; Smith, 1937). As a matter of fact, Marx said that the balance achieved between the demand and the supply on the market is a very exceptional condition, and the market itself is inevitably imbalanced as described in the Capital, Volume II (Marx, 1978).

However, with the rapid increase in the decision power of the economic growth of technology and market in the global economy in the late 20th century and 21st century, discussions on the limits of capitalism have been suggested in various ways. For example, there are Drucker's post-capitalism, Ripkin's end of work and zero marginal cost, Piketty's acceleration of unbalanced distribution, and Ostrome's Comedy of Commons (Drucker, 1993; Ostrom, 1990; Piketty, 2014; Rifkin & Kruger, 1996; Rifkin, 2014; Rifkin & Kruger, 1996).

2.1. Theoretical Discussion on Growth Limits of Capitalism in the 19th Century and Early 20th Century

Marx discussed the labor process and the process of producing the surplus value altogether (Marx, 1867, p. 197). According to him, the absolute surplus value and the relative surplus value are generated from labor, and they are converted into capital. Thus, the general law of capitalist accumulation originated from the accumulation of surplus value, and it is called primitive accumulation (Marx, 1978, p. 784). Based on the logic of Mark, it tends to decrease the surplus value (Marx, Simpson, & Ryazanskaya, 1963). However, the tendency of decreasing interest in a capitalistic society was noticeable in Western society after the Industrial Revolution in the 19th century as well as in the US after the mid-20th century (Medio, 1972; Wolff, 1979). Marx predicted that capitalism essentially reduces the ratio of surplus value, resulting in the panic of the capitalistic society. The surplus value generated from labor is fundamentally converted into capital, and the accumulation of capital reduces the value. Lastly, there has been a financial panic in capitalist society.

Schumpeter significantly dealt with Marx's theory that capital is accumulated through labor. He actively and sharply criticizes the theory (Joseph A Schumpeter, 1942, pp. 9-58). However, he asked, "Can capitalism survive? No. I do not think it can." He also showed his skepticism about the sustainability of the current capitalism (Schumpeter, 1942, p 61). Lastly, it indicates that the rate of increase for the total output will reach a certain limit. Schumpeter admits that the new combination based on the process of creative destruction led by entrepreneurs was not an alternative to the continuous growth of capitalism. He insists that the new combination disappears, and the closed season controlled by big business will emerge. The situation leads to the vanishing of investment opportunity (Schumpeter, 1942, p. 111). However, with the changes in the economic process brought about by innovation, together with all their effects and the response they received from the economic system, Schumpeter designated the term, Economic Evolution (Schumpeter, 1939, p. 83). This type of innovation combines factors in a new way or carries out a new combination. However, the future of economic evolution suggested by Schumpeter is the decomposition of capitalism and socialism, set with a model of the Labor Party of the UK (Schumpeter, 1942, p. 167). Marx said that corporation and production cooperatives are "social ownership."

2.2. Discussion on Growth Limits of Capitalism in the Late 20th Century and Early 21st Century

Peter Drucker suggested that the knowledge-based society is a society wherein knowledge controls the main area of the society as well as the economy and added that it is a form of a post-capitalist society. First, knowledge brings about industrial revolution integrated with working tools, manufacturing processes, and products. Second, knowledge leads the productivity revolution which significantly improves productivity. Third, knowledge leads the management revolution which is applied to it (Drucker & Drucker, 1994, p. 46). Drucker identified that even with a three-stage revolution, the existing capitalist society is being changed to a knowledge-based society, which is very different from the capitalist society. As a means of production, the importance of knowledge increases in post-capitalist society. Thus, it is expected that, among the two important means of production in a capitalist society, the traditional role and the function of capital as well as the disappearance of labor will be redefined (Drucker & Drucker, 1994, p. 115). That is, labor that serves as an asset disappears, and an employees' society in which they serve as the subjects is formed. Furthermore, because the pension fund accounts for a major part of the capital, the prevalence of a capitalist society having no capitalists is increased. Drucker said that the size and sustainability of the productivity of a knowledge-based society depends on the effort to improve the productivity of knowledge and service employees, the improvement of knowledge productivity, the design of an organization based on knowledge, and the reliability of the goal for an individual. The peculiar thing is that Drucker mentioned the necessity of the recovery of government and citizens' function in the sustainability of a knowledge-based society (Drucker & Drucker, 1994, pp. 236, 251). This point is very similar to the vision of Schumpeter on social democracy. He called the knowledge-based society an entrepreneurial society, led by an innovation agent, who is an entrepreneur, and suggested that the requirement for society to thrive is substantial social innovation (Drucker, 2014, p. 257).

Jeremy Rifkin identified that the world led by the progress of technological innovation is the end of work. For a growing number of working people who find themselves either underemployed or unemployed, the concept of trickle-down technology is of very little solace (Rifkin & Kruger, 1996, p. 165). He said the characteristics of the new society are the decline of the global labor force, the reduction of the middle class, a new division between high-tech winners and losers, an increasing rate of unemployment, and a more dangerous world. As a result, Ripken predicted that globalizing the social innovation economy would be realized by re-engineering the work week, a new social contract, and empowering the third sector (Rifkin & Kruger, 1996, p. 275). In this third industrial revolution, the lateral power is the transforming energy, the economy, and the world. Ripken said mutual cooperative, horizontal, and open economic system, which are different from the existing system, would be established, and is being established (Rifkin, 2011, p. 277). That is the sharing economy or the Collaborative Commons, summarized as the zero marginal cost society (Rifkin, 2014, p. 7). It refuted the opinion of Hardin that in the end, all commons are destined to collapse head-on. It also completely coincides with that of Rose and Ostrom who once raised the question on the old idea thought by economists for a long time that individuals pursue only their self-interest in a market (Hardin, 1968; Ostrom, 1990; Rose, 1986).

Piketty said the capital-labor split in the 21st century occurs as the ratio of capital continuously increases the dynamics of the capital/income ratio around the world. He said that the acceleration of unequal distribution based on the capital of the capitalism of the 21st century is a global phenomenon and suggested that a viable alternative of capitalism is a social state (Piketty & Goldhammer, 2014, p. 471). A modern redistribution based on a social state does not include transferring the income from the rich to the poor, at least not in such an explicit way. Instead, it includes financing public services and replacement incomes that are more or less equal for everyone, especially in the areas of health, education, and pensions (Piketty & Goldhammer, 2014, p. 479). All the rich countries, without exception, faced the 20th century from an equilibrium in which less than a tenth of their national income was consumed by taxes to a new equilibrium in which the figure rose to between a third and a half (Piketty & Goldhammer, 2014, p. 476). However, it is true that a social state in poor, and emerging countries are different from the rich countries in terms of status or tendency. A nation takes 10–15% of its national income in Sub-Saharan Africa and South Asia; 15–20% in Latin America, North Africa, and China; and about 10% in India. However, it has been shown that the ratio of a nation's national income decreased or is on the decrease, and the tendency accelerates the inequality between the capital and labor of nations (Piketty & Goldhammer, 2014, p. 491). Piketty said that overcoming the accumulated inequality of the distribution between capital and labor of capitalism by forming a social state, including a global capital tax, is an alternative to handle the stagnation of economic growth. This is also shown as a worsening of the distribution inequality of capitalism in the 21st century (Piketty, 2010, p. 61).

2.3. Discussion on Growth Limits of Capitalism in Korea

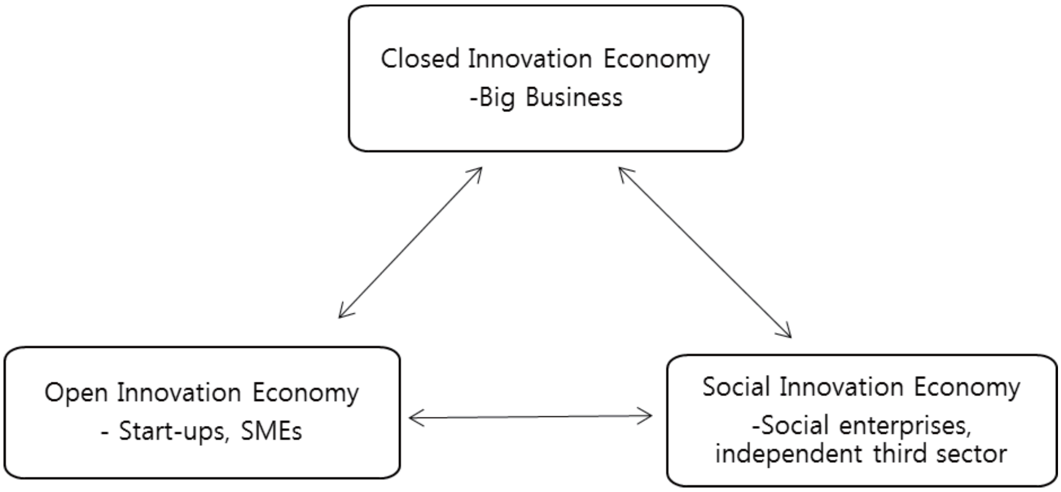
Ha-Sung Chang identified that Korean capitalism is broken because it does not have the three growth elements: employment, wage, and distribution. As an alternative, he suggested righteous capitalism (Ha-Sung Chang, 2014. p. 521). For five years from 2008 when the economic crisis occurred until 2013, the average global growth rate of Korea was 1.7%, and the average growth rate of the US and England was 0.8% and -0.6%, respectively. The record rates brought about capitalism in crisis. Chang pointed out that the crisis was caused by the structure of inequality and the worsening of inequality rather than by the slowdown of growth, and that the fruit of growth did not have an impact on people's lives (Ha-Sung Chang, 2014 p. 20). He said, for the past 30 years when market fundamentalism dominated, the conditions of employment have been aggravated, and unstable employment has increased such occurrences as income inequality, class polarization, an economic growth structure without employment, and an increase in low-wage employees and temporary workers. Korea has experienced the same economic conditions. Ha-Sung Chang analyzed that as corporate income continuously increases against household income among household income, corporate income, and government income, which comprise the gross national income, it seems that the internal reserves of listed companies rise without an end, resulting in a lack of corporate investment for job creation, a decrease in consumption in the household section, and the stagnant growth of capitalism in Korea. He takes an optimistic view that the growth limits of capitalism in Korea can be overcome by converting capitalism to righteous capitalism guaranteed by a competing system, fair market, and realization of justice. He also added that the current growth stagnation can be handled. In particular, he identified that based on trust in shareholders, who are the owners of assets in modern capitalism rather than capitalists, if shareholder capitalism in the investment of foreign companies in Korea and even in the state-run firms of state capitalism like in China and Russia is based on competition, fairness, and justice, capitalism, with its growth stopped, will begin again (Ha-Sung Chang, 2014. p. 247).

The discussion on partnered growth suggested by the former Prime Minister of Korea Un-Chan

Chung and professor Jang-Woo Lee also showed that as the growth of Korean capitalism is halted, it is necessary to have capitalism with partnered growth as an alternative for sustainable growth. This shows that Korean capitalism does not grow, or its growth is significantly stagnated (Jang-Woo Lee, 2011. p. 49; Un-Chan Chung, 2014. p. 20). Chung mentioned that if there is strong intention from the government leading the change in large companies and self-help from small- and medium-sized enterprises (SMEs) for partnered growth which is crucial for the new capitalism, the alleviation of polarization, improvement of job stability, and continuous creation of new jobs can be achieved. These three factors should be addressed for capitalism in Korea (Un-Chan Chung, 2014. p.226). He said that the key values for partnered growth, including profit sharing, are not applied to companies and the economy but to both the philosophy of life and the value of a new social community (Un-Chan Chung, 2014. p. 228, 230). Shared value creation focuses on identifying and expanding the connections between societal and economic progress (Porter & Kramer, 2011). Shared value as the next evolution in capitalism will not just hold the key value, unlocking the next wave of business innovation and growth, but will also reconnect the success of companies and communities in ways that have been lost in an age of narrow management approaches, short-term thinking, and deepening divides among institutions in society (Porter & Kramer, 2011). Lee said that the new coexistence of large, small, and medium-sized companies through partnered growth, a rule of the game that has no loser, is a way to build a sustainable economy (Jang-Woo Lee, 2011. p. 15). However, he suggested the corporate ecosystem theory for the theoretical background of partnered growth, which is the basic theory that creates the cooperative system among companies, and the theory of behavioral change for partnered growth to focus on the sustainable development of the Korean economy (Jang-Woo Lee, 2011. p. 111). Thus, Lee also mentioned that partnered growth is necessary to overcome the weakness of the capitalist economic system, but his view is different from those of Porter or Un-Chan Chung who said that partnered growth is an alternative to overcome the growth limits of the existing capitalism. In an era when great ideas can sprout from any corner of the world and IT has dramatically reduced the cost of accessing them, it is now conventional wisdom that virtually, no company should innovate on its own (Pisano & Verganti, 2008). In this regard, Lee insisted that partnered growth is essential for the survival and development of large companies as well as start-ups and SMEs (Jang-Woo Lee, 2011, p. 190).

3. Model Building to Conquer the Growth Limit of Capitalism

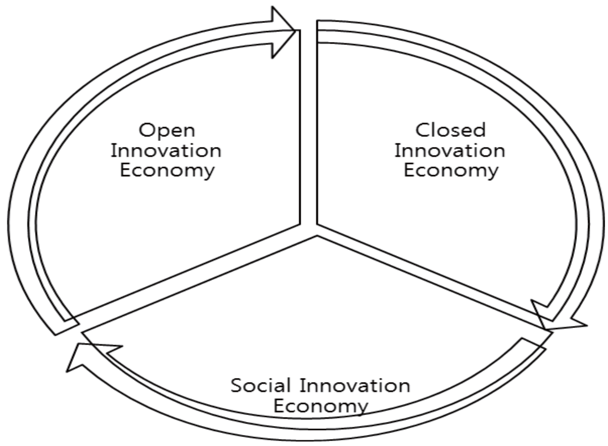
3.1. Model Building: Open Innovation Economic System



<Figure 1> Components and structure of an open innovation economic system

The Open Innovation Economic system (OIES) is a macroscopic economic system wherein a sub economic system based on open innovation led by start-ups and small and medium enterprises (SMEs), a sub economic system based on closed innovation led by big businesses, and a sub economic system based on social innovation economy led by social enterprises or independent third sectors are interconnected, thereby affecting each other. OIES basically targets the economic system of one nation. However, the concept of the same macroeconomic system could be applied to a global and regional economic system.

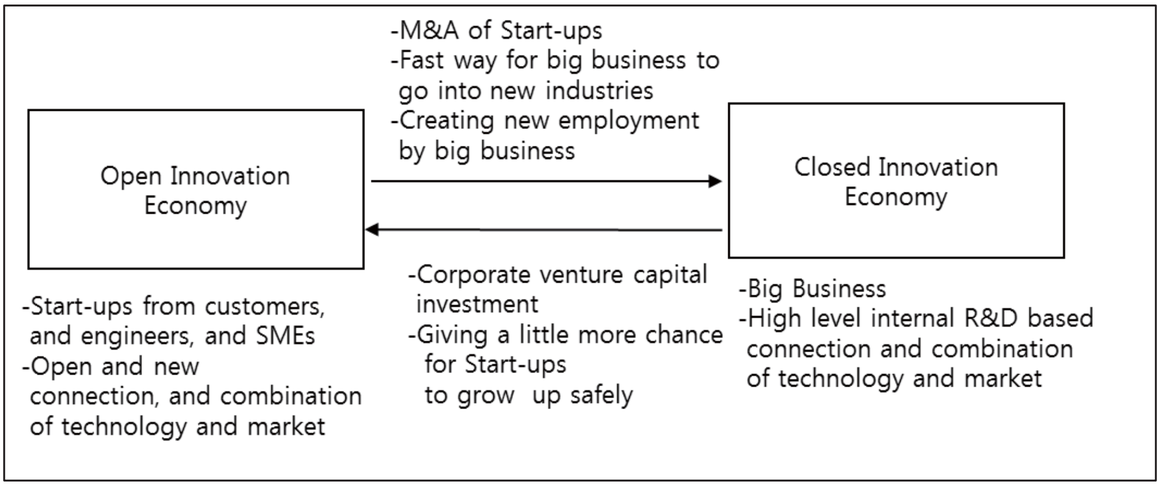
That is, the capitalist economic system in a modern society is composed of the three sub economic systems described in Figure 1 regardless of the characteristics of the political system of the economic system. An open innovation economy indicates an economy based on SMEs or start-ups led by individual entrepreneurs. It features a new combination between technology and the market suggested by Schumpeter (Brunswicker & van de Vrande, 2014; Schumpeter, 1934, pp. 15, 65). Open innovation economy is characterized in such a way that the original producer of technology, including knowledge, is not the same as the subject delivering the production to a market (Chesbrough, 2003, p. 43). Thus, the open business model, which is a new combination between technology and a market and led by various entrepreneurs, defines the growth and development of an open innovation economy (Chesbrough, 2007, 2010; 2013, p. 2). A closed innovation economy is led by mainly big businesses wherein monopolistic practices are dominant, and investment opportunities no longer exist (Schumpeter, 1942, pp. 81, 87). In this case, large companies create their own value based on the technology they have accumulated internally and transfer it to a market. Thus, they lead the closed innovation economy (Chesbrough, 2003, pp. 21-24). Social innovation economy indicates that in the economy, specific technology or knowledge creates a social value that meets social requirements without the intermediation of the market and provides it to the society (Rifkin & Kruger, 1996). Social innovation refers to innovative activities and services that are motivated by the goal of meeting a social need and that are predominantly diffused through organizations whose primary purposes are social(Mulgan, 2006). The so-called sharing economy such as Aribbnb, or Uber, and collaborative economy such as open source communities are concrete examples of social innovation economy which connects new technology and social requirement (Belk, 2014; Kostakis & Bauwens, 2014; Zervas, Proserpio, & Byers, 2014). Social enterprises that comprise the social innovation economy access the Internet of the things through a plug. They also play and use open and distributed architecture to create peer-to-peer horizontal collaborative commons (Rifkin, 2014, p. 109; Zervas, Proserpio, & Byers, 2014). With the activation of the Internet of the Things, including the communication Internet, logistics Internet, and energy Internet, productivity significantly increases, and a zero-marginal-cost society is realized. Thus, it is expected to implement a sharing economy that reorganizes most parts, such as energy, residence, and automobile logistics, based on access from ownership (Rifkin, 2014, p. 389; Sundararajan, 2013; Weitzman, 1985).



<Figure 2> Dynamics of an open innovation economy system

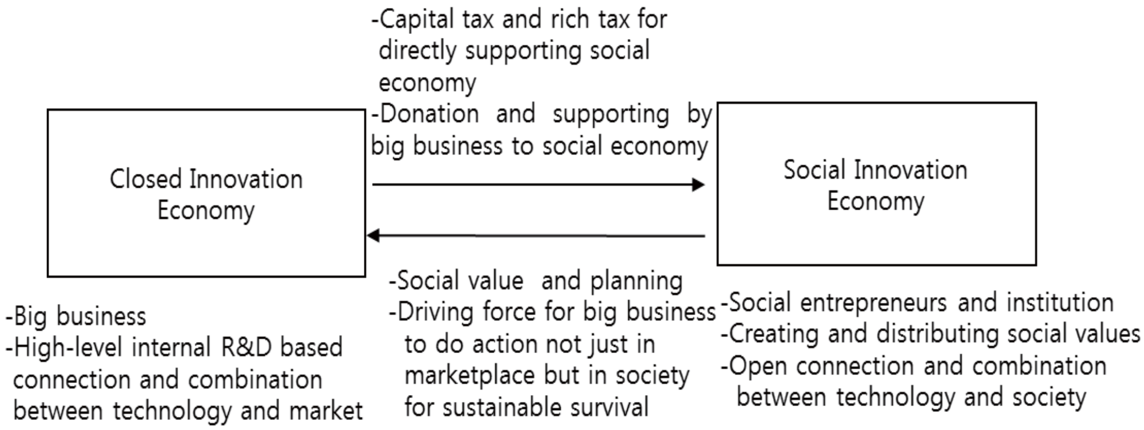
However, for OIES, the dynamics of the three sub economic systems are cyclical shown in Figure 2. An economic system in which the dynamics of OIES actively occur can evolve and continuously create new jobs without the stagnation of growth. Thus, the growth limits of capitalism can be overcome when the dynamics of OIES actively occur based on the interconnection between the three sub economic systems. In this case, first, creative start-ups and SMEs of the open innovation economy are provided to the closed innovation economy in open and innovative ways like M&A, technology licensing, or open platform so that big businesses can continuously perform new combinations in a short period for continuous job creation. Second, virtuous big businesses of the closed innovation economy distribute wages and take on a sufficient tax burden through large scale employment. They continuously support the social innovation economy in an indirect way through this or in a direct way through voluntary contributions. Third, the social innovation economy plays a decisive role in the formation and development of a market by nurturing the social enterprises and social values created through the creative and newly open combination between technology and society. That is, social innovation economy actively provides the seed for open innovation which is a new combination between creative technology and the market in the dynamics of OIES.

3.2 3 Interactive Relations in OIES



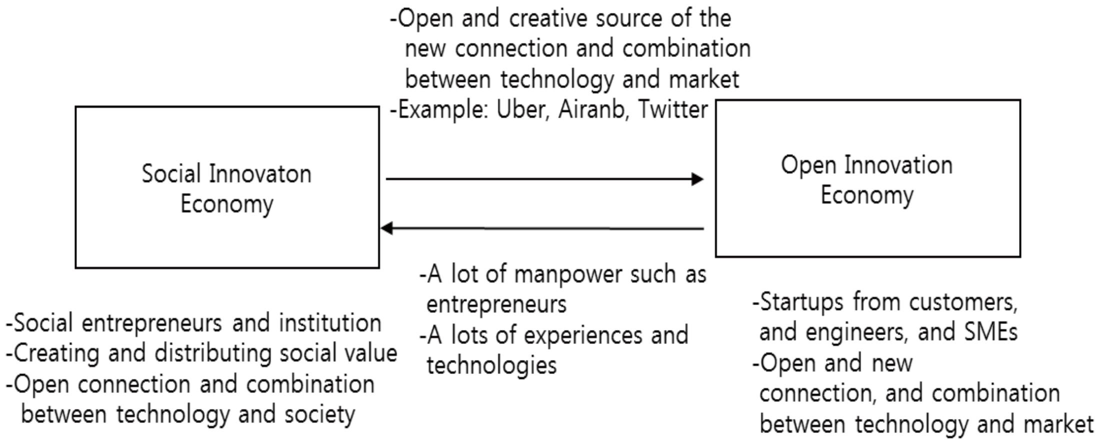
<Figure 3> Concrete relationship between the open innovation economy and closed innovation economy

Companies in the open innovation economy are transferred to the closed innovation economy through mergers and acquisitions (M&A), and they get the opportunity to mass-produce new business models for a short period. Large companies of the closed innovation economy can easily and rapidly perform a new combination between technology and market through corporate venture capital (CVC) investment. Various virtuous interconnected relations, including the M&A in Figure 3, are important factors for the activation of the dynamics of an open innovation economic system. For example, Apple bought about 20 technical companies related to smartphones through M&A, and opened the App Store to have a partnership with many SMEs around the world to enter into the smartphone industry for a short time and created millions of employment opportunities. Google also entered into the smartphone industry for a short time period through M&A with about 10 SMEs and start-ups like Android OS companies to create more new jobs around the world, specifically in the US. IBM changed itself as a software company from a manufacturing company through positive M&A with promising SMEs and start-ups. It achieved a new combination between technology and market, which is different from the existing computer industry, and created new jobs that replace the presently declining industry. SMEs and the large companies of Silicon Valley in the US that joined the Corporate Business Model Innovation Program of UC Berkeley confirmed the pursuit of mutual interests based on virtuous interactive relations described in Figure 3. Large multinational corporations (MNCs) of the closed innovation economy basically apply various open innovation strategies for relations between SMEs and start-ups (Mortara & Minshall, 2014).



<Figure 4> Concrete relation between the closed innovation economy and the social innovation economy

The closed innovation economy and the social innovation economy described in Figure 4 are the core of corporate social responsibility (CSR). In particular, in terms of the relations between a big business and a local society as well as between a big business and a government, large companies should consider social and environmental interests and voluntarily cooperate with stakeholders for their sustainable survival (Crowther & Aras, 2008; Jones, Indexes, Register, & Socially, 1980). Big businesses of the closed innovation economy directly and indirectly support the social innovation economy. Through this process, a big business directly gets a social reputation, which is essential for its long-term survival and indirectly benefits from the final marketization of the value created in an open innovation economy by social enterprise. The relation described in Figure 4 gives the direct benefit of securing potential customers to large companies and contributes to various and continuous production of social value in a social innovation economy. In addition, it continuously allows new combinations between technology and market, which are essential for the survival of large companies. The increasing number of companies known for their hard-nosed approach to businesses, such as Google, IBM, Intel, Johnson & Johnson, Nestle, Unilever, and Walmart, have begun to embark on important shared value initiatives (Porter & Kramer, 2011). The simple macroeconomics of profit-sharing possesses natural immunity to stagnation (Weitzman, 1985).



<Figure 5> Concrete relation between social innovation economy and open innovation economy

In a social innovation economy, social enterprises create social values by combining technology with society, which becomes a source of new combination between creative technology and the market. Open social innovation functionally defines open combination as being between technology and society. Open Social Innovation (OSI) is the application of either inbound or outbound open innovation strategies, along with innovations in the associated business model of the organization, to social challenges (Chesbrough & De Minin, 2014). Meanwhile, many SMEs and start-ups of the open innovation economy try to join the social innovation economy with their experience and know-how and become a major supply source of knowledge, know-how, and manpower for the social innovation economy. In the open innovation economy, the creative source of new or shifting start-ups through the new combination between technology and the market is based on the social innovation economy. In addition, even if the social innovation economy is financially supported by the closed economy, the actual manpower, know-how, and experience are supported from the open innovation economy. The case of the 8th National Biennial Grassroots Innovation Awards of India, which was identified through participant observation, is exactly similar. All 41 winners, including the three student award winners, were supported with manpower, patent application, product development, and market sales know-how beyond the social type from the open innovation economy, such as the honey Bee Network. They were also financially supported from the closed innovation economy like the National Innovation Foundation of India. This action has vitalized the social innovation economy. If both economies configure the innovation community with a flat and open collaboration network, the most active collaboration can be realized. In the case of India, the role is played by the Honey Bee Network (Pisano & Verganti, 2008).

3.3. Theoretical Roots of OIES

First, the theoretical reason for the relation among the open innovation economy, its closed innovation, and the social innovation economy can be found in the innovation and economy development through the new combinations of Schumpeter as well as in the open innovation for the open connection between technology and the market and the open business model for the open combination of Chesbrough. To produce other things or the same things using a different method means to combine these materials and forces in various ways. This is called a "new combination" (Schumpeter, 1934, p. 65). Innovation combines factors in a new way or carries out new combinations (Schumpeter, 1939, p.84). In addition to this, entrepreneurs carry out innovations (Schumpeter, 1939, p.100). Open innovation means that valuable ideas can come to a company and the market both internally or externally (Chesbrough, 2003, p. 43). In addition, a business model serves as an intermediate construct that links those technical and economic domains (Chesbrough, 2003, p. 69). The knowledge economy, the open connection in an open innovation and the open combination in the open business model of technology and market, is the driving force of new start-ups and creative value creation (Chesbrough, 2010).

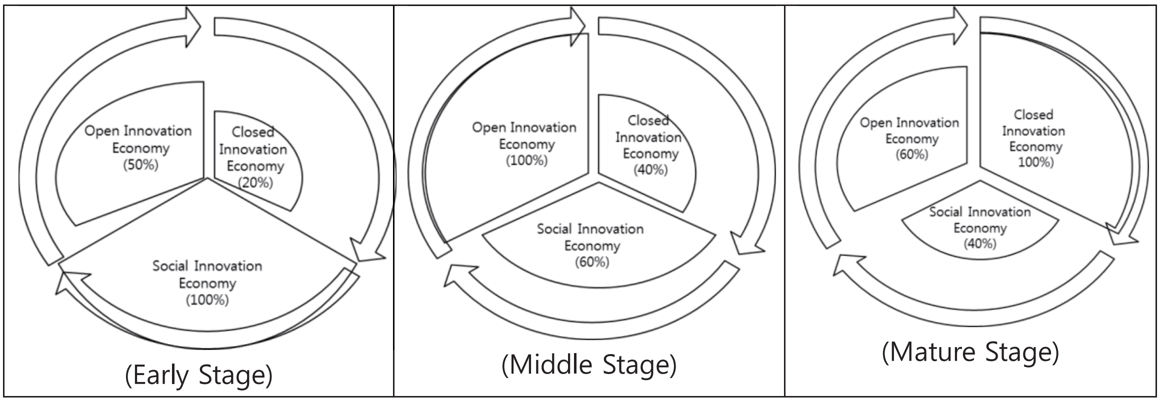
Second, the theoretical framework of big businesses based on the closed innovation economy is Schumpeter's Monopolistic Practices, Closed Season, and Corporate Social Responsibility, as well as the theory of partnered growth of Un-Chan Chung and Jang-Woo Lee. If big businesses continuously pursue monopolistic behaviors and closed strategies, investment opportunities will vanish (Schumpeter, 1942, pp. 87, 111). In addition, if large companies directly and indirectly support the social innovation economy and creating shared value (CSV), it is essential to guarantee corporate social responsibility (CSR) for long-term survival (Holme & Watts, 1999; Porter & Kramer, 2011). The theory of partnered growth, which handles the win-win growth strategy and partnered growth between SMEs that represents the open innovation economy and big businesses that represent the closed innovation economy, also serve as the theoretical basis for a mutual, virtuous, cyclical relation between the open innovation economy and the closed innovation economy (Un-Chan Chung , 2013, p. 226; Jang-Woo Lee, 2011, p.15).

Third, the theoretical basis of social innovation economy is Schumpeter's Socialist Blueprint, Ostrom's Governing the Commons and Sharing Economy or CSV. Socialist management would be able to start from a system of values that have evolved because of their capitalist predecessors (Schumpeter, 1942, p. 172). With the development of the Internet, marginal cost approaches zero, and the sharing social innovation economy emerges in automobiles, homes, and energy fields. The social blueprint of Schumpeter is partially being realized. Lastly, the shared economy offers a happier life, more money, more flexible lifestyle, reduced reliance on debt, and more trust in strangers as the subjects of the sharing economy that creates sharable value to essentially give benefits to them (Benkler, 2004). According to Ostrom, common pool resources (CPR) could be managed successfully without falling as prey to the "tragedy of the commons" through the design of durable, cooperative institutions that are organized and governed by the resource users (Ostrom, 1990, p. 25). Social open innovation based on the open combination between technology and society receives direct and indirect support from big businesses based on CSR and CSV. In addition, the interaction between the social innovation economy and open innovation is actually based on CSV.

Fourth, the dynamics of OIES has various theoretical bases. 1.) The theoretical base of the dynamics of OIES comes from Schumpeter. The dynamics of OIES basically complements the one-way, three-step discussion on dynamics like Schumpeter's individual entrepreneur based new combination, big businesses based monopolistic practices, and socialist blueprint based on socialist democracy by changing it to simultaneous and feedback loop-style dynamics (Schumpeter, 1934, p. 59; 1939, p. 65–106; 1942, p. 87, 172, 232). 2.) Simon's bounded rationality defines organizational learning beyond personal recognition and offers a theoretical basis for the dynamics of OIES as well as his organizational dynamics (Simon, 1982; Simon, 1991). 3.) The discussion on dynamics capability in a company suggested by Teece is the basis of the dynamics of OIES centered on the learning dynamics at the basic organizational level (Teece, Pisano, & Shuen, 1997). 4.) Christensen's discussion to find the industrial dynamics based on the viewpoint of open innovation and Kong Rae Lee's research inquiring about the innovation dynamics of the Japanese machine tools industry with users collectively forming the theoretical basis of OIES dynamics because they analyzed open innovation based on economic dynamics (K. R. Lee, 1996). Industrial dynamics must increasingly be conceived in terms of convergence and divergence rather than industry-bounded trajectories by open and industry-transcending patterns of innovations (Christensen, 2014; Christensen, Olesen, & Kjær, 2005). 5.) Linsu Kim's theory, which suggests organizational learning through catch-up growth and the dynamics of Korea's technological learning through innovative imitation, is also an important theoretical basis of the dynamics of OIES (Kim, 1997, 1998). 6.) Keun Lee's and Chaisung Lim's discussion on the learning and dynamics of Korean industry through catch-up is the basis of the dynamics of open innovation (K. Lee & Lim, 2001). They introduce the external base by adding knowledge-based learning and industrial dynamics through catch-up growth with an internal base and by explicitly applying the open innovation-based industrial dynamics to the catch-up model. 7.) For the effect of open innovation policy on the National Innovation System (NIS), the inquiry about the dynamics of open innovation at the national level through system dynamics is also matched with the theory of the dynamics of OIES (Yun, Won, Hwang, Kang, & Kim, 2015).

4. Simulation of the Dynamics of OIES

4.1. Natural Life Cycle of OIES Dynamics in a Knowledge-based Economy



<Figure 6> Example of the Natural Life Cycle of OIES

In the 21st century, knowledge-based economies or knowledge-based societies in which knowledge production and distribution are activated around the world and knowledge and technology become a major deciding factor are already established as dominant characteristics (Burton-Jones, 2001; Foray & Lundvall, 1998). OIES dynamics and a knowledge-based economy can be simulated through a mental experiment shown in <Figure 6>.

That is, if the ratio of the social innovation economy is 100%, the ratio of the open innovation economy grows in the early stage. Then, the closed innovation economy, based on big businesses, develops. However, as OIES dynamics evolve, the ratio of the open innovation economy significantly exceeds the majority of the social innovation economy.

In addition, in the middle stage, the open innovation economy becomes the largest portion, followed by the social innovation economy and closed innovation economy. The open innovation economy actively operates, and the social innovation economy continuously decreases. The closed innovation economy, based on big businesses, slowly increases. The OIES dynamics in the middle stage accelerates to increase the speed of economic growth and employment.

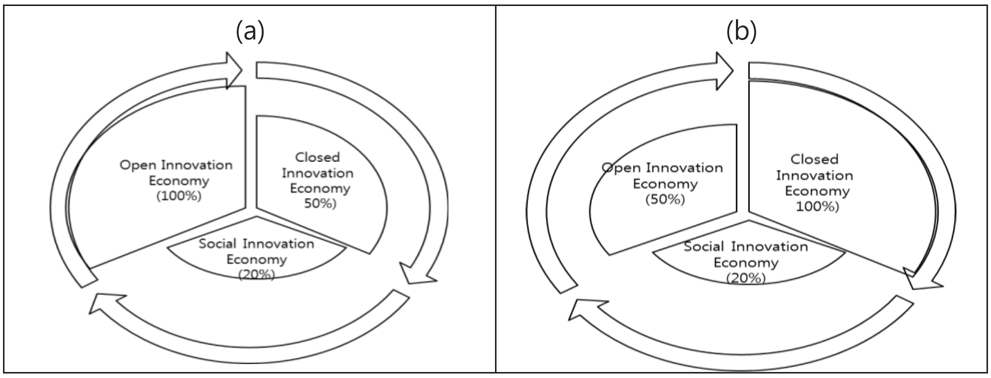
If the OIES dynamics mature when social agreement and government intervention are weak, the economy, which is led by the closed economy based on big business like the example in <Figure 6>, is established. In addition, the ratio of the social innovation economy decreases, greatly lower than the majority, and that of the open innovation economy also decreases to the majority or lower than that of the majority. The maturity led by the closed innovation economy restricts new employment because of limited new combination. The ratio of the open innovation economy and social innovation economy, leading the largest portion of job creation, significantly decreases, thereby resulting in a high unemployment rate. By any chance, if the economic growth, led by the closed innovation economy, lasts for a certain period, the growth continues without employment.

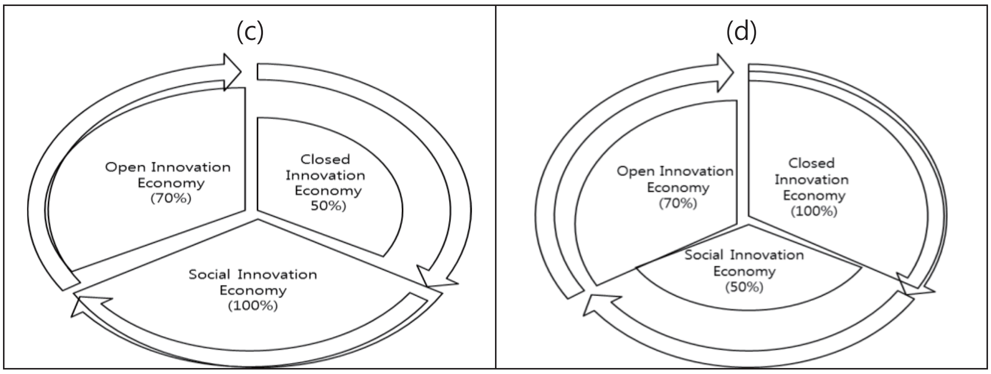
4.2. Low-speed and High-speed Example of OIES Dynamics

The low speed of the dynamics of OIES as well as the economic growth and high unemployment rate are shown in (a) and (b) of <Figure 7>. In the case of (a), big businesses sustain closed innovation-based growth without a social contract or national intervention, and SMEs as well as start-ups that are competing in an open innovation economy are depleted. Of course, the social innovation economy with slight direct and indirect support, in the good will of the closed innovation economy, is more contracted to a size that decreased during the OIES dynamics procedure. In this case, big businesses do not prefer the cooperation method with SMEs or start-ups through open innovation strategies like friendly M&A, partnerships, and technology licensing based on its strong market share and capital power. In the case of (a), economic growth stagnates because it is led by big businesses, and even if economic growth is fast because of environmental factors, it leads to growth without employment and stops the economic growth. This is the OIES dynamics that are closest to the conditions of the current Korean economy. The economies of most European nations, except for Germany, apply to this case.

In the case of (b), there is a strong open innovation ecosystem based in SMEs as well as a sound and sizable closed innovation economy but a weak social innovation economy. Because of this, the growth stagnates. In this case, the financial support to the social innovation economy of big businesses is weak, and the support to the social innovation economy becomes insufficient in terms of experience, know-how, and manpower from the open innovation economy. The subjects of the open innovation economy focus on limited open innovation that the combination of the current technology and market is newly improved rather than the creation of new jobs through creative and new start-ups based on the seed grown in the social innovation economy. In addition, there are not enough open innovation relationships between the open innovation economy and the closed innovation economy. The closed innovation economy based on big business also creates new source technology inside and focuses the activity to deliver the technology to the existing or expanding market, resulting in a more aggravated situation of no additional job creation. Japan and Germany have an economic system that is closer this. Without the efforts of vitalizing the social innovation economy and, an open innovation strategy based the relation between the open innovation economy and the closed innovation economy, it is inevitable that this economic system promotes growth without job creation resulting in growth stagnation.

It is of note that the common point of the two case models in which the dynamics of OIES are weak is a weak social innovation economy. The social innovation economy is a necessary condition that determines the vitality of the dynamics of OIES.





<Figure 7> Examples of Low-speed OIES Dynamics and High-speed OIES Dynamics

The fast speed of the dynamics of OIES, low unemployment, and rapid speed of economic growth are shown in (c) and (d) of <Figure 7>. In the case of (c), social enterprises and new social entrepreneurs in a sizeable and strong social innovation economy actively combine technology and society in various ways. For this, massive support from the government and strong financial support of large companies supported or built by the government are established. In addition, in an open innovation economy, manpower and know-how are massively provided to activate the social innovation economy and convert a new combination between technology and society to a new combination between technology and the market to establish the foundation of start-ups for the open innovation economy. Exemplary nations at an early stage of economic development apply to this case. Up to know, China's economy has only closely resembled this case, although now, India's economy also applies to this case. The Indian government has made efforts to strengthen the open innovation economy, vitalize the social innovation economy, financially support the social innovation economy, and promote the growth of big business at a certain scale by linking the open innovation economy and the social innovation economy through the Grass Roots Innovation Awards, Innovation Festival of India, and Innovation Foundation of India, respectively. Korea's rapid economic growth from the 1960s to the 1980s also applied to this case.

In case of (d), this economic system is formed through a social contract or a strong government intervention when the growth of the OIES dynamics is stagnated. Mutual development with SMEs or start-ups is pursued through strong regulation by the government on the closed innovation system and on open innovation strategies like friendly M&A, partnership, and technology licensing. For example, the US continuously implements and develops the world's first and top regulation system on big businesses of the closed innovation economy, such as stipulating unfair businesses to be unlawful and allowing people take legal actions through the Sherman Act of 1890, Clayton Act of 1914, Hart–Scott–Rodino Act of 1976, and the Federal Trade Commission. In addition, big businesses directly provide financial support or the nation activates various types of social economies by using taxes. Then, a social innovation economy continuously creates jobs in all economic systems. In the short term, it becomes the source of a new combination between the technology and the market of SMEs and start-ups. In the long term, it becomes the seed of continuous new combinations of big businesses. In the US, the image of the best big companies set by Rockefeller, Carnegie, etc., in the 1910s has led to continuous contributions and financial support of big businesses to the social innovation economy. The economic systems of the US and European countries from the 1970s to the 1980s, enjoying rapid economic growth, belong to this case. The economy of the US with a high economic growth of 4% and little promotion of job creation as of late 2014 is similar to this case. President Obama suggested the "Startup America Partnership" program to lead the mutual virtuous circle between large companies and SMEs, and the ratio of the open innovation economy against the closed innovation economy would increase. Then, its economic growth rate rises.

5 Discussion and Conclusion

5.1 Discussion: Not capitalism, socialism, and democracy but Schumpeterian dynamics

It is clear that the dynamics of OIES have theoretical and practical implications by comparing them with the dynamics of economic evolution and development discussed by Schumpeter.

Even though Schumpeter did not concretely mention technology and market, he is the first scholar who clearly suggested economic evolution and dynamics explaining that the new combination between technology and the market promotes innovation, creates new jobs, and develops the economy (Schumpeter, 1934, p. 15). However, the economic evolution or development discussed by Schumpeter is unilinear. Schumpeter separates the subject that leads to the new combination of the first stage from capital class and defines it as an entrepreneur.

Schumpeter suggested that the subject of economic evolution and the development of the second stage is big businesses. A big business pursues the rate of increase of total output, creates new combination through massive investment in research and development, and leads the process of creative destruction (Schumpeter, 1942, p. 81). However, the big business-based economy goes through monopolistic practices, closed season, and the disappearance of investment opportunities.

As an alternative to overcome the limits of the second stage, Schumpeter showed socialist blueprints that focus on the civilization of capitalism and provided the Labor Party in the United Kingdom (UK) as an example.

The three stages of the economy development logic of Schumpeter are generally accepted as the types of sub economies in the dynamics of OIES. So we call it Schumpeterian dynamics of OIES. The unilinear economic development of Schumpeter had been practically complemented based on the practical experience in economic development and the academic performance accumulated for the past 65 years after the death of Schumpeter. After this, the Schumpeterian dynamics of OIES were created.

All capitalist economic systems have a development stage identical with the economic development stage model of Schumpeter. However, the reasons that the current situation is different from the final expectation of Schumpeter and that the economic development speed and employment of capitalistic economic systems are different can be gleaned from the fact that economic development in three stages is performed by the stages and overlap. These overlapped economic development dynamics are shown in various ways in accordance with each economic situation or with internal and external conditions.

Therefore, in the Schumpeterian dynamic of OIES, the distinction between low and high dynamics is not absolute. The models and practical cases shown in the simulation are just a few examples. However, it is essential to introduce a new combination between technology and the market for creative and new emergence of SMEs and start-ups and a new combination between technology and society for creative social enterprise and social innovation economy development, as well as a proper open innovation strategy to maintain the virtuous cyclic relation between the closed innovation economy and the open innovation economy as well as with the social innovation economy, and to sustain a creative and new combination.

5.2 Conclusion

General conditions to invigorate the Schumpeterian dynamics of OIES, the key of this research, are divided into five items. First, the new combination between technology and the market should be activated to encourage the emergence of new creative SMEs and start-ups. Second, big businesses should continuously make efforts to introduce new business models and create new jobs by creating new combinations for a short period through friendly M&A, partnerships, and technology licensing with SMEs and start-ups rather than just focusing on its internal R & D. Third, big businesses should make an active contribution to vitalize the social innovation economy through direct donations as well as indirectly through the payment of sufficient taxes for creative new combinations between technology and the market for a long time. Fourth, the social innovation economy should actively create creative social values that are necessary for society through the social open innovation of new combinations between technology and society, instead of just focusing on the production of social values. Because of the third industrial revolution that is mainly based on the Internet, various shared values based on zero marginal cost sharply increase, and the importance of social innovation economy rises. Fifth, SMEs and start-ups should actively provide manpower, technology, knowledge, and experience to the social innovation economy based on their expertise in creating a new combination because that is the source of creative new combinations between technology and the market.

Because this research was conducted to develop an economic model to overcome the growth limits of capitalism, it has many limitations and follow-up research projects. First, a global comparative study of the Schumpeterian dynamics of OIES is necessary. Through these related studies, concrete and practical cases of high- and low-level dynamics can be accumulated. In addition, the composition of the three types of sub economies of high- and low-level dynamics and cases of interaction among them can be accumulated. As such, this research proposes a research program called the "Global Research Program" to analyze the differences between high and low Schumpeterian dynamics of OIES in the OECD or UN.

Second, to thoroughly define the Schumpeterian dynamics of OIES, multidisciplinary cooperative research in economics, business administration, sociology, politics, engineering, law, etc., should be conducted. For this, first, a "Global Research Network" for research collaboration on the Schumpeterian dynamics of OIES should be established. The construction of a research network should cover the Society of Open Innovation: Technology, Market, and Complexity or the Global Open Innovation Forum, an interdisciplinary cooperative research should be activated to define the Schumpeterian dynamics of OIES in depth and in multidisciplinary ways. In addition, an academic platform is necessary to accumulate and develop the performance of the cooperative research on the Schumpeterian dynamics of OIES. At present, there are journals like the Journal of Open Innovation: Technology, Market, and Complexity; Journal of Evolutionary Economics; System Dynamics Review, etc. to systematically accumulate the performance of multidisciplinary research. Existing journals and new ones should be supported. In addition to theses, there are a lots of research topics such as finding out concrete technology which evolve in OIES dynamics, or active interaction conditions between sub economies which motive Schumpeterian dynamics of OIES.

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June 15 (Monday)

R# : 202 Conference Room

Special Session 1

"The Importance of Valuation and Big Data as a Source of Technology Commercialization in Open Innovation Era"

■ **Session Chair: KeeHeon Cho** (Korea Valuation Association)

- Paper 1: "Valuation using royalty data in Life Science area- Focused on Anticancer and cardiovascular therapies" by **JeongHee Lee(Digital Science Co., Ltd.), Youngyong In(Digital Science Co., Ltd.), Il-Hyung Lee(KISTI), JoonWoo Lee(KISTI)**
- Paper 2: "Review of the New Product Development Strategy and Corporate's Competition" by **JaeMan Joo (Duksung Women's University)**
- Paper 3: "Open Innovation of Knowledge Cities" by **JinHyo Joseph Yun(DGIST), EuiSeob Jeong(KISTI), SangChul Lee(DGIST), JeongHo Yang(DGIST)**
- Paper 4: "Technology Valuation by Collective Intelligence" by **YoungGi Kim(Gisang Co., Ltd.), Taehoon Kwon(KISTI), TaeJong Jang(KISTI)**
- Paper 5: "The Economic Value of Brands and Patents in Manufacturing Firms of South Korea" by **SoJin Lim(Korea Institute of Intellectual Property)**
- Paper 6: "Schumpeterian Analysis of Catch-up and Catch-up cycles" by **Keun Lee(Seoul National University) and Franco Malerba(Bocconi University)**
- Paper 7 : "Empirical Study and Analysis on the Technology Valuation of Promising Technologies" by **Tae-Eung Sung(KISTI)**
- Paper 8 : "Analysis and Model Validation of Patent Value Drivers based on its Transaction Real Data" by **Tae-Eung Sung(KISTI)**

Valuations using royalty data in life science area - focused on anticancer and cardiovascular therapies

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Abstract

Purpose: This research seeks to answer the basic question, "How can we build up the formula to estimate the proper royalty rate and upfront payment by using data I can get simply as input?" This paper suggests the way to estimate proper royalty rate and upfront payment by using the formula derived from the regression of historical royalty dataset.

Design/methodology/approach: This research analyzes the dataset including the royalty-related data running royalty rate (Backend Payments), Upfront Payment (Up-front fee + Milestones) regarding drug candidates for specific drug class like anticancer or cardiovascular by regression analysis. And then we derive the formula to predict royalty-related data by using the attrition rate for the corresponding development phase of the drug candidate for the license deal and the revenue data of the license buyer (Licensee). And then we investigate the relationship between the formula to predict royalty related data and e-NPV.

Findings: For the drug class of anticancer(antineoplastics) & cardiovascular, the formula to predict the royalty rate &Upfront Payment is as follows:

- X= (Attrition Rate * Licensee Revenue)/100

<Drug Class : Anticancer activity drug candidates>

- Royalty Rate = (1+a*X) / (b + c*X) = (1+-5.14147E-09*X)/(0.128436559+ -6.37E-10*X) (Formula 1)

- Upfront payment (Up-front + Milestones) = (a+X) / (b + c*X) = (-133620928.7+X)/(-3.990489631+ 2.04191E-08*X) (Formula 2)

<Drug Class : Cardiovascular activity drug candidates>

- Royalty Rate = y0 + a/X + b/X2 = 9.262e+0 + (-8.528+5)/X + 1.744e+10/X^2 (Formula 3)

- Upfront payment (Up-front + Milestones) = y0 + ax + bx2= 7.103e+6 + -3.990489631 * X + -1.536e-12 * x2 (Formula 4)

In case of Formula 2 and 4, it's statistically meaningful (R2: 039 ~ 0.41), but in case of Formula 1 and 3, it has weak relationship (R2: 022 ~ 0.28) and so it requires further study.

Research limitations/implications (if applicable): This research is limited to the relationship for two drug classes of anticancer (antineoplastics) and cardiovascular and royalty related data.

Practical implications (if applicable): Valuation for the drug candidate within specific drug class can be possible and the royalty rate can be variable according to drug class and Licensee revenue.

Keywords: valuation, licensing deal, drug, royalty data, royalty rate, up-front fee, milestones, regression, drug class, anticancer, antineoplastics, attrition rate, development phase, licensee, life science, rNPV, eNPV, DCF, QSAR, computational chemist

Review on new product development and related competency of the company

JaeMan Joo
(Duksung Women's University)

Companies should pursue future-oriented growth and development through ongoing revenue and benefit. To do this, companies should strengthen innovation activity and develop and perform a variety of strategies and tactics according to their retention capacity.
The strategy and implementation of more effective management activities for new product development is essential to ensure financial stability and growth potential and the company's competitive advantage due to changes in the business environment.
However, high-tech, banking system, laws and regulations, due to the dynamic changes in the external business environment of rapid change, such as consumer behavior on a newly-market products are not all that successful.
Urban & Hauser(1993) has noted that about 25% to 30% of the new product to be introduced into the market failed.
The various paradigms and changes in trends by country, industry and management activities of the company with intensified competition between companies is making it more difficult. As a result, greatly shorten the life cycle of the company(CLC).
The shortening of the technology life cycle(TLC) and product life cycles(PLC) with the development of advanced science and technology needs, and that the rapid reduction of strategic decisions on investment in new product development and recovery period, the company generated revenue.
Only the establishment and execution of the highly thorough analysis in relation to consumer behavior, marketing strategy can lead to the existence and survival of new enterprises in the market.
Companies with limited resources under global competitive environment, it is necessary to strengthen innovation activities.
Companies save time and money ranging from idea generation to market surveillance and the development of new products in order to perform effectively and efficiently and should improve profitability. To do this, companies are required to build and operate a structured system that can establish and run a new development strategy for retention capabilities.
The increase of sales due to new product development of the company can be found that the CEO's will, and corporate R&D investment is held depends on the capacity of the tangible & intangible.
However, previous research on the relevance of new product development and most of the reserves at the results of the research capability and new product development company were not. In addition, the type of paper on the development of new products strategically selected according to the retention capacity of the company were not.
In this study, investigate and suggest appropriate with respect to new types of skills required by a look at the new competence with respect to the type of business or enterprise product development strategies of the retention capacity of the company not covered in previous studies.

Open Innovation of Knowledge Cities

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Abstract

Purpose: This research seeks to answer the basic question, "As a city evolves from an industrial city to a knowledge one, are its open innovation activities vitalized?"

Design/methodology/approach: In this research, we compare the total number of patent applications, the number of joint applicants of each patent, and the ratio of patents jointly applied, in four Korean cities—Daegu, Kwangju, Cheonann total, top 10 percent patent applicants group among total patent applicants, and the lower 70 percent patent applicant group among total patent applicants. The research included 144,625 patents submitted to the Korea Patent Office from 1981 to 2010.

Findings: As knowledge-based urbanization proceeds, the size of a knowledge city increases. The lowest 70 percent of patent applicants (rather than the top 10 percent) apply for more patents, and the breadth and depth of open innovation rises.

Research limitations/implications (if applicable): This research is limited to mutual patent applications as a target of open innovation. In the future, additional research will need to be conducted on various open innovation channels such as patent citation, intellectual property right transfer, licensing, and M&A.

Practical implications (if applicable): To maximize the beneficial characteristics of a knowledge city in a large city, the improvement of open innovation across the city is essential.

Social implications (if applicable): If strengthening open innovation by SMEs or start-ups is set as a corporate strategy or a government policy, it will be a source of development of knowledge-based urbanization and continued economic development of a knowledge city, as well as of the total knowledge assets.

Keywords: Knowledge City, Open Innovation, Power Law, Long Tail

Technology Valuation by Collective Intelligence

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Abstract
This study attempts to compare the valuation of technology by collective intelligence of crowd with by professional. Based on the review of related literature, typical technology valuation methods of income approach, market approach, and cost approach, all of these are performed by professionals, but the values cannot reflect the real market situation. Ideal value can be given in real time market by ideal crowd. We uses a new concept for measuring the value of technology using collective intelligence to improve the credibility and objectivity on the valuation. These results are compared to the valuation result by professional to analyse the effect of open innovation on valuation.

Keywords: open innovation; knowledge based economy, collective intelligence, crowd, valuation

The Economic Value of Brands and Patents in Manufacturing Firms of South Korea

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Abstract

This study measures the monetary value of patents and brands as an intellectual capital using the information in balance sheet of South Korean manufacturing firms (8,315 firms) in the period of 2005~2011.
The results show that the average ratios of value of patents and brands in firm's intellectual capital are 13.7% and 30.7% respectively. By industries, the electronic and medical & precision instrument have much higher ratio of patent value (30.5% and 31.7%) than other industries. On the other hand, the value of brands take large part in firms' intellectual capital in food, clothes industries (50.7% and 41.3%).

Keywords: Brand, Patent, Intellectual Capital, Knowledge Capital Earnings

Schumpeterian Analysis of Catch-up and Catch-up cycles

Keun Lee and Franco Malerba

Many industries have witnessed numerous changes in industrial leadership and successive catch-up by late entrants. The incumbent fails to maintain its superiority in production or market shares, and a latecomer catches up with the incumbent. The latecomer, who gains leadership, then loses to another latecomer. We call these phenomena of successive changes in industrial leadership as 'catch-up cycles', where catch-up means a substantial closing of the gap in market shares between firms in a leading country and those in a latecomer or follower country. This paper attempts to explain these phenomena in six sectors of cell phones, memory chips, camera, steel, mid-sized jets, and wine. These cases were analysed in view of the common theoretical framework on successive changes in the industrial leadership and a catch-up cycle proposed by Lee and Malerba (2015a) which is based on the notions of sectoral systems and the evolution of these systems over time (Malerba, 2002).

Several discontinuities may occur during their evolution, which we call as 'windows of opportunity' which was first used by Perez and Soete (1988) to refer to the role of the rise of new techno-economic paradigms in generating leapfrogging by the latecomers who take advantage of a new paradigm and thereby surpass the old incumbents. We broaden the notion of windows of opportunity by consider more dimensions, and identify three windows, namely, technological, demand and institutional windows (Lee and Malerba, 2015a). With the notion of 'windows of opportunity', this study uses the concept of 'response' by firms and systems. A few firms from emerging countries and the sectoral system that supports them may respond to the opening of windows and rise to global leadership, whereas the falling behind of the current leaders from a certain country may be due to a lack of effectiveness in the response, often due to an 'incumbent trap' (Chandy and Tellis, 2000), by firms and by their sectoral system leading to misalignments to the new window. In sum, the gist of our theory is that diverse combinations of windows of opportunity and the responses of firms and sectoral systems of latecomers and incumbents determine the pattern of successive catch-ups that will most likely emerge in a sector.

While we consider all these 'three windows' of opportunity, the final emerging picture is quite 'Schumpeterian' because we confirm the supremacy of technological innovation as the critical interface connecting the three windows. While the demand-related windows are important, they tend to have an influence on the forging-ahead stage primarily because they lead to demand-driven innovation and new investment or demand-driven adoption and diffusion of new technologies. Similarly, while the role of the institution and government window is 'significant' during the forging-ahead stage in several cases (such as Japanese steel), its actual impact is realized through the adoption or diffusion of new innovations. However, we have also proposed to qualify and specify the subtle nature of technological windows along the different dimensions of exogenous versus endogenous innovation and of competence-enhancing versus destroying innovation. However, the aforementioned distinctions must be complemented with the nature and types of capabilities and strategies of the incumbents and latecomers, as well as their sectoral system adequacies, alignment and responses.

Empirical Study and Analysis on the Technology Valuation of Promising Technologies

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Abstract

In this study, by performing technology valuation on KISTI promising technologies selected and announced officially every year, promising business opportunities for SME support, and outstanding technologies patented and registered by Korean Intellectual Property Office (KIPO) and Korean Invention Promotion Association (KIPO).

We analyze the correlation between the value of the technologies selected and the actual sales performance for directly commercialized technologies.

In addition, this study targets 85 technologies (items) discovered through the three support programs in the 2009-2012, in order to demonstrate statistical significance by comparing and analyzing the actual revenues in 2-3 years after valuation and the resulted value of promising technologies at the selection year.

Keywords: Technology Valuation, Promising Technologies, STAR-Value System

Analysis and Model Validation of Patent Value Drivers based on its Transaction Real Data

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Abstract

The purpose of this study is to extract the determinants affecting the quantitative value of patents by their transaction data based on real trading practices. To attain the goal, we examine 15 national and international patent valuation models to date for this purpose by selecting 11 value drivers to explain the determinants of good market performance.
The collection of patent technology trading data has been completed by the favorable cooperation of public institutions (Korea Invention Promotion Association , Technology Guarantee Fund) and private trade organizations (12 companies), so that we have a total of 250 patents, technology, industry classification for trade practices, transaction date, transaction prices, the title of the invention, application number and degree of innovation, stage of commercialization, type of technology, etc. The patent information and specific details associated have been obtained from patent-related websites (WINTELIPS) based on patent application number and its title. Also, the identifiable information has been confirmed through online patent trading market websites (http://www.idea.kr) to disclose the patent bargain prices.
To perform screening the value drivers from the data collected in this study, we have verified categorical variables and continuous variables via logistic regression analysis, where the classifications appear as a mixture of order. In addition, we conducted variable MF (Model Fit) test and TPL (line parallelism) verification, in order to see how much well the models assumed explain dependent variables, and classified into significant patent factors (value determinants) by the preceding observation and hypothesis.

Keywords: Patent Value Drivers, Transaction Real Data, Logistic Regression Analysis

June 15 (Monday)

R# : 202 Conference Room

Special Session 2

"Complexity, Open Innovation & Knowledge City"

- **Session Chair: DongKyu Won**(KISTI)

- Paper 1: "How do we conquer the growth limit of capitalism: Schumpeterian Dynamics of Open Innovation Economy System" by **JinHyo Joseph Yun(DGIST)**
- Paper 2: "How Do Academics Engage in Technology Transfer Activity? An Exploratory Study of the San Diego Biotechnology Community" by **SangTae Kim(Small & Medium Business Administration of Korea), YongIl Jeong(KISTI)**
- Paper 3: "Measuring the easiness of diffusion in social networks through the agent-based modeling" by **HyoungSun Yoo(KISTI), TaeEung Sung(KISTI), SunHi Yoo(KISTI), DongKyu Won(KISTI)**
- Paper 4: "Simulation of Weak Signals of Technology Innovation in Complexity" by **SunHee Yoo(KISTI), DongKyu Won(KISTI)**
- Paper 5: "Complex Adaptive Systems Approach to Sewol Ferry Disaster in Korea" by **DongKyu Won(KISTI), HyungSun Yoo(KISTI), SunHi Yoo(KISTI)**

How do we conquer the growth limits of Capitalism? - Schumpeterian dynamics of open innovation economy system

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Abstract

The purpose of this study is to answer the research question, "How do we conquer the growth limits of capitalism?" Based on existing studies on growth limits of capitalism by Marx and Schumpeter as well as the recent discussions of Drucker, Rifkin, and Piketty, the Schumpeterian dynamic model of an open innovation economy system (OIES) is proposed as an answer to this research question.
OIES consists of an open innovation economy, closed innovation economy, and social innovation economy. The Schumpeterian dynamics of OIES occurs from the positive interaction among the open innovation economy, closed innovation economy, and social innovation economy. The Schumpeterian dynamics of the OIES circle are from an open innovation economy, through a closed innovation economy and social innovation economy, and back to an open innovation economy again. In addition, the validation of the model for the Schumpeterian dynamics of OIES is improved by simulating the life cycle of the dynamics of OIES, low-level OIES dynamics, and high-level OIES dynamics, and by inquiring about a practical economic system corresponding to each simulation situation. Next through a comparative discussion between the linear steps of Schumpeter 1 and 2, and Socialist Democracy, and the Schumpeterian dynamics of an open Innovation economic system, the practical and theoretical characteristics of the Schumpeterian dynamics of OIES are clearly defined. Finally, the limits of this study and a follow-up research project are presented in addition to a summary of the discussion.

Keywords: open innovation economy system, Schumpeterian dynamics, open innovation, closed innovation, social innovation

How Do Academics Engage in Technology Transfer Activity? An Exploratory Study of the San Diego Biotechnology Community

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Abstract

Technology transfer and academia-industry collaboration have emerged as a growth engine for the knowledge-based economy, thus drawing much attention from scholars and policymakers. This study explores how academics at a research university and non-profit research institutions in San Diego have developed their practice and relationships to transfer and commercialize knowledge by drawing on a qualitative approach. By tracing academic researchers' trajectories and experience in transferring technology using 43 in-depth interviews and historical archives, this paper argues that academics learn to be comfortable with and capable of translating basic research into products by participating in companies as senior staff and by interacting with their entrepreneurial colleagues. Learning by doing and interacting helps academics to venture into entrepreneurial activity. Based on these observations, this research suggests that universities and governments seeking to facilitate technology transfer need to motivate and encourage academics to embark on development efforts. Similar to the strategies used to stimulate entrepreneurship, the focus must be on individuals and their learning experience.

Keywords

Technology (knowledge) transfer, academic entrepreneurship, San Diego biotechnology cluster, organizational learning

Highlights

- This research explores how academic scientists at UCSD and research institutes in San Diego have developed their knowledge, attitude and relationship necessary for commercializing their laboratory discoveries.
- By being involved in entrepreneurial activity and engaged with entrepreneurs, academics develop attitude toward and practice for technology transfer.
- This research implies that to facilitate technology transfer and academic entrepreneurship, academic institutions, first of all, need to focus on learning experience of their scientists by supporting them to do entrepreneurial activity and facilitating them to interact with entrepreneurs.

1. Introduction

Many dynamic industrial clusters have intimate links with neighboring research universities: the emergence of Silicon Valley is at least partly attributable to the role of Stanford University in supplying basic research ideas and scientific talent; the revival of Route 128 – and, to some extent, the resurgence of the Massachusetts economy – can be traced to the efforts and engagement of the Massachusetts Institute of Technology (MIT) and Harvard University. Increasingly, the literature and policymakers share the view that research universities and academic scientists are indispensable elements for nurturing technology-based innovation and entrepreneurship. This observation resonates with Castells and Hall's (1994, p. 231) suggestion that "research-oriented universities are to the informational economy what coal mines were to the industrial economy."

This recognition has led regions and states to introduce policies of investing in research universities and adopting programs to stimulate university-industry collaboration. For instance, the U.S. government recently launched a public-private partnership initiative, known as *Startup America* to stimulate entrepreneurship throughout the country. One of the primary components of this initiative is to facilitate technology transfer by building *concept centers* at universities and providing mentoring services to academic scientists (White House, 2011). In seeking to nurture the biotechnology industry, state governments largely focus on strengthening basic research capacity by installing research grant funding and constructing research facilities for their universities and research institutes (Battelle Memorial Institute & State Science and Technology Institutes, 2006). Not only states and the U.S. federal government but also countries around the globe passionately pursue measures to enhance research capacity and exploit their academic research in developing technology-based industries (Govindan, 2005; Lehrer & Asakawa, 2004; Sohn & Kenny, 2007).

However, the role of research universities in local economic development is far more nuanced (Florida & Cohen, 1999). A study (Feldman, 1994) on the influence of Johns Hopkins University on local economic development has notable implications for rethinking the role of research universities. The effects of research universities on local economic development are not linear, as they are mediated by various factors and contexts. In this respect, more studies in recent years elucidate the social contexts of university-industry collaboration and academic entrepreneurship. A corollary of this understanding is that the extent of knowledge transfer between academia and industry and the entrepreneurial activity of faculty are contingent on social contexts, including their organizations' and individuals' social relationships, regulations, routines and attitudes toward entrepreneurship (Bozeman, 2000; Colyvas et al., 2002; Di Gregorio & Shane, 2003; Etzkowitz & Leydesdorff, 2000; Owen-Smith & Powell, 2003a; 2003b).

Although the channels, motivations for technology transfer, and social institutions necessary for academics to engage in industry have been widely explored, what is less understood is how individual scientists translate their knowledge into innovations. Moreover, it is still less explored how academics become comfortable with and capable of working with the industry sector (Owen-Smith & Powell, 2004). In this regard, the primary question of this research concerns *how academic scientists become confident and competent with technology transfer activity*. In short, this study explores the mechanisms through which academic scientists learn to be entrepreneurial.

This study explores the biotechnology community of San Diego, which consists of a prominent research university – the University of California, San Diego (UCSD) – a group of non-profit research institutes focusing on biomedical research, hundreds of biotechnology companies and other business service groups. Milken Institute ranked the County of San Diego as the top biotechnology cluster in the country (DeVol, Wong, Ki, Bedroussian & Koepp, 2004). Another study conducted by the Brookings Institution (Cortright & Mayer, 2002) emphasized that San Diego is one of the most noteworthy biotechnology centers in the U.S. because of its combination of strong research competence and commercial capacity. During the five-year span from 2009 to 2013, biotechnology companies in San Diego have absorbed approximately 11 percent of the venture capital in the country.

There has been no empirical analysis of the degree of academia-industry interactions in San Diego relative to other regions. However, existing studies and remarks suggest that academic institutions and their interactions with industry in San Diego have been among the most critical factors in vitalizing the biotechnology industry. Walcott (2002) attributed the expansion of the San Diego biotechnology cluster to an outstanding university (University of California, San Diego), advocacy leadership and an entrepreneurial culture. An analysis report by the Council on Competitiveness and Porter (2001) noted that the efforts of UCSD and other research institutes have been the primary engine of the biotechnology cluster. Consistent with those two studies, Smilor and his colleagues (Smilor, O'Donnell, Stein & Welborn III, 2007) also concluded that UCSD had been the key player in creating the regional high-technology center by transferring technology, creating business networks, nurturing startups and boosting entrepreneurial culture. Walshok and her colleagues (Walshok, Furtek, Lee &Windham, 2002) emphasized the influence of local research institutions on accumulating research expertise, generating business networks, and attracting and educating a skilled workforce.

In this sense, the setting of academic institutions and the biotechnology industry in San Diego provides an intriguing opportunity to explore how academic scientists learn to be entrepreneurial and how they become more versatile in managing technology transfer regulations.

2. Theoretical Background: Conditions and Conduits for Technology Transfer

Tacitness in knowing and learning, as suggested by Polanyi (1966), has important implications for understanding why knowledge transfer should involve more than simply contracts. Polanyi (1966, p. 4) noted that *"we can know more than we can tell"* because some part of knowledge cannot be fully described or transferred in a codified form. Knowledge should involve personal interactions and the circulation of shared experiences in addition to documents or written manuals. One of the channels for acquiring tacit knowledge is apprenticeship, through which students learn from their mentors by observing, imitating, and practicing (Nonaka, 1994). The adoption and dissemination of tacit and social knowledge depend on the cumulative experience and organizational structures of institutions (Edmondson, Winslow, Bohmer & Pisano, 2003).

The literature on social learning and communities of practice – I use the term *communities of practice*, following Wenger, McDermott and Snyder (2002, p. 4), to refer to “groups of people who share a concern, a set of problems, or a passion about a topic, and who deepen their knowledge and expertise in this area by interacting on an ongoing basis" – can shed new light on the social aspect of knowledge transfer. Learning and knowing involve the process of situating oneself in the collective local meanings according to a body of literature on organizational learning. Individuals come to know and acquire local knowledge by experiencing and engaging in constructing and reconstructing the embedded meanings of their local community (Lave & Wenger, 1991; Orr, 1996; Wenger, 1998; Yanow, 2003). Learning occurs through involvement in the negotiating practices of a community (Lave & Wenger, 1991). Through participation in communities of practice, newcomers absorb the practices that form the community. To learn and embody social practices, newcomers should be able to participate legitimately in communities of practice and to situate themselves in the ongoing constitutive process, as local meanings are constantly produced and reproduced in the process of members' interactions (Wenger, 1998). In this respect, individuals learn by participating in creating and shaping local meanings at practices of communities Learning occurs in the process of experiencing and interpreting the world and in the relations between the self and the world as a participant in a community.

To perceive and absorb experiences through interactions, individuals need to understand the meanings and values of organizational artifacts, which include language, symbols, stories, and norms. Again, to be able to interpret organizational artifacts, individuals need to have participated or be participating in organizational practices whereby the meanings and values of organizational artifacts are defined and reproduced. To be competent, individuals in a community should be able to take actions and make decisions in accordance with the practices of their community. Their interpretations and actions should be legitimate and valuable in the eyes of their community. Observational research conducted by Orr (1996), Orlikowski (2002) and Strati (2003) provides in-depth insight into how individuals learn and enact organizational routines through everyday practice. For example, Strati (2003) claimed that individuals learn by participating in organizational practices. Strati (p. 72) referred to what individuals learn through interactive processes as 'aesthetic knowledge': "aesthetics, in fact, closely interweaves with the tacit knowledge of individuals, and they both signal the socially constructed personal way in which people interact to invent, negotiate, and recreate organizational life through practice, taste, and learning."

Brown and Duguid (1991) applied the learning process in communities of practice to the understanding of studies explaining innovation and creativity. According to these researchers, innovation arises in communities of practice in which members engage in narrative activity and interact with one another to solve problems. Working, learning and innovating, as noted by Brown and Duguid (1991), occur simultaneously as individuals engage in the practices of their communities. In the process of diagnosing problems and inventing solutions by creating and reshaping narratives, participants encounter and absorb novel concepts and perspectives. Because a large portion of knowledge is embedded in the collective experiences, narratives and artifacts of communities, individuals can access and recognize the hidden dimensions of knowledge by participating in common practices. In their later research (2000, p. 18), these authors wrote that "for all information's independence and extent, it is people, in their communities, organizations, and institutions, who ultimately decide what it means and why it matters."

As the literature on the tacitness of knowledge and learning in communities implies, transferring technology from academia to industry involves the learning and modification of institutions as well as individuals. Commercialization and marketing are under the reign of industries, which have the expertise, facilities and culture necessary to develop marketable goods and services. In the last few decades, concerns and criticisms have arisen regarding the breach of boundaries between academia and industry: universities have performed more translational research when developing prototype products and even when conducting early-stage clinical tests, they have brought companies to their campuses by establishing science parks and incubators, and academics have become more interested in commercializing research discoveries than in purely pursuing basic knowledge based on openness and collaboration. In contrast, industries have endorsed the ethos of academic research by allowing and even encouraging their scientists to publish in academic journals and to seek fundamental inquiries by collaborating with academic scientists (see, for example, Etzkowitz, 2004; Etzkowitz, Webster, Gebhardt & Terra, 2000). However, the two sectors are basically grounded on separate norms, values and practices, and they have different interests and functions. Therefore, there should be a nexus for translating academic invention into industrial innovation (Rosenberg & Nelson, 1994).

Among the many venues situated between universities and industries, knowledge from federal research laboratories is transferred primarily through person-to-person interactions as scientists on one side visit scientists' laboratories on the other side to engage in personal communications, for example, at seminars (Roessner, 1993). Because a large portion of knowledge is circulated within scientists' circles in academy and industry, industries constantly monitor and acquire knowledge regarding academic inventions through their scientists' informal daily communications with academic scientists (Roessner, 1993). Zucker and Darby (2006) identified star scientists in high-technology fields such as biomedical and IT and found that 72 percent of highly prolific scientists have linkages with industry via patent licensing, joint research and participation in scientific advisory boards. These authors (2006) concluded that "the stars themselves rather than their potentially disembodied discoveries play a key role in the formation or transformation of high-tech industries" (in *Abstract*). In previous studies, Zucker and his colleagues (1996; 1998; 2002) consistently suggested that the knowledge created at universities is largely transferred to and utilized by the biotechnology industry by means of face-to-face interactions, social ties and social circles, not through formal and contractual channels.

Owen-Smith and Powell (2004) found empirical data suggesting that in the Boston area, which is a densely collocated biotechnology center, a large portion of knowledge was transmitted through informal channels rather than contractual alliances. Diagnostic biotechnology firms in Boston absorb local knowledge largely by drawing on informal mechanisms, such as by employing Harvard graduate students and hearing ideas and advice from academic scientists. In multiple case studies drawing on open-ended interviews, Nilsson, Rickne and Bengtsson (2010) confirmed that the channels and avenues for technology transfer were diverse and complex, termed as a 'grey zone'.

In the fields in which knowledge is more implicit and tacit, the in-person engagements of academic scientists, rather than legal contracts or licensing, are the major route for exploiting research capacity to grow regional industries. In this regard, research discoveries in their early stage that have not yet reached proof-of-concept need further development for commercialization and require more active interventions in terms of marketing or exclusive rights by technology transfer offices (Colyvas et al., 2002). The success of intellectual property (IP) development, according to Owen-Smith and Powell (2003a), depends on the quantity of scientific findings and network connections with corporate partners, which facilitate discovery of the value of scientific findings. Connections with industrial partners help to identify and evaluate the commercial potential of academic discoveries.

Increasingly, the literature recognizes that the extent of the contribution by a research university to regional economic development is dependent upon social structures and entrepreneurial infrastructure (Audretsch, 2001b; Feldman, 2000; Feldman & Francis, 2004; Florida & Cohen, 1999; Walshok, 1999). Because knowledge transfer involves social interactions and engagements, research expertise is not automatically turned into innovation or entrepreneurial activity. To reach the market, any invention undergoes a lengthy process of refinement, reinvention and redefinition (Nelson & Romer, 1996). Without intimate communication and interactions, the full potential of research knowledge would not be appreciated or translated into innovation.

In this sense, institutions and policies for facilitating interactions between academia and industry contribute to enhancing the competitiveness of both technology industries and universities (Audretsch, 2001b; Lehrer & Asakawa, 2004; Owen-Smith & Powell, 2003b; Owen-Smith & Powell, 2004; Owen-Smith et al., 2002; Prevezer, 2001). The collaborative relationship between universities and industries in the U.S. is partly attributable to the policies and programs of the federal government: the National Institutes of Health (NIH), as the major funding agency for biomedical research, has placed substantial emphasis on academia-industry collaboration and the applicability of basic research when dispensing funding (Owen-Smith et al., 2002). Furthermore, some researchers suggest that the institutions and policies of the federal government, such as the Bayh-Dole Act and the Small Business Innovation Research (SBIR) program, have significantly contributed to facilitating knowledge transfer and promoting academic entrepreneurship (Audretsch, 2001a; Feldman, 2000; Feldman & Francis, 2004).

At the local and regional levels, economic development strategies, liaison programs, leadership, social networks, culture and specialized business services have been identified as necessary infrastructure for capitalizing on academic knowledge to create jobs and to develop industries. In particular, outreach programs and strategies initiated by universities were given high marks as the appropriate tool for knowledge flow. For example, Leslie (2000) and Adams (2005) attributed the formation of Silicon Valley to the affiliate program of the engineering department at Stanford University, which connected academic researchers with entrepreneurs and nurtured a culture of industry-academia collaboration.

Understanding how individual academics engage in the commercialization process is crucial in designing policies, but the literature gives insufficient accounts of this aspect of technology transfer (see, e.g., D'Este & Perkmann, 2011). It is suggested that advancing their research and not merely obtaining financial profits is one of the primary motives driving academics to interact with industry (D'Este & Perkmann, 2011). Owen-Smith and Powell (2003b) argued that the propensity of faculty to disclose is dependent upon individual scientists' perception of the benefits of disclosure relative to the costs of working with technology transfer offices and upon their peers' perceptions of entrepreneurial endeavors. Academics who have adopted organizational logic and learned the logistics of industry through participation tend to become engaged in commercialization activity, according to Etzkowitz (2004). Industry collaboration experience and prior innovation experience help academics to exploit entrepreneurial opportunities based on their scientific discoveries (D'Este, Mahdi, Neely & Rentocchini, 2012). This line of work implies that learning and interacting for technology transfer are contingent on the surrounding contexts of regional and university resources, regulations and culture.

The literature on the tacit dimension of knowledge, the social aspect of learning and technology transfer indicates that knowledge transfer and academic entrepreneurship involve social interactions and engagement. As a large portion of knowledge is of a tacit dimension, individuals should be involved in in-person interactions and have hands-on learning experience. In this respect, a large portion of knowledge is created, circulated and stored in communities, where members have shared experiences through ongoing interactions and communications. The extent of knowledge transfer and entrepreneurial activity by academics depends on the informal social ties and interactions between academic and industrial communities. However, it has not been sufficiently addressed how individuals at research institutions become interested and involved in technology transfer or entrepreneurial activity. The literature does not sufficiently explain how academic scientists become skillful and enthusiastic at translating their laboratory findings into marketable products. Furthermore, research has not fully determined how academics leverage their experience and expertise in transferring technology.

3. Research Methodology

In this study, the authors focused on discovering the contextual properties and structural elements underpinning the interactions and actions of academic scientists based on grounded theory (Corbin & Strauss, 2008). Technology transfer and commercialization, as indicated in the previous chapter, are social and organizing processes. We first needed to pay attention to the underlying structural elements that enable or constrain technology transfer and entrepreneurial activity. Research institutions – both research universities and non-profit research institutes – depend primarily on funding from the federal government, state governments and philanthropists in conducting research projects, and their primary interest lies in understanding the principles of biological mechanisms and processes. Because of this funding mechanism, academic scientists work under a context of regulations, recognitions and reward systems that is distinct from the industry context.

As the literature implies, the role and influence of research universities depend on the relationship with the local business community, attitude and skills of their faculty for commercialization because a large portion of knowledge is commercially capitalized through social and relational channels, which often involve personal interactions and mutual engagement. In turning basic research into products, academic scientists must manage regulations, peer pressure and other barriers. Therefore, we regarded the interpretation and interactions involved in knowledge transfer as social processes, as claimed by interpretivists (Wenger, 1998; Yanow, 2000; 2003; 2006). We focused on people’s experiences and their accounts of experiences as represented in narratives and communal artifacts. By employing an interpretive approach, this research aimed to capture the complexity and dynamism of a community as richly as possible, because the ultimate goal of this research is to understand the invisible but operative “webs of significance” (Geertz, 1973, p. 5).

The data for this research were collected from three sources: archives, interviews and field observations. The regional news media – for example, the San Diego Union-Tribune and the San Diego Business Journal – were examined to discover how research institutions in San Diego have been involved in technology transfer and how individual researchers have engaged in technology transfer activities. Every edition of the San Diego Union-Tribune since 1983 was examined. This information was critical in constructing the development of research institutions as explained in Chapter 4.

For this research, 43 interviews with academic scientists, technology transfer officials, biotechnology entrepreneurs, investors (both venture capitalists and angel investors), program directors, and practitioners in specialized service sectors were conducted from 2008 to 2010. Most interviewees had been involved in a variety of technology transfer activities at multiple organizations, and virtually all entrepreneurs and investors had relationships with academic scientists. At least seven entrepreneurs were faculty members, post-doctoral fellows or graduate students at universities when the interviews occurred. It is noteworthy that at least seven interviewees served as faculty members at research universities while establishing startups to further develop their research findings. Among the interviewees, directors of technology transfer offices at four major research institutes – UCSD, the Scripps Research Institute, the Sanford-Burnham Institute, and San Diego State University – were included.

Each interview took more than half an hour, and some of the interviews led to follow-up personal communications by emails or conversations at social events. All interviews except one were tape-recorded and transcribed. The interview questions were open ended, asking about each interviewee's experience and activity and his ideas about how academic scientists engage in technology transfer activity. Although each interview involved open-ended questions, follow-up questions were raised in most cases: How you have developed your expertise and capacity? How have you worked with scientific and industrial people or programs to translate research ideas into innovations? How have you interacted with community members regarding technology transfers? Which factors do you think foster or hinder technology transfer? How do academic scientists overcome regulatory barriers and participate in commercializing activity?

One of the authors attended dozens of local events or social meetings from 2008 to 2010. Throughout the year, trade associations and research institutes hold many networking meetings, workshops, seminars, business competitions, educational programs, financial forums and award ceremonies. The field observations were helpful for understanding the social context of the San Diego biotechnology community as well as for providing access to interviewees.

Along with collecting archival data, we chronicled events and accounts into categories and added analytical memos for emerging ideas or concepts (Corbin & Strauss, 2008; Glaser & Strauss, 1967). In the theorizing process, concepts became articulated and sophisticated as the author collected more data and spent more time discovering patterns and trends in the data by writing memos (Glaser & Strauss, 1967). By weaving accounts and cases in the data, we identified concepts such as ‘learning by doing and interacting’, ‘understanding the process by practicing’, ‘local communities for learning’, and ‘practice and relationships developed in participation’. To understand these concepts, the literature on ‘communities of practice’ and ‘organizational learning’ was reviewed.

Most of all, this work represented an iterative process of inquiry moving between data analysis and a critical reading of the literature to construct concepts explaining academics’ involvement in the commercialization process, as diagramed in Figure 1 (Corbin & Strauss, 2008; Eisenhardt, 1989; Glaser & Strauss, 1967).

<Figure 1, about here>

The iterative process also involves constant comparisons of data from archives, field observations and interviews. For instance, an academic scientist who represented an illuminating case for academics’ entrepreneurial learning was identified in archival data and then interviewed. We collected more archival data to understand the process of his entrepreneurial endeavors and conducted interviews with his colleagues if accessible.

In this sense, this research did not aim to verify causal factors but sought to illustrate experiences of learning regarding technology transfer and to construct a conceptual framework based on the experiences of individuals to understand how academics and universities engage in commercialization activity.

4. The Emergence and Evolution of Research Institutes in San Diego

4.1. The Arrival of Research Institutes in La Jolla

The three main research institutes in San Diego – UCSD, the Scripps Research Institute (TSRI) and the Salk Institute for Biological Studies (the Salk Institute) – came to La Jolla between the late 1950s and the early 1960s: the University of California's Board of Regents officially approved a new UC campus in La Jolla in 1959, and UCSD initiated undergraduate programs in 1964 (Shragge, 2001); TSRI recruited a prominent immunologist, Frank Dixon, and his colleagues in 1961 to begin research programs at TSRI; and Jonas Salk, developer of the polio vaccine, began to build a research institute on 26 acres of land on a seafront bluff that had been gifted from the City of San Diego in 1960.

Benefitting from the rise of federal government funding and the rapidly expanding stock of science in biology, several new scientific institutes emerged in the following years: in 1976, William H. Fishman, a scientist and former director of the Tufts University Cancer Center in Boston, founded the La Jolla Cancer Research Foundation, which would be renamed the *Burnham Institute for Medical Research* and more recently the *Sanford-Burnham Medical Research Institute* (the Sanford-Burnham Institute); another notable research institution was the *La Jolla Institute for Allergy & Immunology*, which was founded in 1988 with the aim of gathering immunologists under one roof. As shown in Figure 2, these research institutions are located within walking distance in La Jolla.

<Figure 2, about here>

Another important factor facilitating the creation and expansion of research institutions on the mesa was the city's land use planning and its Scientific and Research Zone, which protected the area from the encroachment of commercial and residential buildings. The land use plan, the University Community

Plan, was originally adopted to create high-quality amenities for UCSD (City of San Diego, 1959), and it has evolved to create *a haven* for scientists and research institutions: the natural and created environment on the mesa and the proximity between research institutions have been pivotal in bringing in scientific talent, institutes and companies. Essentially, in the Scientific and Research Zone, only research and development facilities and activities are permitted (City of San Diego, 1983). The largest five research institutes in San Diego brought in $682 million from the NIH in 2013, as indicated in Table 1. In the same year, the total NIH funding granted to San Diego research institutions and companies accounted for 2.7 percent of the agency's total appropriations.

<Table 1, about here>

4.2. The Institutional Evolution of Industry-University Relations at UCSD

From the beginning, the founding faculty of UCSD focused on building a first-class research university by recruiting renowned scientists who would eventually bring funding and graduate students. Until the early 1980s, the university, as one interviewee noted, "was focused on building itself and had been an entity unto itself." The university and its academics were busy building an ivory tower, without much attention to local industries or internal entrepreneurship. Faculty needed to pay attention to the peer review process of federal agencies to obtain research funding. Partnerships with the local community were not seriously considered or sought by the founders of UCSD. Furthermore, as a campus of the University of California, the activities and endeavors of UCSD were restrained by the policies and regulations of the UC system.

In the 1980s, UCSD started to formulate its partnership with the private sector more seriously. In 1984 and 1985, UCSD was involved with the local community in attracting two research consortia that ultimately failed. However, these experiences led industry and academic leaders to rethink their relationships. As a result, in 1985, the university launched CONNECT, an incubation program, in partnership with the local community to stimulate technology transfer and academic entrepreneurship. People on the industry side began to visit the UCSD campus to participate in the CONNECT programs.

These programs included a seminar series, Frontiers in Science & Technology, where academic scientists presented their discoveries to the public, and Springboard, where entrepreneurs coach academics in entrepreneurial skills. Various activities organized by CONNECT helped to open the university gates to the local community and contributed to connecting faculty with local entrepreneurs (for details, see Kim & Jeong, 2014).

The School of Engineering and the School of Medicine have been active in encouraging and enabling their faculty to pursue the commercial development of academic research: the School of Engineering started the Corporate Affiliation Program and the von Liebig Center for Entrepreneurism (the von Liebig Center), and the School of Medicine began the UCSD TransMed Program and established the Clinical and Translational Research Institute. The main programs and centers for facilitating technology transfer and industry-academia relations are listed in Table 2.

<Table 2, about here>

Throughout this process, participants have become linked to the local business community and have learned about entrepreneurial capacity. These programs and centers, along with programs at UCSD and local associations such as CONNECT and BIOCOM, an association of biomedical companies and specialized service companies, have provided academics with venues for interactions with entrepreneurs and with exposure to entrepreneurial activity. As shown in Table 3, by 1980, approximately 90 percent of the R&D expenditures of UCSD stemmed from the federal and state governments, but the portion of R&D funding from non-governmental sources started to grow substantially to become 34 percent of all R&D expenditures by 2012.

<Table 3, about here>

4.3. The Development of Practices at Non-Profit Research Institutes

As new institutions with virtually no endowment or student base, non-profit research institutions adopted a variety of practices for technology transfer to complement their research funding from federal agencies. The most notable practice at local research institutions was to give *first rights of refusal* for licensing research findings to large pharmaceutical companies in exchange for research grants and other forms of financial support. TSRI made this type of contract for the first time in 1982 to secure funding for its facility construction. Similarly, the La Jolla Institute for Allergy & Immunology and the Salk Institute established collaboration programs with pharmaceutical companies.

In addition to partnerships with large companies, the Salk Institute and the Sanford-Burnham Institute were involved in efforts to spin off startups. In 1981, the Salk Institute established Institute Biotechnology/Industrial Associates, Inc. (SIBIA) as its commercializing entity. The Sanford-Burnham Institute utilized a start-up company, Telios Pharmaceuticals. The institute granted licensing rights to this startup in exchange for owning a portion of the company's equity (Fikes, 1993).

Another initiative to promote collaboration with industries and to facilitate the commercialization of basic research involved investments in building capacity for translational research and the recruitment of people with industry experience. Along with these efforts, the institutions engaged in activities to build relationships with the local business community and to maintain robust communications with scientists from the industry side. Along the way, the local research institutions gained a reputation for their capacity for commercialization as well as basic research.

5. Building Understanding and Relationships

5.1. 'Human Factors' in Technology Transfer

In the end, it is individual scientists who initiate or participate in efforts to develop commercial applications. A senior licensing officer (interview) claimed that "if faculty are not interested in working with industry, there isn't any tool forcing them." Academic researchers have a duty to disclose their inventions, but they also have discretion about whether to be involved in the commercialization process. In this regard, the attitude, interest, motivation and experiences of individuals are crucial in turning inventions into innovations.

When asked whether UCSD and research institutions in San Diego were entrepreneurial, a venture capitalist (interview) who had founded several startups stated that the answer depended upon individual academics rather than the institution itself: the major positive impact factor is "the faculty members," even though there are technology transfer offices and other facilitators, because "it is really the initiative, track record, confidence and leadership of individual faculty or researchers" that determine the success of technology transfer. An entrepreneur who had formed a biotechnology firm with academic scientists also argued that the extent of commercialization of university research depends critically on the *people factor*:

> I think it really comes from the academic person who is emotionally involved in technology, wants to see it commercialized and is willing to put a significant amount of energy into that effort as opposed to his academic lab. (interview)

Motivation and interest in commercialization largely depend on the inventors' stock of knowledge, depth of experience and extent of social interactions. According to another entrepreneur (interview), academic scientists become motivated and take actions when they "understand that process, the real value of invention in creating a company or in developing a drug." Therefore, if academic scientists have a greater appreciation for the process of commercialization, then they are more likely to engage in commercializing activity and succeed in mobilizing resources.

In addition, success in finding industry partners depends largely on the interactions and relationships between academic inventors and people in industry. An interviewee who was a senior manager at a technology transfer office described the importance of such interactions:

> Really, our best source of getting licenses out is directly from the investigators because they are going out and talking about their work. We always need cooperation from the faculty again. If they know companies that are interested or could be interested, those are the ones that we want to contact, especially if they have a personal contact at the company. (interview)

Regarding the importance of relationships and mutual trust between academic researchers and scientists from industry or entrepreneurs, an adviser (interview) at the von Liebig Center explained as follows: "it is really quite rare that a company comes in the technology transfer office saying 'I want to license that technology' and then walks away with the technology." A director of a technology transfer office also emphasized the importance of relationships between faculty inventors and entrepreneurs, who bring “an incredible amount of skills” to commercialize technologies by establishing startups:

> You can't start a company just by walking in and having an hour meeting. It takes a long time, it takes many meetings, and even faculty have to see for a long time how they [entrepreneurs] work through challenges and how they work through opportunities before faculty can really say 'this is someone who I want to partner with.' (interview)

As described in this section, the possibility of transferring technology is largely contingent upon academic inventors’ interest, knowledge and relationships. Then, at an individual level, how do academic scientists experience and implement the commercialization of their research discoveries or expertise? How do they utilize their experience and practices in transferring technology?

5-2. Learning to be Entrepreneurial

The diagram in Figure 3 illustrates the process of entrepreneurial involvement: how academics develop their value, capacity and relationships for engaging in technology transfer activities through participation and interactions and how capacity developed through participation and involvement enables academics to be more entrepreneurial. Academics learn how to engage in technology transfer activities by engaging in industry – for example, participation as a scientific adviser, consultant and startup founder – and through this experience, they develop an understanding of commercialization and the relevant practices. Academics with such experience know how to manage regulations and collaborate with people in industry. These understandings, relationships and practices help them take more entrepreneurial initiative and guide their colleagues toward entrepreneurial endeavors. Finally, these activities based on enhanced entrepreneurial capacity open new pathways through which academics and their colleagues acquire more entrepreneurial skills. The speed and scope of the learning process depend on the surrounding milieu: academics in a high-technology cluster are more likely to engage with entrepreneurs; academic scientists working at institutions that provide better networking opportunities and resources are more likely to participate in commercial activities.

5-2-1. Learning to Manage the Commercialization Process

First, personal engagement in commercializing activities critically helps academics to understand the aspects and procedures for technology transfer and industry-academia collaboration. Knowledge about and an understanding of commercialization play a critical role in participants' continuing involvement in industry in a variety of ways. A marine biologist at UCSD was recently involved in establishing a startup company that focuses on translating his academic discoveries into treatments. His interest and expertise in entrepreneurial activity began when his team licensed their discovery to a pharmaceutical company in the mid-1980s: "it was a product that we felt proved the principle that we had been speaking out: there are compounds in the ocean produced by marine life that have commercial importance in pharmaceuticals, cosmetics and agricultural" (interview). In 1998, this biologist and his colleagues founded a biotechnology firm to develop cancer drugs by exploiting the antibiotic and anticancer properties of marine microbes in collaboration with a local venture capital firm.

Around 2006, the biologist embarked on another endeavor to find and develop antibiotics from ocean sediment. This time, he and his team were well aware of how to draw attention from the investor and entrepreneurial community by virtue of their previous experience. They formed an interdisciplinary team addressing medicine, pharmacology, chemistry and biochemistry composed of individuals who knew "after many years of experience what a drug looks like, what properties it needs to have and what attracts attention" (interview). Instead of licensing out to established companies or partnering with venture capital firms, they chose to create a company by themselves with assistance from the von Liebig Center at UCSD. To conduct the early-stage clinical development, the company sought funding from the UC Discovery Program, the SBIR program and the Small Business Technology Transfer (STTR) program. Through experience from academic research and interactions with industry, this biologist acquired the know-how to transfer technology as well as acumen in drug discovery, which involves multiple disciplines.

Another scientist interviewee exemplifies how experience in industry can critically enrich the understanding, perspective and skill sets necessary to collaborate with industry. In 1992, he joined a local biotechnology company to head its R&D program, where he remained for five years until he returned to UCSD. Most of all, by working in the industrial setting, he (interview) learned "how to set up successful collaborations with industry." Returning to UCSD, he knew what industry scientists would want from their academic partners in addition to possessing insights and an understanding of the entire process of drug discovery. Since then, he has been active in developing better treatments by conducting academic research, consulting and advising pharmaceutical companies. The scientist (interview) stated that when an academic has experience working with industry, it "adds something to the environment to have an appreciation, a detailed appreciation of what and how the private sector actually works."

A third example highlights the role of experience and expertise in translating medical research into applications. In the late 1970s, an interviewee synthesized nearly 25 compounds in his laboratory, one of which was approved by the Food and Drug Administration (FDA) in 1993 as a treatment for a type of cancer. As the biotechnology industry started to develop in California, a number of venture capitalists approached him, asking him to identify promising discoveries of academic scientists. Since then, in partnership with venture capitalists, he has been a scientific founder of six biotechnology companies, five of which were founded in San Diego. In an interview, he explained his expertise: "Because I am a physician, I see patients, but I also know how to do organic chemistry, pharmacology and molecular biology." He also learned and developed the acumen necessary to move research into products and processes. During an interview, a biotechnology entrepreneur who worked with the scientist at a biotechnology company attributed this success to his business acumen:

> He is very successful because he knows how a small company works. Most academic people have this idea [of basic research], but they really have no idea of how to get from this point to that point or what investors want to see. [He] knows how to do that. He knows what kind of data should be generated in order to get a patent because he understands intellectual property. He knows what investors look for. (interview)

For a scientist at TSRI, interactions with industry are a critical avenue for educating himself and establishing the direction for his research because collaboration with industry helps him to know "whether the work fills a particular unmet clinical need and whether a partner is out there." The interviewee described his learning experience in terms of engaging with the local community:

> In such an open community, you gain understanding of that [whether the work that you do fills a particular unmet clinical need and whether a partner is out there with whom you can work], not by reading textbooks, but by talking with people in industry – biotechnology or pharmaceutical – by talking to lawyers, bankers and all kinds of people… Without that education, I would not drive the research programs the same way. You might end up with solutions to problems that don't exist. (interview)

Experience in collaboration provides a critical stepping stone for building more productive partnerships. Collaborations involve definitions of roles, approaches to solving problems and channels of communication between participants. To make progress, the partners must "figure out how to formalize collaboration" (Kuhn, 2009). The scientist at TSRI continued to discuss how he had learned to collaborate with academic and industry partners: "If you find a sweet spot of how to work with people, then that really works." Through experience, he learned to formulate and manage a collaborative partnership in a more productive manner: “If you do it once, you learn a lot. But if you do it two or three or four times, you will be getting better and better at it, and you build up your network of people you work with” (interview). This case demonstrates that interaction with industry people helps to develop expertise not only in the commercialization process but also in the process of building collaborative relationships.

5-2-2. Learning to Manage Academic Regulations

A second contribution of experience and engagement in commercialization activities is that it helps academic researchers learn to manage regulations and to leverage available resources. Academics who have experience in and relationships with industry are better positioned to manage regulations during their interactions with industry. Most academic scientists view regulations as “a necessary evil” that protect the environment of academia while also producing paperwork and bureaucracy (an interviewee). To address such regulatory hindrances, academic scientists need to know about any potential conflicts of interest and conflicts of commitment. Whether academics are able to recognize and manage potential conflicts of interest significantly influences their interaction with industry. A marine scientist, as noted previously, recently chose to create a startup on his own to pursue development efforts. Although the paperwork and procedures required by conflict-of-interest regulations require time to complete, it is not a significant obstacle to him because of his knowledge of regulations:

> Fortunately for me, I had served on this [conflict-of-interest] committee prior to being the subject of its oversight. I knew the rules, I knew what should be done, I knew how to behave, I knew the process. (interview)

This type of understanding and these practices also develop through hands-on experience and interactions with technology transfer officers. Another interviewed scientist explained how experience working with technology transfer staff has critically decreased the burden of regulations as a result of the trust formed:

> If one is experienced and has inventions that made money for the university, then the guidelines are much easier to work with because they trust you... Its barrier to entry is very high, but once the barrier is completed and you succeed, then it's not that hard. The hardest for me is the initial barrier to entry. (interview)

In the process of collaborating, trust develops between academic scientists and technology transfer officers. An academic scientist who provided academic inventions as the basis for founding six biotechnology startups emphasized the importance of trust in overcoming the regulation process.

> [T]he technology transfer officials work better with the experienced people, particularly the people who have made money for the university. If one is experienced and has inventions that made money for the university, then the guidelines are much easier to work with because they trust you. (interview)

Learning by doing and interacting enables academics to manage the burden of completing paperwork and collaborating with technology transfer officers.

5-2-3. Learning to Encourage Colleagues to be Entrepreneurial

Another important influence from the faculty's personal experience is that it enables and encourages their students to participate in technology transfer activities. Faculty members who have participated in or experienced commercialization activity, either hands-on or indirectly, tend to support the entrepreneurial endeavors of their students or postdoctoral fellows. Rather than discouraging or resenting students' interest in entrepreneurial paths, senior investigators are more likely to encourage and enable their students to engage with industry. The presence of a group of faculty members favorable to academic entrepreneurism has a positive effect on cultivating the attitude and ability of young talent. A network of colleague scientists is the best referral for industry people, as indicated by the director of the technology transfer office at a research institution:

> There are a couple of kinds of scientists. People who have done this before don't have a problem. The venture capitalists want to find them and want to interact with them because of the attractive record they have built on. If this is your first time, doing a company and building that relationship, there is few way. Many scientists are introduced to investors and entrepreneurs through their scientific network. (interview)

This claim is supported by an academic scientist who explained how he had helped young scientists seeking assistance: "I review the executive summary of their business plan, and I also call up potential investors or CEOs for them" because young people should work with highly experienced people. He emphasized the need to collaborate with professionals from various fields to successfully commercialize basic research:

> They need to work with a very senior person like me or like David [who is a venture capitalist]. They can't do it by themselves. They have to work with somebody who knows the technology

> transfer people, who knows the investors, who knows the lawyers. You can't do it by yourself. (interview)

A first-time entrepreneur (interview) who had established a biotechnology company during his Ph.D. program attributed his entrepreneurial pursuit to his faculty advisor's support and guidance. He noted that the support and advice from his adviser were instrumental to pursuing this entrepreneurial endeavor: "you have to have the support from somebody who has done this before." Most of all, his faculty adviser (interview) gave him "a lot of freedom to do things" as well as guidance on business and introduced him to the venture capitalists with whom he worked. The help and involvement of renowned scientists, such as his adviser, are crucial to elevating the credibility and visibility of first-time entrepreneurs.

The influence of entrepreneurial academics extends beyond their students. The activities and attitudes of renowned scientists play a role in changing the local culture to become more entrepreneurial. A founding CEO of a medical device company that he established to develop his doctoral research at the Salk Institute provided an insider's perspective on the influence of entrepreneurial faculty in nurturing and nourishing academic entrepreneurism:

> We see people that we respect work in companies. They found companies. It's not viewed as a discredit; it's not viewed as a bad thing. Quite the contrary, if you are a scientist doing revolutionary research and you create a company around you, people say, 'wow, this is good.' This is part of the culture. In terms of the process, usually what happens is that your Ph.D. adviser will say when he meets someone, 'my student has created this. We are looking for investors.' And he will talk to other scientists who founded companies, who know investors, investors will come and meet you and your Ph.D. adviser. (interview)

He mentioned that he could not have launched a start-up if he had pursued his Ph.D. or post-doctoral research in another place. At another institution, his adviser might have ordered him to focus only on scholarly work, not allowing him to explore ventures for commercial development, whereas in San Diego, the faculty "understand because they had created companies before." If scientists with entrepreneurship experience lead research organizations, then their influence ripples throughout the entire organization. TSRI and the Burnham-Sanford Institute are generally acknowledged to be more entrepreneurial because of their leadership. An entrepreneur accounted for this tendency as follows: “if the heads of institutes are saying 'it's OK to be entrepreneurial', that spreads its way down” (a venture capitalist, interview).

5.3. Regional Advantages for Learning and Interacting

At the community level, the interaction and engagement of academics and entrepreneurs appear to be robust, as indicated by anecdotal accounts in interviews and archives. A survey (Council on Competition & Porter, 2001) found that more than 80 percent of biotechnology companies in San Diego have occasional or frequent interactions with universities and research institutes. As an anecdote, in 1993, an industry scientist from a German pharmaceutical firm was impressed by the rigorous interaction between academic researchers and people from industry during his trip to San Diego:

> What is striking is how closely university people work together with biotech start-ups. It is my personal impression that the close interaction between industry and science, the almost daily interaction, drives the process forward. (Fikes, 1993)

A first-time entrepreneur (interview) defined San Diego as one of the few places "where scientists can be entrepreneurs." The state of Florida proposed incentive packages of $550 million to TSRI and $310 million to the Sanford-Burnham Institute in 2006 to attract their research campus to Florida (Lieberman, 2006). The proposals sought to tap into the two research organizations’ technology transfer practices and R&D expertise.

The first advantage of San Diego for developing an interactive academia-industry community was the proximity between academia and industry, as illustrated in Figure 2. Joseph Panetta, CEO of BIOCOM, attributed the daily interactions to the geographical proximity between institutions and companies:

> UCSD, Salk, Scripps, [Sanford] Burnham, Venter Institute, La Jolla Institute, all of those are right in the middle of the biotech industry, surrounded by all the companies. Literally, across the street

> are all these companies... The reason that we've got this environment where scientists and industry interact so closely is just because we are right there next to each other. All the time, we see each other. (interview)

Proximity facilitates the gathering of people, as noted by the CEO of CONNECT, Duane Roth: “it requires a major commitment to have a lunch or attend a breakfast seminar or have a cocktail reception in the evening [in other cities], but that happens thousands of times a day here because of proximity.” Because they live and work next to one another, there is a constant flow of interactions back and forth. A city official (interview) commented on the ongoing interactions as the key element for the success of the local cluster: biotechnology firms and institutions can succeed in part "because they can see, hear and feel what is going on." In San Diego, in the words of a UCSD professor (interview), academic scientists are "surrounded by hundreds of biotechnology companies."

Along with spatial closeness, research institutions, including UCSD, and trade associations such as CONNECT and BIOCOM are another important venue fostering interactions. A long-time entrepreneur explained the role of UCSD:

> Many of us came out of the university [UCSD] and used to talk to a lot of colleagues. We didn't come out of a business setting. That was a positive aspect to it. Secondly, physically, a lot of companies were centered very closely to UCSD and came to lectures at UCSD or set up lectures ourselves and invited others. So, it just became a very positive aspect of stimulating communication. (interview)

UCSD and trade associations organize a series of meetings in the forms of lectures, workshops, forums, symposiums, panel discussions and networking events every year. The events or programs held by these community organizations provide another avenue for learning and networking. For example, an annual symposium called the Moores UCSD Cancer Center Translational Oncology Symposium provides a space where “hundreds of people from industry and universities” and, in particular, "very experienced people meet young people" (UCSD faculty, interview).

CONNECT has held a lecture series, Frontier in Science and Technology, virtually every month for academic researchers to present their current discoveries. To facilitate communication between leaders from industry and academia, CONNECT organizes a bundle of networking and training programs throughout the year. For researchers seeking ways to create a start-up, business competitions are an avenue they can use to educate themselves. Both the San Diego Tech Coast Angels, a local network for angel investors, and a student organization, UCSD Entrepreneur Challenge, established platforms whereby scientists formulate business plans and expertise by being engaged with experienced entrepreneurs, respectively, the Annual Quick Pitch Competition by the San Diego Tech Coast Angels and the UC San Diego Entrepreneur Challenge. Scientists without much experience learn not only by participating in such programs but also by attending as audience members. In addition to these meetings, a number of institutions and associations have their own events and programs.

Programs and groups such as CONNECT, the San Diego Tech Coast Angels and local venture capital firms help to stimulate academic entrepreneurship by creating education and resourcing opportunities for academics. In the words of the CEO of BIOCOM (interview), the San Diego biotechnology community has "all kinds of courses outside of the university that give things like business skills and presentation skills." Academics can utilize the von Liebig Center, the Springboard program at CONNECT, the San Diego Tech Coast Angels and the local venture capital community when attempting to create startups or to develop commercial applications.

Finally, regional capacity for commercialization has been crucial to bringing academics into the industry sector. The hundreds of biotechnology companies and numerous specialized practitioners enable academics without any resources or commercializing experience to venture into entrepreneurial endeavors. It is important to consider not only the amount of venture capital or the number of specialized service providers but also the ways and traditions organizing this community. For example, a number of experienced entrepreneurs in a CONNECT program of Entrepreneurs-in-Residence “directly assist [novices who] come to us with an idea but without experience” (CEO of CONNECT, interview). San Diego’s proximity to Silicon Valley, where many nationally renowned venture capitalists and entrepreneurs reside, has supplemented its resourcing base. As a technology transfer official (interview) stated, “many of the investors are in fact out of the Bay area”; thus, “had San Francisco not been there, there would be a lot of troubles.” The story of academics involved in early successful startups such as Hybritech also encourages academic individuals to participate in technology transfer activities. A venture capitalist noted this cultural element in an interview: “I think once people have seen or participated in a success, then they have the confidence to try again. And there have been a number of very successful companies here.”

6. Theoretical and Policy Implications

In summary, the patterns of academia-industry relationships in San Diego have unfolded through the actions and interactions of individuals. Through their involvement in entrepreneurial activities and with entrepreneurs, academics have developed attitudes toward and practices for technology transfer. Academics can thus learn not only the skills and expertise needed for commercialization activity but also the practices necessary to handle regulations and potential conflicts. The development of academic entrepreneurship in the San Diego biotechnology community is rooted in its geographical proximity; the educational and networking programs within and outside of academic institutes, which have fostered hands-on experience and face-to-face interactions; and the regional capacity, which supports and enables academics to pursue entrepreneurial undertakings, as described in detail by Kim (2014).

The objective of this study is to understand the mechanisms by which academics engage in technology transfer activity by investigating the biotechnology industry-academia community in San Diego. Day-to-day practice and interactions in communities have deepened and broadened the capacities for transferring and therefore commercializing academic research. By engaging with people and problems at startup companies and within circles of friends, participants have developed the skills and expertise necessary to be entrepreneurial scientists. Therefore, learning and interacting experiences within communities are the basis for the relationship between academia and industry.

Regarding the role of research universities, the literature provides a limited and somewhat inconsistent explanation. To explain the differences in knowledge spillovers between universities, regions or countries, many researchers draw on the tacitness of knowledge and its limited transferability. In this sense, researchers point to *human factors* to account for the different degrees of impact different research universities have on their local economies. Zucker and Darby (2006, p. 1) noted, for example, that "the embodied knowledge, insight, taste, and energy of the stars plays a role separate from their potentially disembodied discoveries." Owen-Smith and Powell (2004, p. 17) also ascribed variations in the degrees of information spillover to human factors: "the institutional and legal arrangements that secure directed information transmission are an outcome of participant commitments and efforts." This limitation of the literature arises in part because many previous studies regarded knowledge transfer between academia and industry as transactions of goods and services. We need to recognize that knowledge transfer consists of practices and experience.

In essence, technology transfer and academic entrepreneurship involve interactions and shared understanding between academics and entrepreneurs. However, academia is constituted and maintained to serve basic research activity, whereas industries adopt logics and practices to maximize productivity. Because knowledge cannot be automatically transferred because of the differences in practices and rules, academic scientists must understand and be familiar with the practices and culture of industry to be successful in transferring knowledge or in commercializing laboratory discoveries. This study found that academics gain experience in and exposure to entrepreneurial activity through community interactions and engagement. By being embedded in communities of entrepreneurs and investors, laboratory scientists become able (and willing) to appreciate the commercial aspects of their research and to participate in the commercializing process. Furthermore, interactions with academic colleagues who have experience in and relationships with industry provide another opportunity to learn about the industry side. Daily interactions and participation in such communities create and reformulate rules and resources for knowledge transfer. Therefore, the scope and speed of knowledge transfer are a product of "the situation of social life" (Giddens, 1984, p. 22).

At the institutional level, UCSD, TSRI and the Sanford-Burnham Institute, which are important components of the regional economy, have developed rules and practices by trial and error through long-term involvement with industry. These institutions have experienced conflicts of interest and conflicts of commitment among their members, but through effort and engagement, these institutions (or more accurately, their faculty and staff) have learned to leverage the power of industry to develop applications while maintaining academic integrity.

The policy suggestion is that programs and policies promoting technology transfer should focus on creating interactive environments in which academics can easily engage with industry. Attention should be devoted to encouraging academics to engage in communities of entrepreneurs and entrepreneurial activity. The accessibility and availability of advice from experts and colleagues about technology transfer help academics to understand the process of commercial development. Technology transfer is also “a do-it-yourself process” (Jacobs, 1985, p. 140). Individuals must experience interactions with industry to develop their knowledge and practices so that they can collaborate with industry without breaching academic integrity, but for most individuals, it is a time-consuming and risky endeavor to engage in entrepreneurial activity. Universities and governments seeking to facilitate technology transfer need to motivate and encourage academics to embark on development efforts. Similar to the strategies used to stimulate entrepreneurship, the focus must be on individuals and their learning experience.

This exploratory research has several limitations and implications for future research. First, this study considered a single site, San Diego; thus, it cannot verify the influence of regional contexts in fostering academia-industry interactions. Further research comparing the San Diego region with a region that has a high level of academic achievement but less entrepreneurial achievement may result in insights into the role of the regional context. Another way to supplement this study is to empirically analyze the relationship between the degree of academia-industry interactions and the level of entrepreneurship among regions. Finally, further qualitative or quantitative studies that examine the influence of academics’ previous careers or experiences in industry on their productivity in technology transfer, including patenting endeavors, are needed.

Figure 1. Iterative process of discovering theoretical concepts

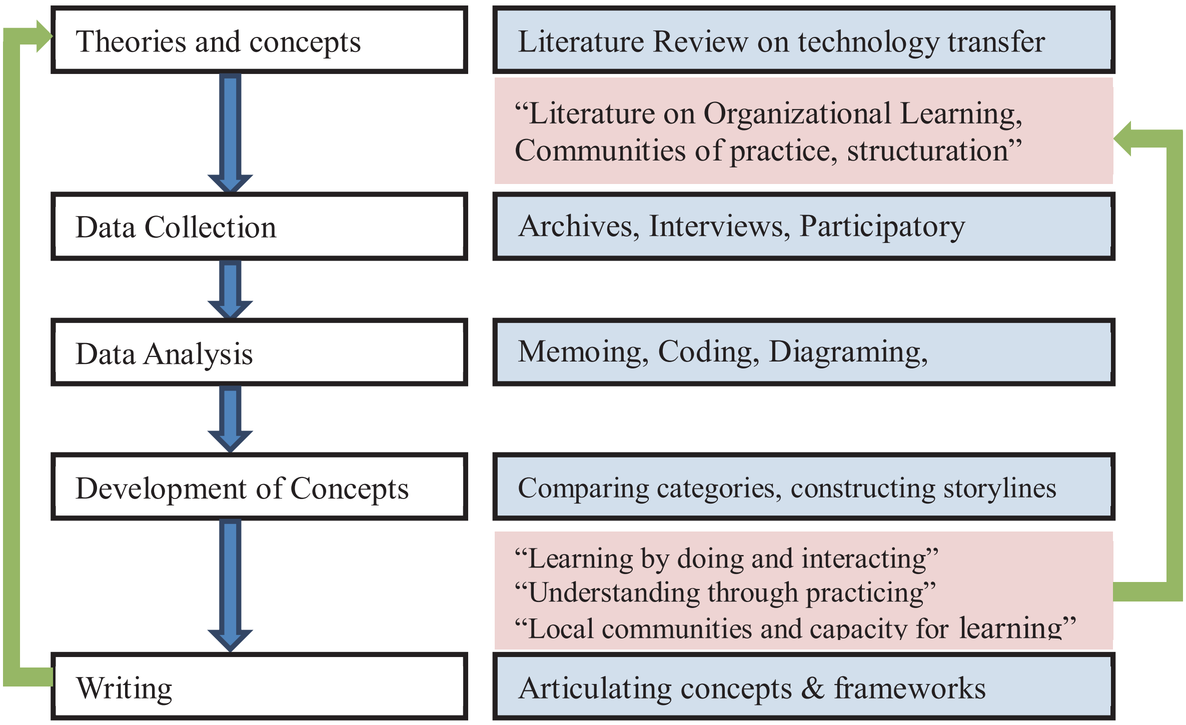
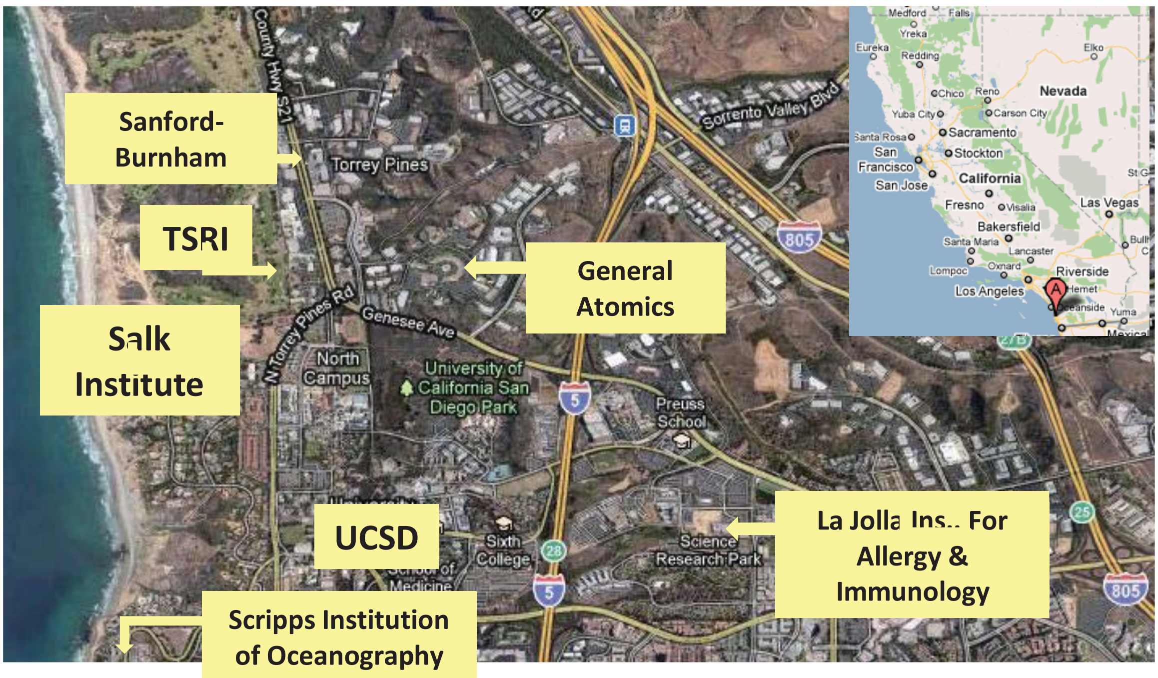


Figure 2. Aerial view of research institutions on Torrey Pines Mesa



Source: Aerial photo by the Google Maps on http://maps.google.com.

Table 1. NIH funding granted to major research institutes in San Diego

($ thousands)

Fiscal Year	UCSD	TSRI	Salk Institute	Sanford-Burnham Institute	San Diego State U.	Sum of 5 institutes	Total NIH funding granted to S.D. (%)
2013	362,005	198,276	41,116	53,588	26,533	681,518	780,986 (2.7)
2010	393,894	219,431	42,689	69,348	27,40	752,765	875,659 (2.8)
2005	309,417	213,209	52,655	64,680	19,249	659,210	815,748 (2.9)
2000	190,542	138,848	40,789	29,898	12,431	412,508	
1995	133,969	84,786	24,986	15,021	9,237	267,999	
1990	103,132	58,183	20,403	8,897	5,652	196,267	
1985	62,129	35,530	16,871	5,597	1,517	121,644	

Note: The entities in San Diego were identified by their cities, and the grants of each entity in San Diego were summed. Last accessed on June 14, 2014.
Data Source: NIH Appropriations - National Institutes of Health, retrieved from http://officeofbudget.od.nih.gov/approp_hist.html
Grants given to entities in San Diego County - National Institutes of Health, retrieved from http://report.nih.gov/award/trends/FindOrg.cfm.

Table 2. Programs for Technology Transfer and Collaborations with Industry at UCSD

Program& Center	Year Founded	Operator	Role & Responsibility
CONNECT	1985	UCSD/Independent Non-profit(2005~)	To Facilitate Commercialization of Academic Research
Technology Transfer Office	1994	UCSD	To Patent and License Academic Research
Corporate Affiliates Program	1995	School of Engineering	To Nurture Academia-Industry Relationship
Research Expo		School of Engineering	To Allow Graduate Students to Present their Research to Industries
Von Liebig Center	2001	School of Engineering	To Help Academics Engage in Commercialization Activity
Translational Medicine Program	2001	School of Medicine	To Bridge Laboratory Research with Medical Treatments
PharmaStart	2003	UCSD in partnership SRI International, UCSF, Stanford	To Help Academic Scientists Process with Clinical Trials, Writing Business Plan & Securing Funding
Clinical & Translational Research Institute	2010*	School of Medicine in support by NIH	To Facilitate Translational Research Through Funding & Education

* Year when the Institute received a $32 million five-year grant from the NIH

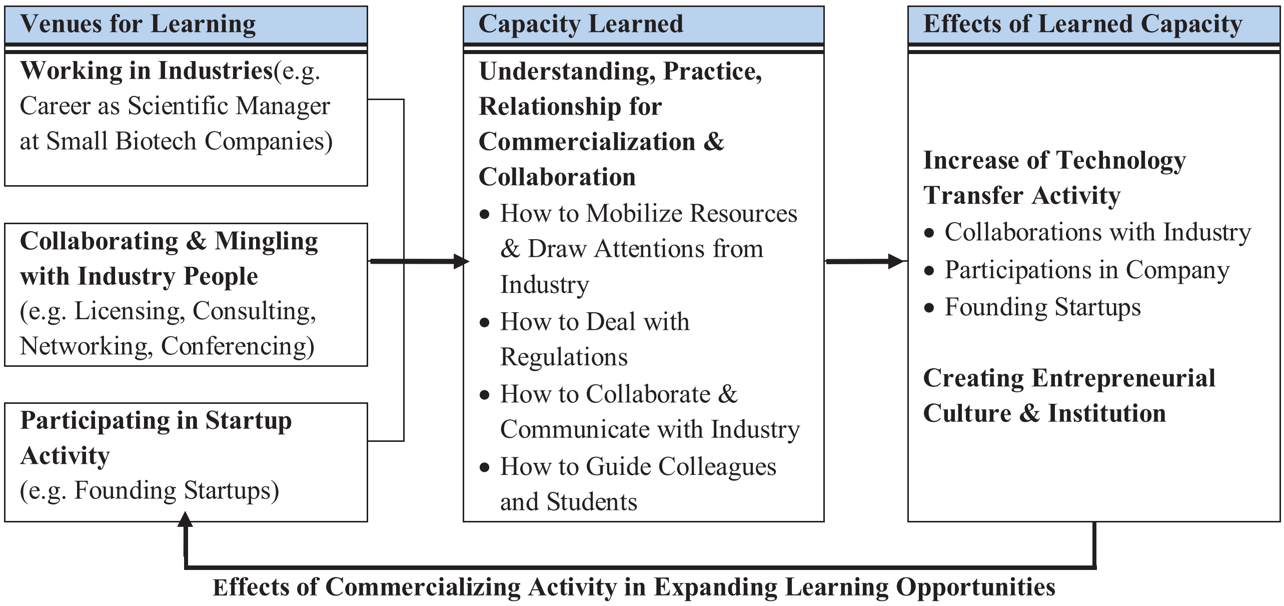
Table 3. Sources for R&D expenditures of UCSD (1972-2012)

($ millions)

	Federal Gov't.	State/ Local Gov't.	Industry	Institution	Other	***Total***	% of Non-Gov't. Sources to UCSD (Entire Univ. and Colleges)
1972	52	0	-	3	2	***57***	8.5 (21.5)
1975	69	0	-	4	3	***77***	9.8 (23.2)
1980	111	1	-	6	7	***125***	10.5 (24.3)
1985	116	1	-	14	15	***146***	20.1 (29.6)
1990	183	5	9	23	17	***237***	20.9 (32.7)
1995	284	9	11	27	26	***357***	17.8 (32.3)
2000	326	24	35	88	47	***519***	32.6 (34.4)
2005	464	18	34	122	83	***721***	33.2 (29.8)
2010	580	35	111	68	150	***943***	34.9 (32.5)
2012	657	55	119	73	170	***1,074***	33.7 (33.4)

SOURCE: National Science Foundation, National Center for Science and Engineering Statistics, Higher Education Research and Development Survey (each year). Last accessed on June 15, 2014.

Figure 3. Learning Process of Academics for Technology Transfer



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Measuring the easiness of diffusion in social networks through the agent-based modeling

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Abstract

We have suggested the concept of the expectation time for equilibrium of a network(ETEN) as a crucial parameter of social networks, which would tell how fast the diffusion occurs in a certain social network. The ETEN can be simply measured by the agent-based modeling suggested in this study. It is expected that the effects of the structural changes or diffusion conditions on the easiness of diffusion could be more effectively investigated by adopting the ETEN in the social network analysis.

Keywords: social network, diffusion, agent-based modeling

1. Introduction

It is well known that the structure of social networks significantly affects diffusion dynamics[1-3]. Furthermore, the studies on the major nodes such as hubs and brokers who play important roles on the diffusion have been actively carried out[4-7]. However, the studies on the parameter which would tell how fast the diffusion occurs in a social network under certain diffusion conditions were inactive. Although the efficiency(E) in Equation 1 would play the most similar role among the currently defined parameters[8-9], there are some limitations to describe the property using the same.

$$E = \frac{2}{N(N-1)} \sum \frac{1}{d(v_i, v_j)} \tag{1}$$

where, N is the number of nodes, $d(v_i, v_j)$ is the distance between ith node v_i and jth node v_j.

In order to complement the limitations, we have suggested the expectation time for equilibrium of a network(ETEN) as the parameter. In addition, we have suggested a method to measure the ETEN through the agent based simulation. It is expected that the effects of the structural changes or diffusion conditions on the easiness of diffusion could be more effectively investigated by using the ETEN in social network analysis.

2. The concept of the ETEN

It is easy to know how fast the diffusion occurs on a social network by measuring the time to reach an equilibrium state starting from the initial state. The initial state means that only one agent in a network that is the initiator has the matter would be transferred, and the equilibrium state means the state with no more diffusion flux. In this study, the equilibrium state was assumed the fully saturated state, because there were no isolated agents. The time for equilibrium for an initiator is strongly depended on attributes such as centralities of the initiator. In order to cancel out the effects of the initiators' attributes, the expectation time that is the average time for equilibrium for all agents was calculated. In addition, because the expectation time for equilibrium is getting longer as the number of node increases, the expectation time for equilibrium should be divided by the number of node. Then, the ETEN(T_N) can be described by Equation 2.

$$T_N = \frac{1}{N}\sum_{i=1}^{N} t_i \tag{2}$$

where, t_i is the time for equilibrium from the ith node as the initiator. In other words, the ETEN means the expectation time for creating an additional receiver.

3. Modeling and Simulations

The ETEN can be measured by the agent-based simulation. In this study, an agent-based simulation model was designed by using the Netlogo platform[10]. Figure 1 shows the user interface of the agent-based simulation model. After formation of an undirected network under the given number of node and the average node degree, the degree centrality, the closeness centrality, the betweenness centrality of each agent were calculated and shown in corresponding graphs. In addition the properties of the network such as the clustering coefficient, the average path length, the degree centrality index, the closeness centrality index, the betweenness centrality index were also calculated and shown.

In order to calculate the ETEN, it was assumed that the diffusion always starts from an initiator, at the initial state and the matter is transferred to all of the linked neighbors at every unit time. Then the matter would be finally transferred to all agents in the network, and the point is the equilibrium state characterized by the no more diffusion flux. The time for equilibrium for every agent was measured, and the ETEN was calculated by averaging the times for equilibrium for all agents.

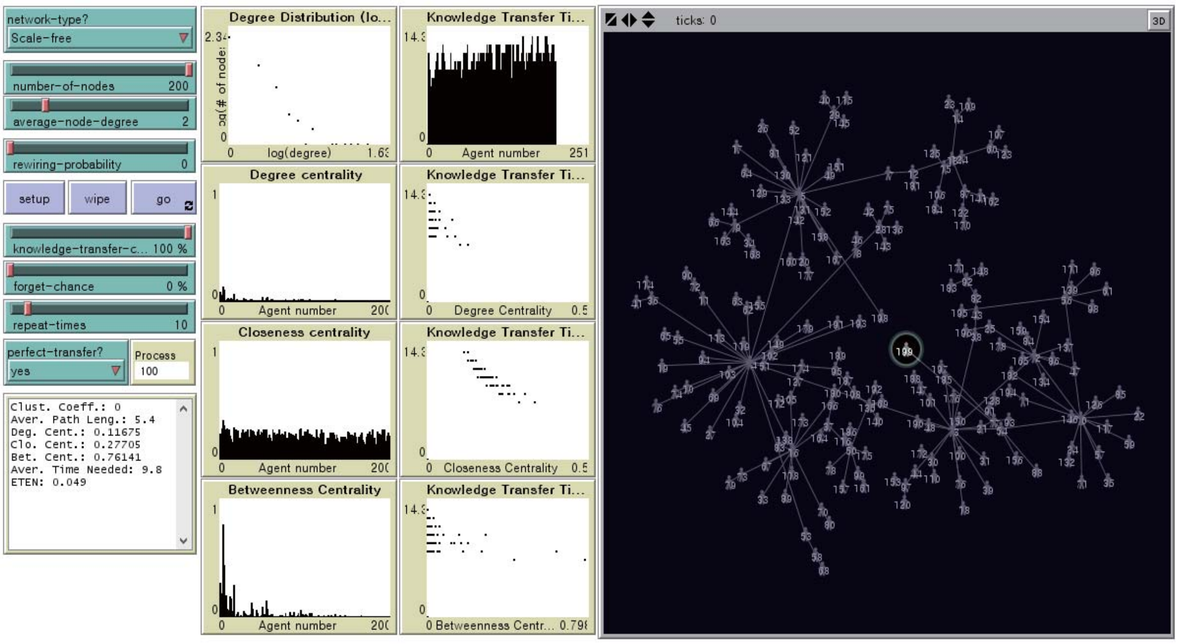
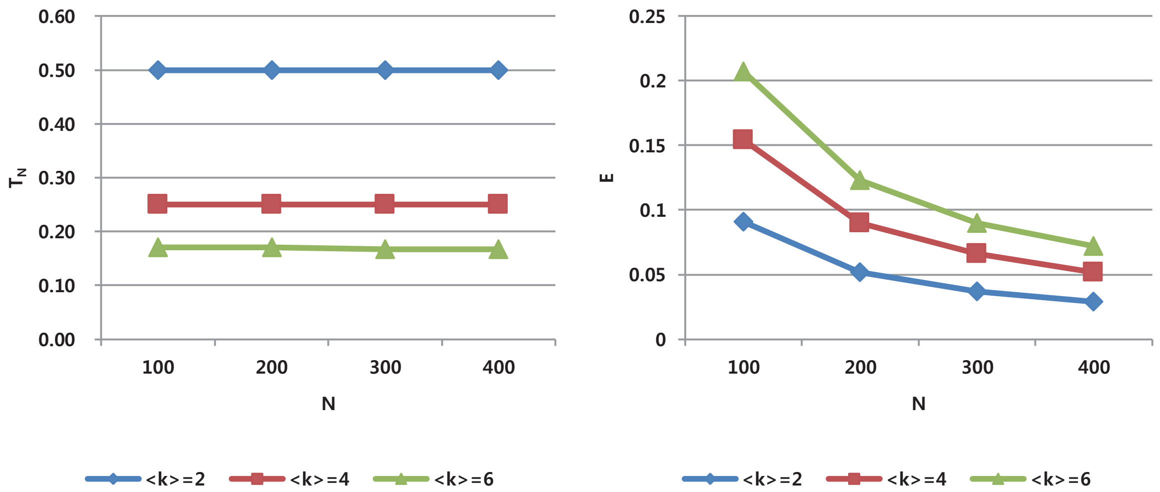


Figure 1. User interface of the agent-based simulation model

4. Results and Discussions

It is expected that the ETEN could act as a representative parameter which shows how fast the diffusion occurs in a social network under certain diffusion conditions. In order to verify it, we have investigated the change of the ETEN depending upon the number of agents and the average node degree in regular networks. The expectation time for equilibrium for all initiators is the same in regular networks. Therefore, it is expected that the diffusion velocity simply increases with the increase of the average node degree in regular networks. Figure 2 shows the ETEN depending upon the number of agents and the average node degree.



(a) **(b)**

Figure 2. (a) The ETEN and (b) the efficiency variation depending upon the number of agent and the average node degree(<k>) in regular networks

When the average node degree was the same, the value of the ETEN was also uniform regardless of the number of node. That is, the ETEN represents the easiness and the velocity of the diffusion depending upon the structural characteristics of networks regardless of the network size. On the other hands, the efficiency was varied with both the number of agents and the average node degree. The difference in the efficiency value by the average node degree decreased with increase of the number of agents. Therefore, there are some limitations to use the efficiency as a representative parameter which tells the overall easiness of the diffusion in a certain social network under certain diffusion conditions.

As shown in Figure 2, the average node degree also shows the easiness of the diffusion in regular networks. However, the average node degree cannot act as the representative parameter in other kinds of network. Figure 3 shows the variation of the ETEN depending upon the average node degree in scale-free networks. The ETEN was decreased with increase of the number of node in the scale-free networks with the same average node degree. That is, the average node degree cannot represent the easiness of the diffusion in non-regular networks like scale-free networks.

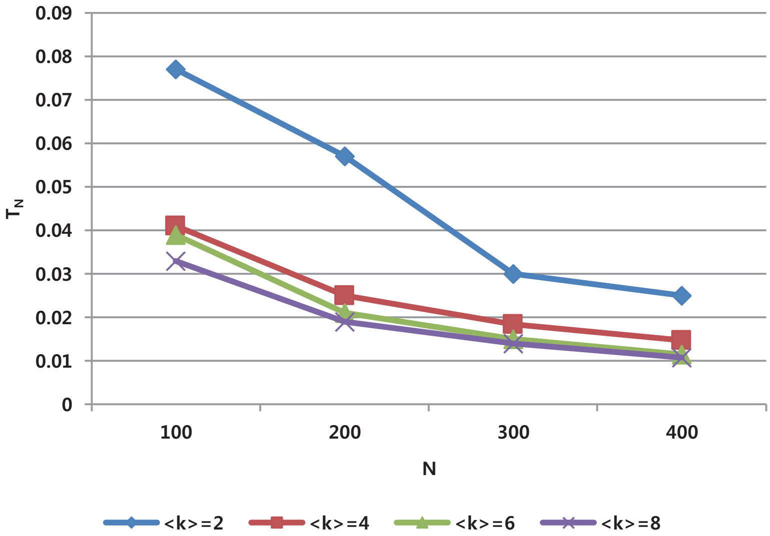


Figure 3. The ETEN variation depending upon the number of agent and the average node degree in scale-free networks

The presence of hubs significantly affects the stability of a network and diffusion dynamics. The power of the hubs in diffusion is getting stronger as the network size increases in scale-free networks, because the number of neighbors of the hubs increases with increase of the network size. Therefore, one can know that the higher the average node degree is needed to obtain the same diffusion velocity in the smaller sized networks from the Fig. 3.

5. Conclusion

There was no single parameter which clearly represents the easiness and the velocity of the diffusion in social networks. The ETEN suggested in this work means the expectation time for creating an additional receiver and could be simply measured by the agent-based simulation. It is expected that the ETEN could be useful to describe the easiness and the velocity of diffusion. In addition, it is expected that one can easily describe the effect of the structural changes of social networks on the overall easiness of the diffusion by using the ETEN.

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Simulation of Weak Signals of Technology Innovation in Complexity

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Abstract

It is indispensable in predicting the future, especially, new business or new industry, to predict the innovation of new technologies. This requires a understanding of the complex process of innovation, that comprises more efficient products, processes, services, technologies or ideas is adopted and diffused in the market, government and society. And detecting "weak signals" of changes in science and technology is also very important, because it foretell big events associated with innovations in technology. So I explored the weak signals' dynamic behavior of a specific technological innovation using agent-based simulating tool such as the NetLogo. This study is to provide a deeper understanding of the early stages of complex technology innovation. And The models are capable of analysing initial complex interaction structures, between components of technologies, between agents engaged in collective invention.

Keywords: *Technology Innovation, Weak Signals, Informetrics, Preliminary Symptom, Word Analysis, Agent-based Model Simulation*

1. Introduction

Predicting the innovation of new technologies is more important to explore the new business or new industry. And technological innovation is increasingly concerned with the complex process of innovation. This is accomplished through more efficient products, processes, services, technologies or ideas that are readily available to markets, governments and society.[1] The trend of complexity is toward greater over time.

So, formal modelling has always been an important part of research on technological innovation.[2] In particular, evolutionary economists developed a family of models addressing technology adoption, diffusion and increasing returns (Fisher and Pry, 1971[3]; Metcalfe, 1988[4];Arthur, 1989[5]; David, 1993[6]; Bruckner *et al.*, 1996[7]; Dalle, 1997[8]; Bikchandani *et al.*, 1998[9]) and the wider role of technical change in industrial dynamics and economic growth (David, 1975[10]; Nelson and Winter, 1982[11];Winter, 1984[12]; Silverberg *et al.*, 1988[13]; Silverberg and Verspagen, 1994[14]; Klepper, 1996[15]; Malerba *et al.*, 1999[16]; Fagiolo and Dosi, 2003[17]). Though these models have been very important in establishing an evolutionary understanding of technical change, their contribution in terms of understanding the innovation process itself has been less important.

Models deal either with technology adoption given a set of technologies or with innovation as a simple stochastic process. This research strategy is perfectly legitimate if the main interest is to understand the role of technical change in the economy. More recently, a new group of models focuses on technological innovation as a complex phenomenon making use of new modelling techniques from complexity sciences.

The important contribution of complexity theory is its ability to model more complex interaction structures with less parameters. In this way, realism can be added to previous models without sacrificing analytical rigour. Regarding the topic of technological innovation, two frames of reference are relevant: (i) complexity can refer to complex interaction structures of components in a technological system and (ii) complexity can refer to structures of interactions between agents in innovation networks. Complexity theory proves to be applicable in both domains.

Here, we will use the second frame, the structures of interactions between agents in weak signals of technological innovation.

Reviews on subsets of complexity models have been numerous recently, including Cowan (2004)[18] on network models of innovation, Dawid (2004)[19] and Pyka and Fagiolo (2005)[20] on agent-based models of innovation, Llerena and Lorentz (2004)[21] on technical change and evolutionary macroeconomics, Silverberg (2003)[22] on long waves in technical change, and Windrum (2004)[23] on neo-Schumpeterian models of industrial dynamics.

Early detection of emerging issues (signs) is the first important indications of a change. This may be understood as advanced, somewhat noisy and generally socially situated indicators of change in trends and systems that constitute raw informational material for enabling anticipatory action. Many times it is difficult to spot because they are indicating an unknown, unexpected or rare change which makes it hard to distinguish them as relevant. Therefore they are usually referred at as “faint” or “weak” signals.

The purpose of scanning the weak signals is to enhance resilient policy-making and address policy makers’ needs and concerns regarding new issues they will encounter or to identify business opportunities by anticipating consumer and societal needs or prepare society on less expected or rapid changes.

In recent years, interest in the future promising business is more growing, and the demand for forecasting future trends in science and technology (S&T), especially by exploring “weak signals” of potential changes, is increasing as well. Although weak signals are uncertain and irregular, they may indicate future trends. Ansoff (1982)[24] [1] described weak signals as “. . . warnings (external or internal), events and developments which are still too incomplete to permit an accurate estimation of their impact and/or to determine their full-fledged responses.”

Weak signals are signals where the impact cannot be estimated accurately (Ansoff, 1984). It might be that a new event will possibly have an impact on a target in future. It also might be that an existing event− that does not have an impact on the target up to now − will possibly have an impact in future. For strategic planning, it is hard to identify weak signals from the large number of existing signals. Literature proposes methodologies for weak signal identification.

They can be used to identify the future impact of weak signals on own strategic directions. Weak signals cannot be found in the core area of an organization. This is because all internal events of an organization and their impacts normally are already known by strategic decision makers.

Thus, Ansoff shows that weak signals can be found in organization’s environment. This requires the use of an environmental scanning procedure to identify signals in a first step.

This also requires the use of a clustering approach to group the large number of identified signals and to identify clusters of weak signals in a second step. [25]

Generally, the procedure for forecasting or early warning scanning consists of four steps: (1) exploring weak signals, (2) assessing weak signals, (3) transforming the signals into issues, and (4) interpreting the issues for new futures[26]. Among the steps, exploring weak signals is a prerequisite for analyzing alternative futures.

However, scanning weak signals has been possible because of the intuitive insight of experienced experts, whose services are often costly and not widely available. Further, their findings on weak signals may be subjective and contradictory.

Weak signals are current oddities, strange issues that are thought to be in key position in anticipating future changes in organizational environments. Scanning for them and using them in scenario work is thought to be successful for looking to the future. However, defining weak signals is problematic, and various authors term the concept differently.

The debate about the characteristics of weak signals has been active especially in Finland. Hiltunen E.(2008)[27] aims to develop a deeper theoretical understanding of weak signals. For this purpose, a semiotic approach, Peirce’s triadic model of sign in particular, is used. She introduces a new starting point for defining weak signals (signs) by using the novel concept future sign, which consists of three dimensions: the signal, the issue and the interpretation.

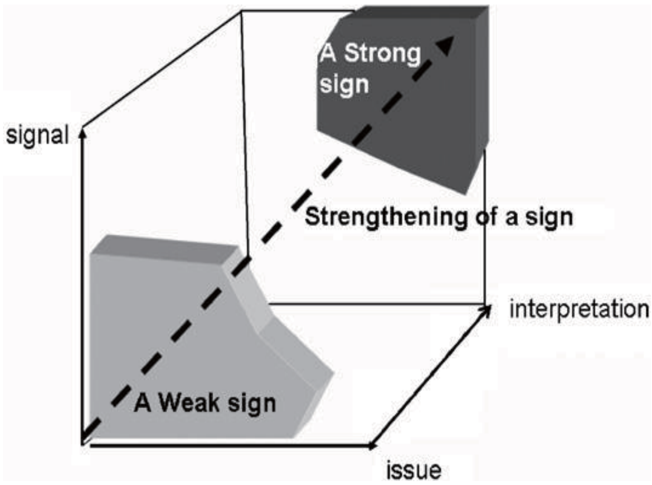


Figure 1. Strengthening of the future sign (Hiltunen, 2008)

In this figure, the axes (i.e. the dimensions of the future sign) are called the signal, the issue and the interpretation. The units of these dimensions are the following:

The signal: the number and/or visibility of signals.

The issue: for example, the number of events. A variety of other units that describe the diffusion of the phenomenon are also possible (e.g. the percentage of net sales or the percentage of internal sales, the amount of employees abroad).

The interpretation: the receiver's understanding of the future sign's meaning (an organizational point of view of this can be the importance of the sign for an organization in the future).

Today, the internet is a large and valuable source of information (Decker, Wagner, & Scholz, 2005)[28] where many signals occur. Further, the internet can be used to represent organization's environment. Additionally, most of the data available in the internet are textual data, e.g. websites or blogs. As a result, existing weak signal identification approaches use an environmental scanning that considers textual information from the internet (Decker et al., 2005; Uskali, 2005 [29]).

With an internet based environmental scanning, documents e.g. webpages can be identified. This scanning normally has a wide scope and thus, it leads to a large number of extracted internet documents. This makes the use of a (semi-) automatic approach more appropriate than the use of a manual approach. The documents possibly contain texts related to several different topics. Thus, a document as a whole normally does not represent a signal but specific textual patterns that occur within the document probably do (Uskali, 2005).

Text mining can be used to extract textual patterns from the full text of the documents and a specific clustering approach can be applied to identify groups of textual patterns that represent weak signals (Yoo, 2009[30];Tabatabei, 2011[31]; Thorleuchter & Van den Poel, 2013a[32]).

Literature shows some approaches that use internet based environmental scanning for weak signal identification.(Schwarz, 2005[33]; Decker et al. ,2005; Uskali, 2005)

The approach of Schwarz (2005) aims at the identification of new arising technologies with relevance for the high tech companies in Europe. Unfortunately, the approach could not be applied in practice. It has caused a very high manual effort because an automated environmental scanning tool was not available and thus, the scanning was processed by human experts. Further, the results of the clustering approach are of low quality. In contrast to this, the approaches of Decker et al. (2005) and Uskali (2005) have been applied successfully.

However, they prevent the high manual effort by restricting the number of retrieved documents to a small value. Thus, they could not be seen as wide scope internet based environmental scanning approaches. Yoo (2009) [34] provides an automated approach for internet based environmental scanning and clustering. A further knowledge structure based approach is provided by Yoon (2012) that detects weak signal from internet news related to solar cells.

In this paper, we have proposed a longitudinal analysis, particularly a time series analysis of word and/or co-word occurrences, based on word frequencies extracted from a full text of S&T news articles. Results of the analysis should be effective for solving the problems noted above.

In this study, we are to provide a deeper understanding of the early stages of complex technology innovation. So that, in the case of technological innovation, we assumed the weak signals as technological innovation terms (TI-terms), which will be processed by text mining procedure, will be categorized to be the emerging issues after simulating for a given period and will be grown to be the strong signals such as events.

2. Background

2.1. Complexity Models of Innovation[35]

2.1.1 Fitness landscapes

Understanding technologies as complex systems means that one has to define its elements and their interactions. LetN be the number of elements in a system and i an index for each element (i = 1, . . . , N). For example, a car can be described by a number of elements including the engine, brakes, transmission, steering device, etc. To design a technological system, there is generally more than one option for each element. Assuming (without loss of generality) that there are two options for each element, the total number of possible designs adds up to 2N.

Thus, even for systems with a small number of elements, the total number of possible designs is large. The space (hypercube) of possible designs is called the design space of a technology. Technological innovation can then be understood as a move of an agent (the designer) from its current location in the design space to a new location. Formally, this representation is equivalent to mutation in biological organisms, which involves a move from one string (say 00110) to another string (say 10110) in genotype space.

Technological innovation, generally, does not only involve a move in design space, but also an improvement in performance. Thus, when a designer is searching the design space of a technology, it is looking for strings with high performance or 'fitness'. Trial-and-error search can then be defined as an algorithm that randomly changes one or more elements (from 0 to 1 or vice versa), evaluates whether the fitness of the newly found string exceeds the fitness of the old string and moves to the new string if a fitness increase can indeed be realized. If one assumes that a designer searches myopically (Atkinson and Stiglitz, 1969), it means that innovation involves the mutation of only one element at the time. Put differently, in myopic search a designer searches only in the direct neighborhood of the present design, where neighborhood stands for the subset of strings that can be reached by mutation in one element. Trial-and-error search will halt once a designer has found a string with fitness that exceeds the value of all its neighboring strings. Using the metaphor of a fitness landscape that maps the fitness values onto the strings in the design space, myopic search halts at a peak in the landscape, which may well be only locally optimal and not globally optimal, which would require a string to have the highest fitness of all strings in the design space.2

2.1.2 Complex Networks

A second body of recent literature addresses the question how and to what extent network relations between innovating agents affect the rate of innovation and diffusion (for an extended survey, see Cowan, 2004). As with fitness landscapes models, one can distinguish between models of exogenous networks and models of endogenous formation of network structures. More generally, the economics of networks has become an important topic of research as it relaxes some of the crude assumptions underlying mainstream economics.

In the context of technological innovation, for example, studies have been done on coalitions, R&D alliances and innovation networks (Axelrod et al., 1995[36]; Duysters and Hagedoorn, 1996[37]; Powell et al., 1996[38]; Hagedoorn, 2002[39]; Pyka and Kuppers, 2002[40]; Breschi and Lissoni, 2003[41]).

Apart from networks defined at the level of agents such as firms, the concept of networks is also applicable to technologies. In this context, one speaks of network technologies, in particular, information and transportation infrastructures (airports, railways, Internet, etc.).We will discuss a model of complex network technologies when discussing endogenous network formation.

2.1.3 Percolation

Percolation models from physics are useful to model the dynamics of adoption (Stauffer and Aharony, 1994[42]; Grebel, 2004[43]) and of the role of spillovers in innovation (Silverberg and Verspagen, 2005[44]). Although our focus here is on models of technological innovation, we will first discuss the basic percolation model as a model of technology adoption.

2.2. Identification of weak signals and signal tracing

A well-known concept for implementing an early warning system used in strategic planning is introduced by Ansoff (1975)[45] that focuses on the identification of signals, specifically weak signals. Signals are defined as events, e.g. future trends, changes, or further emerging phenomena with a specific impact on a given target (Yoon, 2012)[46]. It could be distinguish between strong signals and weak signals. A strong signal impacts a target at present above a specific threshold and it is expected that this signal also will impact the target in future (Mendonca, Cardoso, & Caraca, 2012) [47]. In contrast to this, a weak signal has none or a small impact on a target at present but possibly, it will get an impact on the target in future (Tabatabei, 2011)[48].

Thus, the identification of weak signals makes it possible for decision makers to be aware of events in advance that will impact the decision in future (Kuosa, 2010)[49]. A further definition of weak signals describes them as unstructured information with low content value at present time that reflects e.g. aspects of an opportunity or a threat without aiming at a specific target (Mendonca, Pina e Cunha, Kaivo-oja, & Ruff, 2004)[50]. If the content information becomes more concrete by mention the impact of the opportunity or threat on a specific target then a weak signal has become a strong signal (Holopainen & Toivonen, 2012)[51].

In the internet, many webpages can be found where strong signals are mentioned. This is because their impact on a specific target is already known and they are widely discussed on several websites, new articles, and internet blogs. Thus, strong signal with impact on a specific target occur high frequently in the internet. In contrast to this, weak signals occur low frequently in the internet because they lack a current impact on a target and thus, they are not attractive for discussion and seldom mentioned on websites, new articles, and blogs. However, it might be that a small number of authors recognize the future impact of a weak signal and describe it in the internet. These few documents are among the large amount of information available in the internet. The identification of these documents and thus, the identification of weak signals in the internet is difficult and many practical approaches fail because of this information retrieval problem (Schwarz, 2005)[52].

Literature introduces two approaches that specifically are built to identify weak signals within the large internet information. A knowledge structure based clustering approach is introduced by Tabatabei (2011)[53] and a semantic clustering approach is introduced by Thorleuchter and Van den Poel (2013a)[54]. Both approaches use a document collection crawled from the internet at a specific point in time. However, they do not use time series. Time series are defined as sequences of data chronologically arranged (Hamilton, 1994)[55]. Several methodologies exist for analyzing time series, e.g. the use of regression analysis for time series forecasting (Graff, Escalante, Cerda-Jacobo, & Gonzalez, 2013)[56] and the use of pattern recognition for time series clustering (Rodpongpung, Niennattrakul, & Ratanamahatana, 2012)[57]. The methodologies are applied in several application fields, e.g. statistics, signal processing, and weather forecasting. The advantage of time series is that events can be traced over time and thus, event changes can be identified. This advantage may also be useful for tracing weak signals in the internet.

In today′s competitive business environment, the keyword ′future′ is becoming more important because it can be directly connected with the identification of promising business opportunities for formulating long-term businesses (Yoo, Park, & Kim, 2009) [58].

Various methods for identifying future business opportunities are such as customary approaches (Seol, Lee, & Kim, 2011)[59], weak signal analysis (Ilmola & Kuusi, 2006[60]; Kerr, Mortara, Phaal, & Probert, 2006[61]; Kuosa, 2010[62]), etc. Among these approaches, weak signal analysis has received much attention as a method for analyzing businesses of an uncertain future. In studies about the future, it has been concluded that futures cannot be forecasted by past inertia but are transformed discontinuously by interrupting events (Dator, 2002).[63]

However, scanning weak signals has relied heavily on the intuitive insight of experienced-experts, whose services may be costly and not widely available and who may provide different results on weak signals. Furthermore, information sources including scientific articles, news and blogs are now increasing exponentially in number and amount, so it is almost impossible to rely only on experts to scan weak signal topics for business intelligence.

3. Methodology

In previous study, the three-dimensional model by Hiltunen[64] [3] that conceptually describes the conditions of weak signals by combining signal, issue and interpretation in the concept of the "future sign" were adopted to detect such signals quantitatively. Building on her model, we considered weak signals as emerging topics related to words that were not selected by author's keywords in their articles. For example, if the growth rate of the occurrence frequency of a word is odd, then the word will relate strongly to future unfamiliar and unusual issues.

The method proposed in this paper identifies concepts that have a strong possibility of being weak signals, both quantitatively and automatically. Therefore, this paper describes a text-mining procedure, especially informetrics, for exploring weak signals. The proposed quantitative procedure generates a type of criteria—the growth rates of occurrences of terms. This automated method is expected to complement the expert-based approaches. Further, it can be used for analyzing large amounts of information (e.g., unstructured web data).

In this study, we use the agent-based model of cultural dissemination model (Axelrod, 1997)[65] , the culture is regarded to the group of weak signals of TI-terms. The weak signals of technological innovation terms in the case of technological innovation, we defined the weak signals, as technological innovation terms (TI-terms), which will be categorized to the emerging issues after simulating for a given period.

The culture dissemination model has 3 principles as followed.[66]

1. Agent-based modeling: Mechanisms of change are specified for local actors, and then the consequences of these mechanisms are examined to discover the emergent properties of the system when many actors interact.[67] Computer simulation is especially helpful for this bottom-up approach, but its use predates the availability of personal computers (e.g., Schelling 1978).
2. No central authority: Consistent with the agent-based approach is the lack of any central coordinating agent in the model. It is certainly true that important aspects of cultures sometimes come to be standardized, canonized, and disseminated by powerful authorities such as church fathers, Webster, and Napoleon. The present model, however, deals with the process of social influence before (or alongside of) the actions of such authorities. It seeks to understand just how much of culture emergence and stability can be explained without resorting to the coordinating influence of centralized authority.
3. Adaptive rather than rational agents: The individuals are assumed to follow simple rules about giving and receiving influence. These rules are not necessarily derivable from any principles of rational calculation based on costs and benefits or forward-looking strategic analysis typical of game theory. Instead, the agents simply adapt to their environment.

Culture is taken to be what social influence influences. For the present purposes, the emphasis is not on the content of a specific culture but rather on the way in which any culture is likely to emerge and spread. Thus the model assumes that an individual's culture can be described in terms of his or her attributes, such as language, religion, technology, style of dress, and so forth. [68] As the same way, in this study, an individual's tech innovation, technological innovation terms (TI-terms, pre-weak signals) which is agent actors has its attributes, such as factors from technological innovation process.

Axelrod (1997) prominently showed how tendencies toward local convergence in cultural influence can help to preserve cultural diversity if influence is combined with *homophily*, the principle that "likes attract." We argue that central implications of Axelrod's may change profoundly, if his model is integrated with the assumption of *social* influence as assumed by an earlier generation of modelers who did not use homophily.

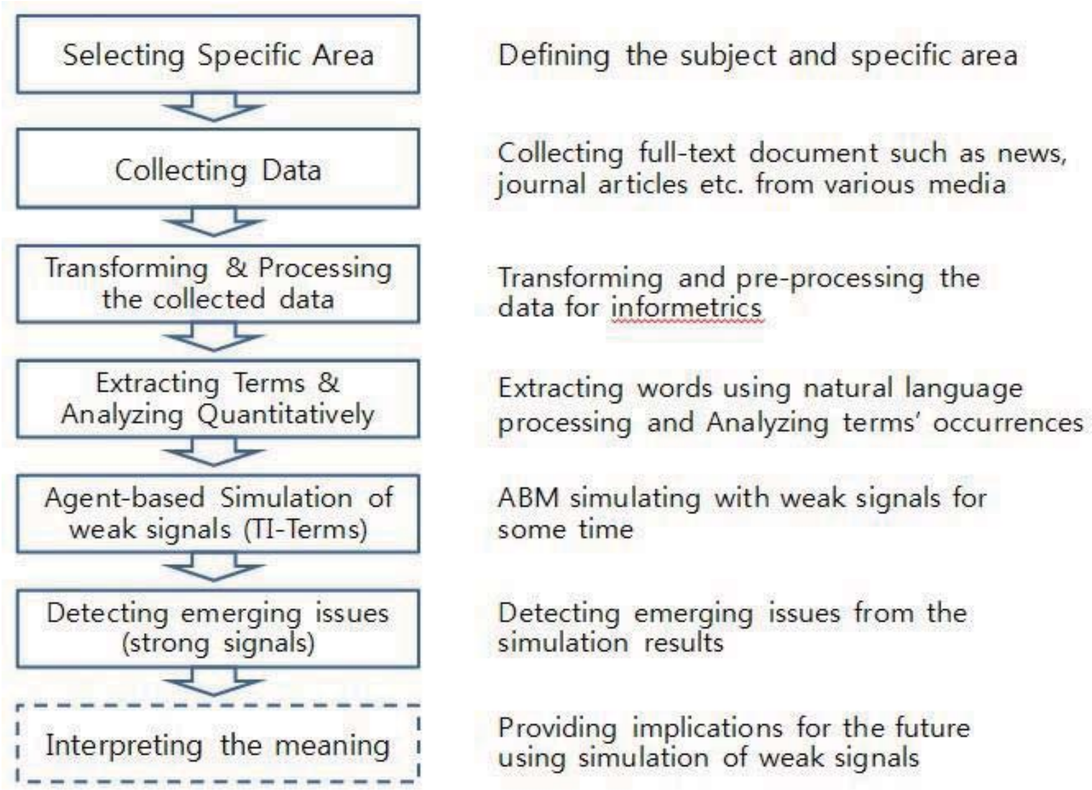


Figure 2. Procedure for exploring weak signals

4. Text mining Analysis of Technological innovation; Case Study

4.1 Data collection

In this paper, nanotechnology(NT) was selected as the specific subject area, which is nowadays more interested concerning the topic of "technological convergence". Nanotechnology would be more appropriate to describe as "nanotechnology-converged industry"—a combination of traditional and high-tech industries categorized according to specific applications such as IT(Information Technology), BT(Bio Technology), ET(Environment Technology), ST(Space Technology), and CT(Culture Technology).

In this study, full-text information from articles in a specialized journal such as the *Journal of the Korean Ceramic Society* were used for exploring weak signals of nano-materials in the nanotechnology area. The journal has a long history (50+ years) of publishing information relevant to this field.

The number of article titles between 2008 and 2012 with references to nanotechnology was 130. Fifty such articles were extracted for analysis. As mentioned above, it is useful to rely on recent and broad information to explore weak signals for predicting the future. Especially in technology, articles, proceedings, letters, and conference materials are relevant sources of information; however, this study's research regarding weak signals has focused on findings published by specialized academic journals. (Yoo & Won, 2013)[69]

4.2 Processing data

Using a morphological analyzer (morpheme analyzer), terms were extracted for a quantitative analysis based on full texts focused on nano-materials. Because extracted words included words with general meanings, these were deleted from the data selected for analysis. Then, terms with similar meanings were refined and pre-arranged.

The occurrence frequencies of the extracted and refined words were shown in a matrix and the growth rate for occurrences of each word (grade) were measured. A weak signal appears rarely; it becomes stronger when merged with surrounding environments; the growth rates of the terms could be significant indicators of future forecasting.

4.3 Quantitative analysis for searching weak signals

The most terms used in full-text articles focused on nano-materials, not author's keywords, were divided and extracted from those and the occurrence frequencies are measured. General terms were eliminated and terms with similar meanings were classified into groups with representative names.

Using the occurrence frequencies generated by this process, the annual growth rates of the occurrence frequencies of the terms were measured. For reference, the annual occurrence frequencies were measured by total counts of the extracted terms annually. And to recognize the changes in nano-material fields, the number of occurrence frequencies of the extracted terms were divided by the total number of annually published articles and then normalized into the occurrence frequencies per article.

Strictly speaking, annual growth rates of normalized occurrence frequencies reflect the changes in average occurrence frequencies of terms per article. Numerous gaps between measured figures and normalized ones could be indicative of future change. Certain findings from the measured results are shown in Table 1.

Table 1. Annual growth rates of occurrence frequencies for extracted terms

Term	Annual occurrence frequencies				Annual occurrence frequencies (normalization)				Annual growth rate
	09	10	11	12	09	10	11	12	
Carbon	2	0	0	99	0.22	0.00	0.00	8.25	2.34
Composite	1	0	35	40	0.11	0.00	3.18	3.33	2.11
Filler	1	0	0	28	0.11	0.00	0.00	2.33	1.76
Adsorption	1	6	0	24	0.11	0.46	0.00	2.00	1.62
Coating film	3	0	38	70	0.33	0.00	3.45	5.83	1.60
Calcination	1	0	1	18	0.11	0.00	0.09	1.50	1.38
Nanoparticles	2	7	48	34	0.22	1.31	4.36	2.83	1.34
Powder	1	0	0	16	0.11	0.00	0.00	1.33	1.29
Dispersion stability	1	0	0	15	0.11	0.00	0.00	1.25	1.24
Grain growth	2	4	0	21	0.22	0.31	0.00	1.75	0.99
Decomposition	3	20	6	27	0.33	1.54	0.55	2.25	0.89
Catalyst	2	23	1	18	0.22	1.77	0.09	1.50	0.89
Crystal grain	4	13	14	34	0.44	1.00	1.27	2.83	0.85
Low temperature	1	7	0	8	0.11	0.54	0.00	0.67	0.82
Chain	1	2	1	8	0.11	0.15	0.09	0.67	0.82
Microsphere	1	1	0	7	0.11	0.08	0.00	0.58	0.74
Liquid phase	1	3	1	7	0.11	0.23	0.09	0.58	0.74
Nanotube	3	0	0	18	0.33	0.00	0.00	1.50	0.65
Densification	3	1	4	18	0.33	0.08	0.36	1.50	0.65
Resin	1	0	2	6	0.11	0.00	0.18	0.50	0.65
Insulation	1	0	0	6	0.11	0.00	0.00	0.50	0.65
Chamber	1	1	8	6	0.11	0.08	0.73	0.50	0.65
Remain	1	5	1	5	0.11	0.38	0.09	0.42	0.55

Mass ratio	1	0	1	5	0.11	0.00	0.09	0.42	0.55
Penetration	1	6	4	5	0.11	0.46	0.36	0.42	0.55
Chemicals	1	0	4	5	0.11	0.00	0.36	0.42	0.55
Strength	8	31	24	39	0.89	2.38	2.18	3.25	0.54
Precipitate	4	4	0	19	0.44	0.31	0.00	1.58	0.53
Plasma	16	48	14	65	1.78	3.69	1.27	5.42	0.45
Gas	1	5	4	4	0.11	0.38	0.36	0.33	0.44
Bulk	1	1	4	4	0.11	0.08	0.36	0.33	0.44
Amorphous	1	0	1	4	0.11	0.00	0.09	0.33	0.44
Relative density	1	1	0	4	0.11	0.08	0.00	0.33	0.44
Biological	1	0	0	4	0.11	0.00	0.00	0.33	0.44
Fiber	1	90	26	4	0.11	6.92	2.36	0.33	0.44
⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮

*Original terms were in Korean

5. Structure of the Simulation Model

5.1 Innovation Indicators[70]

Study of new media adoption has been based on a theory. Specifically, "Innovation diffusion theory" (Rogers, 2003)[71] has been considered as the basis for academic theory. Innovation diffusion theory has been used as a framework to analyze innovation diffusion in society and innovation adoption at the individual level. Innovation diffusion theory analyzes the causes that leads to differences in time of employment and the rate of innovation diffusion of ideas recognized as new. Empirical studies based on innovation diffusion theory reveal that characteristics needed to recognize innovation are the most influential factor concerning innovation adoption. In other words, characteristics needed to recognize innovation have higher explanatory power than consumer-related characteristics. Various studies based on innovation diffusion theory have announced results showing five typical characteristics concerning the adoption of innovation, as shown in Figure 3.

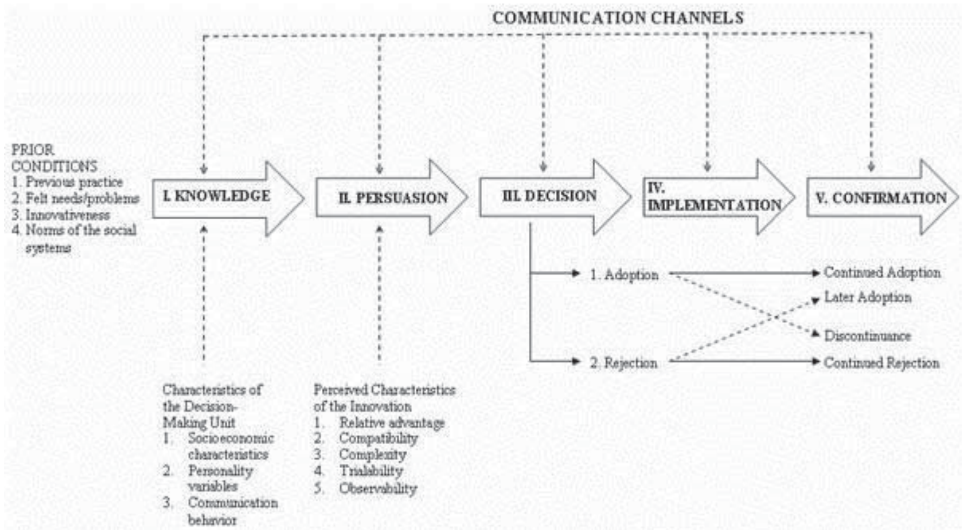


Figure 3. Innovation-decision process
Source: Rogers (2003)

First, relative advantage means innovation that provides the benefits and value that are superior to existing products and services. Second, compatibility refers to the degree recognized to meet your needs, experience, and existing values. Third, trial ability means the possibility of being able to experience products and services prior to adoption of the innovation. Fourth, observability means the degree of confirmation about the results of adopting the innovation. Fifth, complexity refers to the degree to which you feel you can understand, or have difficulty understanding, how to use the technological innovation.

The five characteristics are use to recognize innovation are evaluated to determine the most important factors that can explain about 50 percent of the diffusion rate of innovation, according to the innovation diffusion theory of Rogers (2003). Rogers explained inter alia, that relative advantage and compatibility were particularly important in describing adoption of innovations. In the results of the meta-study on innovation characteristics and innovation adoption, relative advantage, compatibility and complexity exhibited a high degree of explanatory power concerning innovation adoption.

5.2 Design of the Simulation Model

5.2.1 Netlogo Model: Axelrod's Cultural Dissemination

This is Axelrod’s model of cultural dissemination. It is an agent-model designed to investigate the dissemination of culture among interacting agents on a society[72]. Axelrod model consists in a population of agents, each one occupying a single node of a square network of size L. The culture of an agent is described by a vector of F integer variables called 'features'. Each feature can assume q different values between 0 and q-1. In the original Axelrod model the interaction topology is regular bounded (non-toroidal). Each agent can interact only with its four neighbors (von Neumann neighborhood).

Dynamics are based on two main mechanisms: (1) agents tend to chose culturally similar neighbors as interaction partners (homophily) and (2) during interaction agents influence each other in a way that they become more similar. The interplay of these mechanisms either leads to cultural homogeneity (all agents are perfectly similar) or the development of culturally distinct regions (multicultural society). The model allows studying to which degree the likelihood of these two outcomes depends on the size of the population, the number of features the agents hold, the number of traits (values) each feature can adopt and the neighborhood size (interaction range).

5.2.2 Description of simulation

Each agent is located at each patch of the grid with the default shape. Agents hold a number of features F. Each feature is a nominal variable that can adopt a certain number of values (called traits) from 0 to q - 1. Initially, agents adopt randomly chosen traits. However we can modify from randomly chosen traits to given traits which is come from the extracted value of text mining.

At each time step (tick) agents update its cultural value in an asyncronous-random updating. That is that the computer makes a list where all agents are included in a random order and the list is followed until all agents are choosen. Each agent them become a focal agent and then, one of the focal agent’s neighbors is selected at random. Neighbor agents are those who are in distance less than the value of the parameter 'radius'. If radius = 1, then it is von Neumann neighborhood. The cultural overlap between these two agents is computed. The cultural overlap is equal to the percentage of similar features. With probability similar to the overlap, the two agents interact. Otherwise, the program continues with the next agent until the list is exhausted and it follows the next time step (next tick).

An interaction consists of selecting at random one of the features on which the two agents differ and changing the focal agent’s feature to the interaction partner’s trait. Note that if the overlap is zero, interaction is not possible and the respective agents refuse to influence each other.

First, you should choose the population size selecting the size of the grid society on x and y directions and write these values on 'world-size-x' and 'world-size-y'. Also you should choose value for F (number of features), q (how many traits each feature can adopt) and radius (size of the neighborhood). Here, 1 means that each agent has 4 neighbors, 2 corresponds to 12 neighbors, and so on.

Each agent adopts a color which represents its culture. If two agents adopt the same color, they have the same culture. Click on Go and the simulation starts. You can follow the changes of the agents culture according to his color. Furthermore, there is a graph reporting the number of different cultures on the society and the number of possible and real interactions. A possible interaction is that which agents share more than zero and left than all its features. A real interaction is when focal agent actually change the value of one of its features. Simulation stops when the number of possible interactions reaches zero. That means that each agent share all of none of its traits value with all its neighbors.

At the end it is calculated and reported the number of cultural regions in the population and the number of agents in the biggest one (also normalized). A region is a set of agents that are similar on all features. We included an extensions of Axelrod's model: agents can move. Then, you should also decide if the agents can move or not. In original Axelrod model the agents do not move. If moving, select the velocity of agent movement with 'veloc', select the length of the step with 'steplength' and the angle of rotating with 'angle'. If moving, at each tick agents decide to move taking 'veloc' as a probability. In case of actual movement, agents select at random an angle were the upper half values add this angle value to the current one the agent has and the lower half subtracts this angle to the current one. Then, ones direction is selected, agent moves a distance 'steplength'.

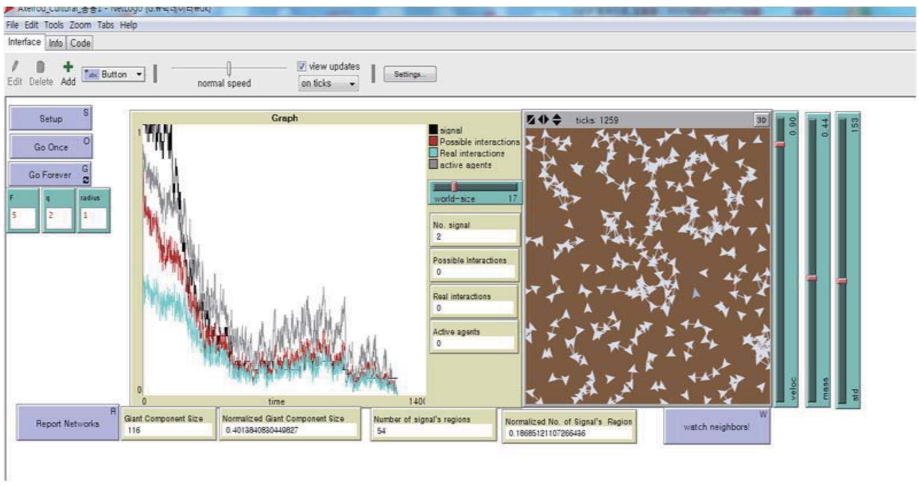
5.3 Simulation of weak signals

Here we have setted toroidal boundaries, but the simulation can properly function as well in the original non-toroidal one. In their case, the four von Neumann neighbors are at distance 'radius' one. The model permits to change the value of 'radius' to explore the implications of other neighborhood sizes. It is also implemented the possibility for agents to move.

At the end, in the absorbing final state, when calculating for the number of regions, the model makes different visible networks which include all neighbors agents with the same culture. Then, when counting the number of cultural domains it is considered that two domains are different if they are not connected, even if agents in both domains share same culture.

Note also that two agents could have similar (but with zero overlap) cultural values and then, its corresponding colors could be so similar that it could induce to think that the cultural values are the same. Just check to see that it is not.

Vary the population size, the number of features, the number of traits, the range of interactions and also the movement of the agents. The program stops when the first absorving state is found (the number of possible interactions are zero on one time step), even if the agents are moving. Try toroidal and not toroidal borders activating 'World wraps horizontally' and 'World wraps vertically' in the Settings menu. This simulation shows me that the groups of weak signals are to be strong signals over time



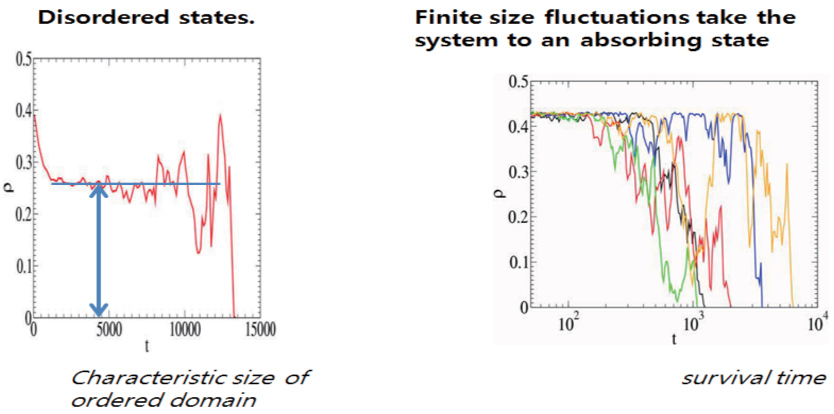


Figure 4. Agent-based Model simulation of weak signals

5.4 Weak signal search and interpretation

In the nano-material field, a weak signal search was conducted to investigate an indistinct signal; this type of investigation differs from megatrends. Table 2 shows the terms with high annual growth rates in average occurrence frequencies and with high growth rates in normalized occurrence frequencies.

It was necessary to confirm the original sentences in the article to discover meanings of terms extracted from the full texts of the articles. It was also possible to verify the extracted terms with high growth rates and interpret their meanings.

Table 2. Words with possibilities as weak signals and high growth rates

Category	Words*
Growth rate of the number of occurrences (Upper 15%)	Carbon, composite, filler, adsorption, coating, calcination, particles, powders, dispersion stability, particle growth, decomposition, catalysts, grains, low-temperature
Growth rate of the normalized number of occurrences (Upper 15%)	Carbon, composite, filler, adsorption, coating, agglomeration, calcining, nanoparticles, conductive powders, dispersion stability, absorption, particle size, spherical

*Original terms were in Korean

This paper describes knowledge from the field of nanotechnology, especially nano-materials, as highly dynamic and representative of an increasing number of new fields. Such growth has been coupled by a strong interrelationship among fields. Harnessing the results from our analyses paves the way for gathering insights, mainly from a scientific perspective, into the array of capabilities and competencies underpinning research and development (R&D) associated with the future generation of nanotechnology.

Now we are trying to get a final conclusion by comparing the results of simulation and the above one (table 2).

6. Conclusion

In this study, we explored the weak signals' dynamic behavior of a specific technological innovation using agent-based simulating tool such as the NetLogo. It was because to provide a deeper understanding of the early stages of complex technology innovation.

We have explored weak signals in the nano-material field; such signals are still insignificant but may be predictive of megatrends in support of R&D decision making for nano-material technologies. By searching weak signals to perceive future technology trends, the terms with high occurrence rates are extracted using informetric analysis to suggest backup and evidence for the prevailing expert-based detection method. It is likely that more meaningful interpretations of extracted terms can be obtained through comparisons with full texts.

For more realistic and evidence-based predictions in the future and deeper understanding of technology innovation, it will be necessary to aggregate weak signals in markets and surrounding environments, to simulate by various innovation models and to develop objective indicators for detecting weak signals based on unstructured S&T information from various sources such as web information.

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Complex Adaptive Systems Approach to Sewol Ferry Disaster in Korea

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Abstract

This paper aims to introduce the concept and characteristics of natech disaster (Natural hazards triggered Technological disaster) and to explore the policy issues in complex disaster management in Korea. This study is to apply the risk management or policy for improving effective public acceptance and to investigate the changing factor analysis of the risk communication with dynamic characteristics using the the model of complex adaptive systems.

Based on the results of analyzes, this research concludes with a few policy suggestions. First, the natech (natural-technological) complex disaster management needs to be approached in complex adaptive perspective. By psychological, social network analysis, linking reaction after the disaster, we could cope with the physical disaster similar in the future. Third, the perception of vulnerability as a "psychological event" implies that the vulnerability as well as the disaster has periods of onset, development and finally an end.

In conclusion, complex adaptive systems approach to the vulnerability could cause us to change our focus on preparing for the impact of events, and perhaps it should induce us to widen our horizon concerning the dynamics and implications of the natech disaster.

Key Words: Sewol ferry disaster, Natech disaster, disaster management, complex adaptive systems, bowtie model, social network model, ABM (Agent-Based Model)

1. Policy issues in Natech disaster management

This thesis aims to introduce the concept and characteristics of natech disaster[1] (Natural hazards triggered Technological disaster) and to explore the policy issues in complex disaster management in Korea (Vetere Arelanno et al., 2004). Natech disaster (or risk) has been studied in European countries and America since late 1990s. As the disastrous accident in Fukushima nuclear power plant hit by Tsunami in early 2011 proved the unmanageable size and impact of the complex disaster, the issues in Natech disaster has drawn attention from all over the world.

Generally speaking, the relentless evolution of technology provides sources of both vulnerability and its mitigation: it is a double-edged sword (Alexander 1995). Students of humanitarian aid have developed a portrait of the modern complex emergency, a phenomenon characterized by a mixture of military, social, economic, political and environmental instability aggravated by recurrent natural disasters and underpinned by regional or global political strategies. Proponents of the idea argue that the complex emergency is the fruit of globalization, the shifting global power balance, decolonization and the world arms trade (Copat 1981, Duffield 1996). Opponents argue that all disasters are more or less complex, and the roots of the so-called 'complex emergency' are a matter of sustainable development and political stability. However, neither group would dispute the fact that people caught up in complex emergencies evolve patterns of coping and survival, sometimes spontaneously (Kirkby et al. 1997).

The sinking of the Sewol ferry occurred on the morning of 16 April 2014 en route from Inchon to Jujus. The Japanese-built Korean ferry capsized while carrying 476 people, mostly secondary school students. The sinking of Sewol ferry has resulted in widespread social and political reaction within Korea. Many criticize the actions of the captain and most of the crew of the ferry. More criticize the ferry operator and the regulators who oversaw its operations. Additional criticism has been directed at the Korean government and media for its disaster response and attempts to downplay government culpability.

Earthquakes, storms, and torrential rains are natural phenomena we refer to as “hazards” and are not considered to be disasters in and of themselves. For instance, an earthquake that occurs on a desert island does not trigger a disaster because there is no existing population or property affected. Also to a hazard, some “vulnerability” to the natural phenomenon must be present for an event to constitute a natural disaster. "Vulnerability" is defined as a condition resulting from physical, social, economic, and environmental factors or processes, which increases the susceptibility of a community to the impact of a hazard. “Exposure” is another component of disaster risk, and refers to that which is affected by natural disasters, such as people and property. In general, “risk” is defined as the expectation value of losses (deaths, injuries, property, etc.) that would be caused by a hazard. Disaster risk can be seen as a function of the hazard, exposure and vulnerability as follow function 1;

Disaster Risk = { H, V, E, B, Rr, Dr, ... } --- (1)

Risk is a function of hazard (H), vulnerability (V), exposure of vulnerable elements to the hazard (E), background levels of the hazard (B), the release rate of the hazard (Rr), the dose rate of those elements or people that absorb its impact (Dr), and sundry other qualifiers (Alexander ,2000).

Growing exposure and delays in reducing vulnerabilities result in an increased number of

[1] Natural disasters can trigger technological disasters (a dynamic also called domino effect), and these concomitant events (also known as natechs) may pose tremendous risks to countries and communities.

natural disasters and greater levels of loss. Natech disaster requires a new approach to disaster management, because of its cascading effects on interdependent systems. The field of natural disaster management and that of technological disaster management, separated in research and policy process, need to integrate their expertise working within a unified disaster management system. The four fundamental dimensions of disaster are magnitude (of the causal phenomena), intensity (of the effects of these phenomena), time (duration and frequency) and space (territorial extent and geographical variations in intensity). As most disasters are recurrent, the pattern of magnitudes and intensities distributed in space, time and social psychology is cumulative (Alexander, 1995). This research examines the issues of natechs complex disaster through analysis of Sewol ferry disaster. Various variables of developing the risk communication were derived using bowtie model, and the detailed causes were derived using ABM (Agent -Based Model) (Wilensky, U., 1999).

This study is to apply the risk management or policy for improving effective public acceptance and to investigate the changing factor analysis of the risk communication with dynamic characteristics using the model of complex adaptive systems.

2. Research Models

2.1 Social Network Analysis

The disaster has several forms of significance for human communities. First of all, it is--obviously--a source of death, injury, destruction, damage, and disruption. Ideas on what is a significant level of these vary considerably, often in relation to mass media 'constructions', or choice of elements to emphasize, of what is significant (Goltz, 1984; Ploughman, 1995). Secondly, disaster is a marker point in history and a milestone in the lives of survivors (Lifton, 1980). Thirdly, it is an indicator of future catastrophe potential.

To investigate potential interactions between disaster signals (factors), network analysis of significant word co-occurrence patterns may help to decipher the structure of complex disaster system across psychological or temporal gradients. The current disaster management policies were analyzed based on the literature, SNA (Social Network Analysis) and ABM which were conducted to verify the issues and possible solutions in complex disaster management. This study used R-package for SNA that provide a simple way to analyze large volumes of unlabeled text.

Network analysis tools and network thinking[2] (Proulx et al., 2005) have been widely used by social scientists, and computer scientists to explore interactions between entities, widely applied to exploring co-occurrence patterns between factors in complex communities or systems. Co-occurrence patterns were readily revealed, including general non-random association, common life history strategies at unexpected relationships between community or system factors. Overall, we demonstrated the potential of exploring inter-factor correlations to gain a more integrated understanding of complex disaster structure. This analysis presents a social network analysis based on co-occurrence patterns with R using package “igraph”. Our text data consists of the title of newspaper editorial of the KPF (Korea Press Foundation) database (http://www.kinds.or.kr) of 25 participating newspapers from April 16, 2014 to May 28, 2014.

We were removing numbers, stemming words, and weighing a term-document matrix by term frequency. After that, it was transformed into a term-term adjacency matrix, based on which a graph was built. Then we plotted the graph to show the relationship between frequent

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[2] A network is any collection of units potentially interacting as a system.

terms. In the term-term adjacency matrix, the rows and columns represent terms, and every entry is the number of co-occurrences of two terms. For time series clustering with R, the first step is to work out an appropriate distance/similarity metric, and then, at the second step, use existing clustering techniques, such as k-means, hierarchical clustering, and density-based clustering or subspace clustering, to find clustering structures (see Appendix 1).

The analysis results have shown that the perception of disaster is an “events”, which are inherently linked to our cognition levels. That implies that disaster has a point of beginning and an end. Therefore we categorize disaster situations regarding the event in focus; before, during and after disasters. And this can provide important clues about new emerging network patterns so that the decision makers can predict the coming events and react in near real time. The change of clustering structure can be relating to the emerging interesting patterns. Stream event clustering is especially important to the psychological time-critical areas such as disaster monitoring, anti-terrorism, and network intrusion detection. The change of critical clustering structure in event streams involves three forms: new emerging clusters, disappearing clusters that is caused by the convergence of growing clusters, and drifting cluster centers that is we can precisely monitor the change of clustering structure in the categorical event stream(see Figure 1). The working mechanism can be described as follows.

1. The records from the data stream are inserted into the hierarchical clustering tree sequentially.
2. After a time interval, the change of critical clustering structure in event streams involves three forms: new emerging clusters, disappearing clusters that is caused by the convergence of growing clusters, and drifting cluster.

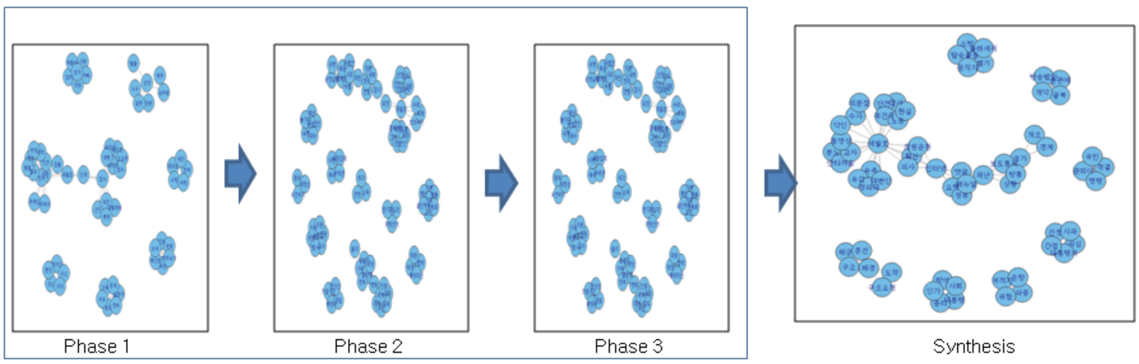

Figure 1. The change of critical clustering structure in event streams by real time

In data mining, hierarchical clustering (also called hierarchical cluster analysis) is a method of cluster analysis which seeks to build a hierarchy of clusters. The results of hierarchical clustering have presented in a dendrogram. The synthetic dataset has a two-layered clustering structure (see Figure 2) with 30 attributes and the hierarchical clustering dendrogram would be as such:

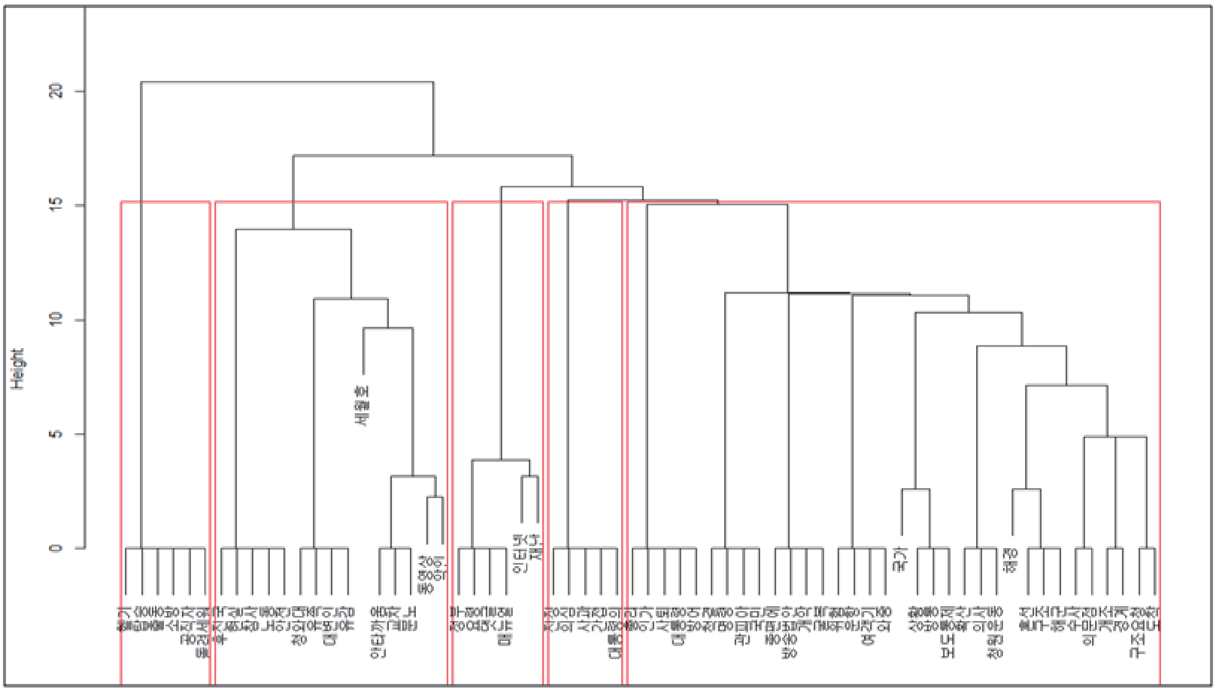

Figure 2. Hierarchical Clustering with Euclidean distance

2.2 Structure of Bowtie Model

Bowtie model is one of many barrier risk models available to assist the identification and management of risk, and it is this particular model we have found (and are still finding) useful. The bowtie elements that help in identifying the safety and risk priorities can also be applied. Bowtie is a visual tool that effectively depicts risk providing an opportunity to identify and assess the key safety barriers either in place or lacking between a safety event and an unsafe outcome.

A network with bowtie structure consists of six parts: giant strong component (GSC), substrate subset (IN), product subset (OUT), tendrils subset (Tendrils), disconnected subset (Disconnected) and tube subset (Tube). The GSC is the biggest of all strongly connected components and is much larger than all the other ones, while a strongly connected component is defined as the largest cluster of nodes within which any pair of nodes is mutually reachable from each other. IN consists of nodes that can reach the GSC but cannot be reached from it, while OUT consists of nodes that are accessible from the GSC, but do not link back to it. The “"Tendrils”" of the bowtie consist of (a) the nodes reachable from “IN” that cannot reach the giant SCC, and (b) the nodes that can reach “OUT” but cannot be reached from the giant SCC. The "Disconnected" contains nodes that cannot reach the GSC, and cannot reach from it. The "Tube” travels from IN to OUT without touching the giant SCC.

By computational network analysis of the word group of psychological time series in KPF database, we discovered that the disaster structure of the Sewol ferry is organized in the form of the bowtie model. When reconfiguring the analysis results described above in the form of the bowtie model is as follows (see Figure 3): Generally, the bowtie model is focused on the flow of the relationship between the factors. Large examining the functional significance between each group of the factors can be divided into six parts (David Easley, et al., 2010).

- SCC Strongly Connected Component: the most strongly intertwined that component, in the relationship of knowledge; it is “Exchange Zone” in that knowledge circulated.

- IN: is a link into the SCC group, and “Source Zone” is a source of knowledge.
- OUT: is coming links out of the SCC, is a “Target Zone” to the the depot of knowledge.
- Tube: is a group that is connected directly “Source Target” groups and groups without going through an intermediate point circulating.
- Tendrils: is “Source Group” or “Target Group” to dependent manner related to that “Dependent Group”.
- Disconnected Components: is a distant group that away without exchanged all of the groups with the relationship.

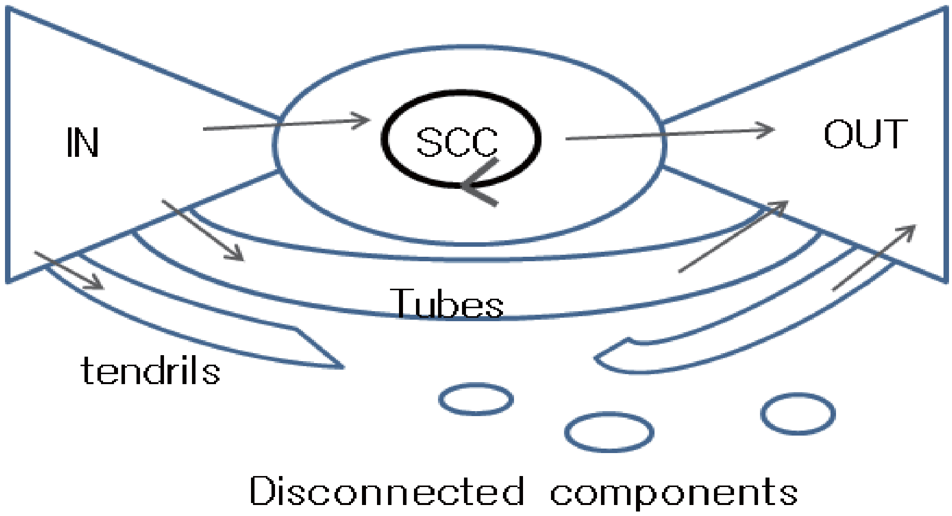

Figure 3. Data component of the bowtie model

Source: David Easley, et al., 2010.p.389.

A dataset suitable for clustering is a collection of points, which are objects belonging to some space. In its most general sense, a space is just a universal set of points, from which the points in the dataset are drawn. However, we should be mindful of the common case of Euclidean space, which has some important properties useful for clustering. In particular, Euclidean space’s points are vectors of real numbers. The length of the vector is the number of dimensions of the space. The components of the vector are commonly called coordinates of the represented points. We introduced the common Euclidean distance (square root of the sums of the squares of the differences between the coordinates of the points in each dimension) serves for all Euclidean spaces. It assumed that more high height of the inter-word clusters caused more cognitive events. Therefore, the height of each word group is divided into three steps for steepness vector. It assumed that the size of the steps was of a uniform size of 0.4 from 0.1 to 0.9. And the total number of words in each group was assumed intercept values (the weight of each word is assumed to be 0.1). Values of the” b” (intercept) of” a” (steepness) of each word group based on this are as follows (see Table 1).

Table 1. Classification and characterization of clusters

NO	Group (Cluster)	*Contents*	Steepness (a)	intercept (b)
0	Sewol ferry	*Sewol ferry*	0.1	0.1
1	sailors response system	*investigation, wicked, questionable*	0.5	0.3
2	safety management system	*safety, disaster, labor, developing countries, the reality*	0.9	0.5
3	national control tower	*Cheong Wa Dae, the bereaved, pity, spokesman*	0.9	0.4
4	ship operations and management	*video, anger, cross, sadness*	0.5	0.4
5	maritime police response system	*petition exercise, intention, spreading*	0.1	0.3
6	disaster confrontation system	*comments, tips, manuals, government, disaster*	0.5	0.5
7	actual ship operation parts	*press control, broadcasting & telecommunications, national, conditions*	0.5	0.6
8	corresponding manual	*modifications, boundary*	0.1	0.2
9	press control	*navy, confusion, coast guard, arrive, rescue request*	0.5	0.6
10	country remodeling	*fire, mobilize, helicopters, boarding, stand up*	0.1	0.5
11	rescue	*aircraft, flight, danger*	0.1	0.3
12	government accountability	*defense, the prime minister, permission, president*	0.1	0.5
13	apology of the president	*calm, apology, doubt, indirect, president*	0.1	0.5
14	bureaucratic mafia	*people, bureaucratic mafia, dispel, command,*	0.1	0.4
15	internet	*internet*	0.9	0.1

Figure 4 shows the “bowtie picture” from the analysis results described above. Here, 0(Sewol ferry), 15(Internet) and 5 group (petition exercise, intention, spreading) that are intertwined most strongly, are corresponding to the "SCC". The "IN" group is the source of knowledge (Source Zone), includes the Group 1 to Group 4. Conversely, the "OUT" group includes Group 6 to Group 7. On the other hand, the cluster set included in the group 9, 10 and 11 are “Tendrils_in” that come from “IN” but cannot reach the giant SCC. Also, the cluster set included in the group 12, 13 and 14 are “Tendrils_out” that come from “OUT” but cannot reach the giant SCC.

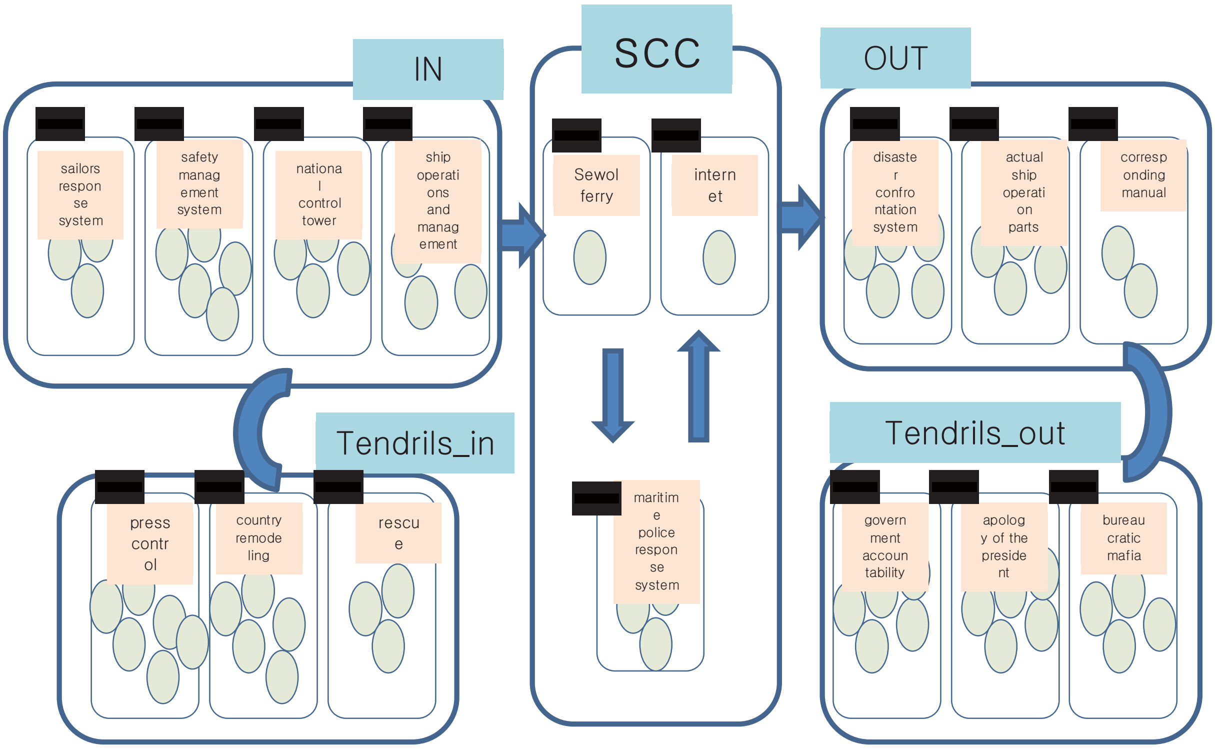

Figure 4. Conversion to the result of the bow-tie model of clustering analysis

2.3 ABM (Agent-Based Model)

This model is a representation of major risk factors. The nodes in this model represent the symptoms of major risk factors. According to the bowtie model above there are sixteen factors which make direct causal relations with one another : These factors are “Sewol ferry”, “sailors response system”, “safety management system”, “national control tower”, “ship operations and management”, “maritime police response system”, “disaster confrontation system”, “actual ship operation parts”, “corresponding manual”, “press control”, “country remodeling”, “rescue”, “government accountability”, “apology of the president”, and “bureaucratic mafia and internet”.

Therefore, these risk factors causing disruption of society were assumed to show the mutual causal direct influence with other factors and this is called the causal network perspective (Borsboom, 2008; Cramer, Waldorp, van der Maas & Borsboom, 2010; Schmittmann, Cramer, Waldorp, Epskamp, Kievit & Borsboom, 2013; Cramer, Borsboom, Aggen, & Kendler, 2012). For instance, if one develops a symptom of major risk factor then this increases the likelihood of developing other symptoms. Conversely, if one of the symptoms disappears, this increases the likelihood that other symptoms disappear as well. This model is made to illustrate this effect of vulnerability. Also, this model predicts that a factor that is vulnerable and develops a risk due to, for example, severe risks, will not recover automatically when the risks are solved. More is needed to trigger recovery from risks. Conversely, for the factor that is resilient to risk, mild stress cannot trigger a cascade of risks. Severe stress can lead to a full-blown risk, but when the stress subsides, the risk will subside too. This effect is also known as the hysteresis effect.

The model is based on two parameters for the whole network that can be controlled by connection strength and external activation (Van Borkulo, C.D., Van der Maas, H.L.J., Borsboom, D., and Cramer, A.O.J., 2013). Furthermore, the stress levels can be varied per risk factor. The network architecture is based on partial correlations between risk factors. At each time step, the probability of a risk factor being developed is calculated for each risk factor. This probability depends on certain parameters as well as the total activation of its neighbors at the previous step. These parameters are regression parameters (a intercept and a steepness) for each risk factor by substituting the coefficient values which came out in the previous social network model to attribute value (“a”: steepness, “b”: intercept). The parameter "a" is a risk factor-specific parameter that controls the sensitivity of the probability function. When "a" is high, the probability of becoming infected is larger. Parameter "b" is a symptom-specific parameter for the degree of inertia of a risk factor; a risk factor with a higher threshold needs more activation to become infected than risk factors with a lower threshold. The value of the weight for the links depends on the configuration of relationships in the bowtie model (in this case, links: 1, unlinked: 0).

The probability activated for risk factor “i" is represented as a following function (2)[3].

$$\frac{1}{1+e^{a(b-c)}} \quad \text{--- (2)}$$

Here, "c" is the total amount of stress on risk factor "i". The amount of stress consists of the individual stress level of risk factor "i", the amount of external activation and the influence of the activation of the neighbors of risk factor "i". The influence of the neighbors depends on whether or not they are activated and on the strength of the connection between the activated neighbor and risk factor "i". The strength of the connections determines the degree to which the activation signal of a risk factor is sent to the other risk factors. The external activation can be seen as influences from the environment.

On the other hand, in the hysteresis plot of the agent-based model (ABM), the hysteresis effect can be demonstrated (see Figure 5). The term "hysteresis" is derived from an ancient Greek word meaning "deficiency" or "lagging behind". Hysteresis is the time-based dependence of a system's output on current and solidarity strength between elements in the past. The dependence arises because the history affects the value of an internal state. To predict outputs, either its internal state or its history must be known. If a given input alternately increases and decreases, a typical mark of hysteresis is that the output forms a loop that may occur purely because of a dynamic lag between input and output. This effect disappears as the input changes more slowly. This effect meets the description of hysteresis given above but is often referred to as rate-dependent hysteresis to distinguish it from hysteresis with a more durable memory effect.

At a certain fixed connection strength and changing external activation, it is made visible that the shifts from depressed to healthy states and vice versa generally follow a non-linear pattern (hysteresis).The histogram represents the frequency of the number of activated risk factor per tick (the unit time) of the last 1000 ticks in the model. The network can be regarded as disordered when the total number of active risk factors is larger than 8 (above the black line in the network status plot of the model). Conversely, the network is regarded healthy when there are 8 or fewer symptoms activated (below the black line).

For the ABM analysis, first select the connection strength of the hysteresis effects of

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[3] The logistic function is the inverse of the natural logit function and so can be used to convert the logarithm of odds into a probability; the conversion from the log-likelihood ratio of two alternatives also takes the form of a logistic curve (http://en.wikipidia.org/wiki/)

certain risk factors and activates the strength of the external shock was analyzed whether any level of the network is causing the change. To reduce the intensity of the external shock to the speed of the station at some level was analyzed whether the network is switched. The following case is the hysteresis effect results under various scenarios.

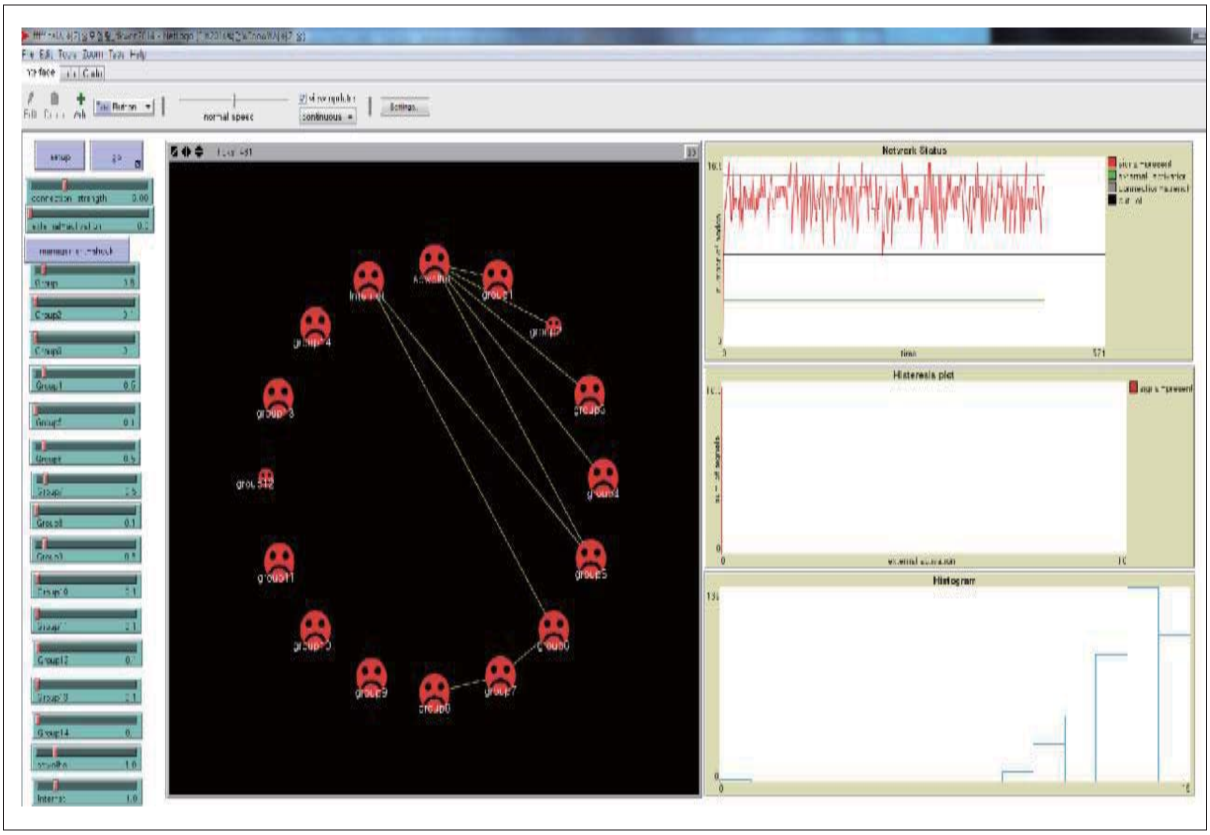

Figure 5. Apply screen simulation models developed ABM tool NetLogo

3. Hysteresis Effect Analysis

For analysis of the hysteresis effect, firstly, if the level of the intensity of the external shock is activated under the connection strength of the specific risk, whether the network causes changes at which levels is analyzed. Inversely if the magnitude of an impact from the outside is reduced at the same speed, it was analyzed whether or not to switch the network to certain levels. In the following cases, it is the result of the hysteresis effect analysis under some scenarios.

< Scenario 1> In the risk above critical threshold assuming the occurrence of a hazard (disaster) (cut-off: 8), even if increasing the connection strength between the risk factors, frequency of risk has not changed significantly. Conversely in the risk below a critical threshold, the frequency of risk has significantly changed relatively (see Figure 6).

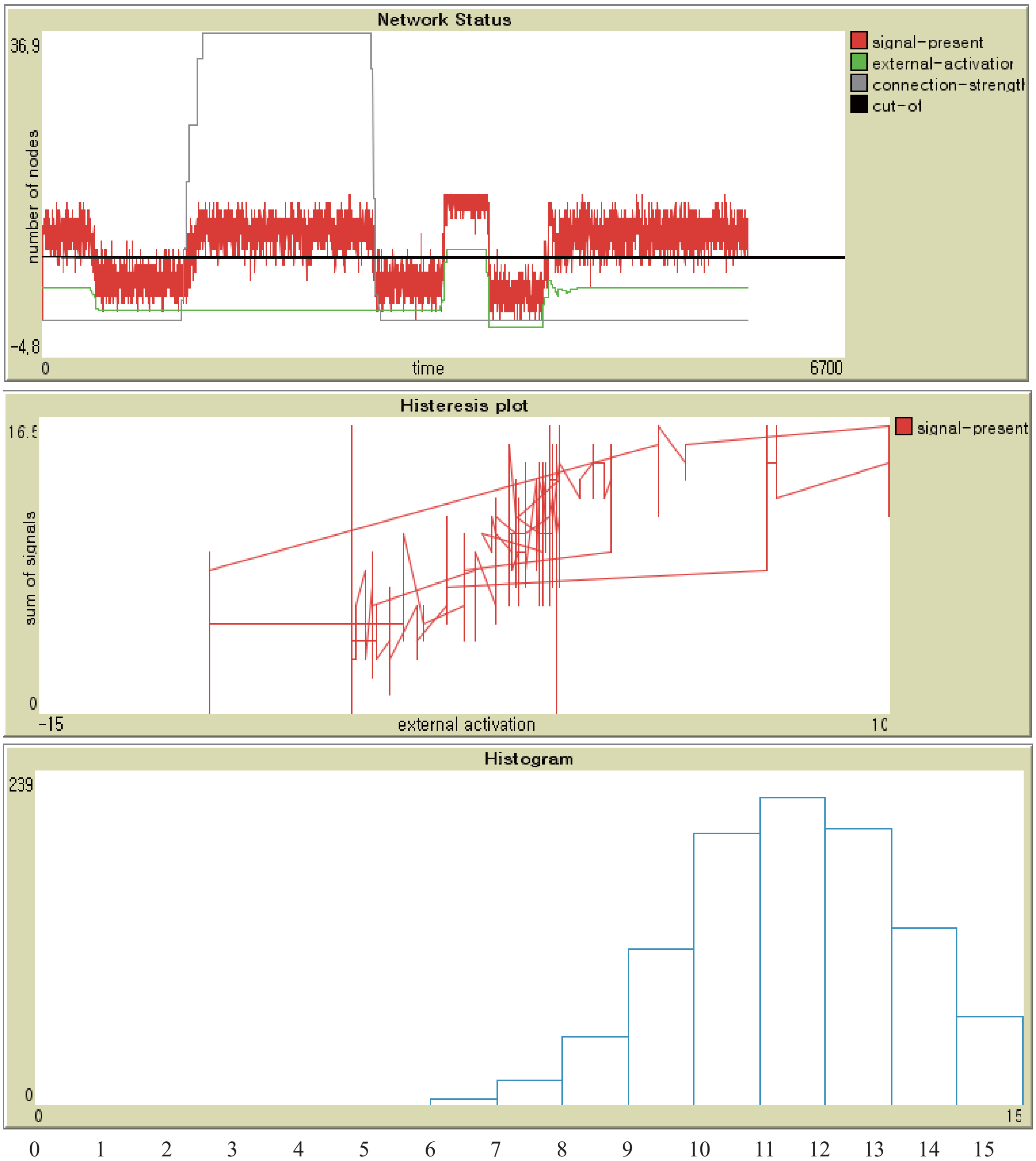

Figure 6. Results of the hysteresis in the case of changing the connection strength between the risks

The results of the simulation according to the “scenario 1” mean that in the case of weak risk, measures that could reduce the frequency of disasters may exist, but the frequency variation is difficult for large risks.

< Scenario 2 > When comparing characteristics between the risk groups according to the impact strength from the outside, if the external impact is weak, high risk groups belong to IN groups (factor 3, 4, 5) in bowtie model(see Figure 7). Conversely, if the external impact is strong, mainly risk groups in the OUT group are enabled (see Figure 8).

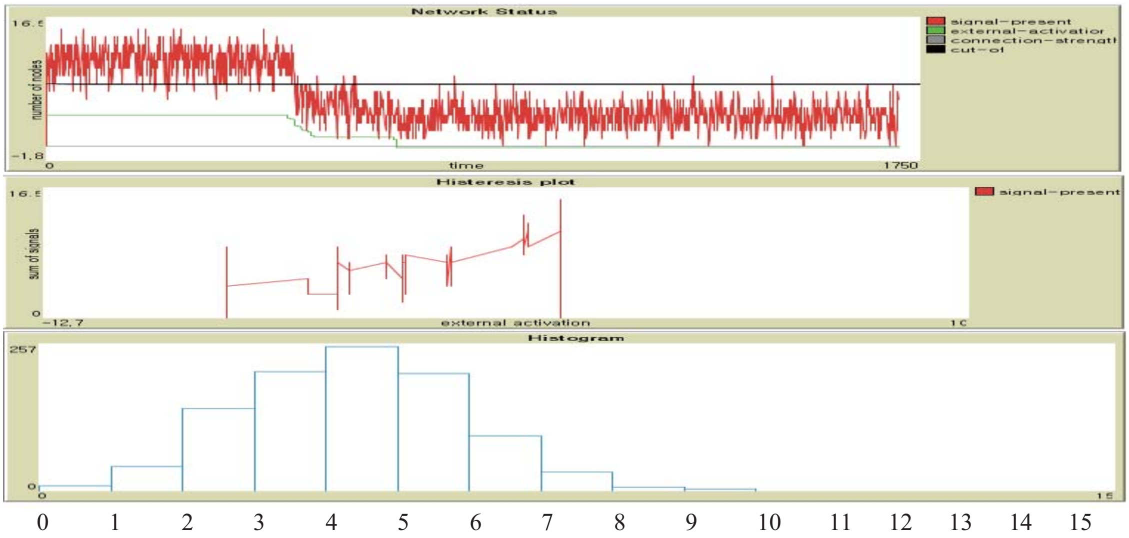

Figure 7. Comparison results between the risk groups according to the impact strength of the external (if the external impact is weak)

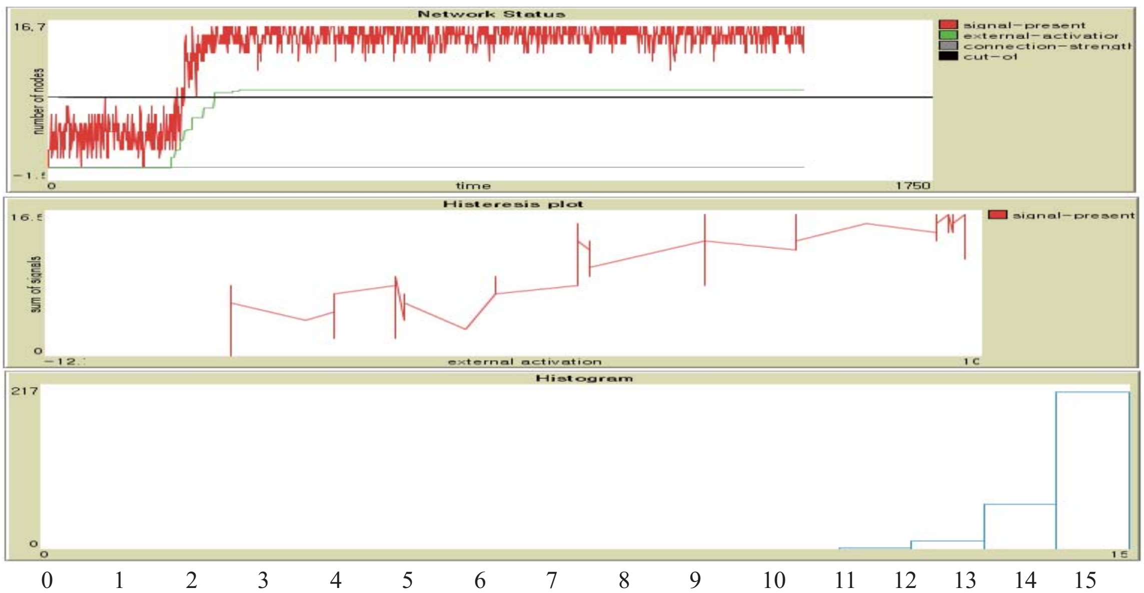

Figure 8. Comparison results between the risk groups according to the impact strength of the external (if the external impact is strong)

The results of the simulation according to the "scenario 2" mean that preventive measures are needed to management a strong external shock hazard. On the other hand, constructions of ex-post infrastructure are needed to management the weak disaster that occurs frequently.

< Scenario 3 > In the results of hysteresis analysis in accordance with the strength of the connections among the risk factors, if the connection strength is weak, the frequency of risk factors is significantly lower in the form of mountain-shaped graph. It is usually found to be led to the 3, 4 and 5 factors in the "IN group" (see Figure 9). Conversely, if the connection strength is strong, the frequency of risk factors has changed smoothly. And it is led by the 9, 10, 11, 12, 13 and 14 factors in the "Tendrils_in" and "Tendrils_out" (see Figure 10).

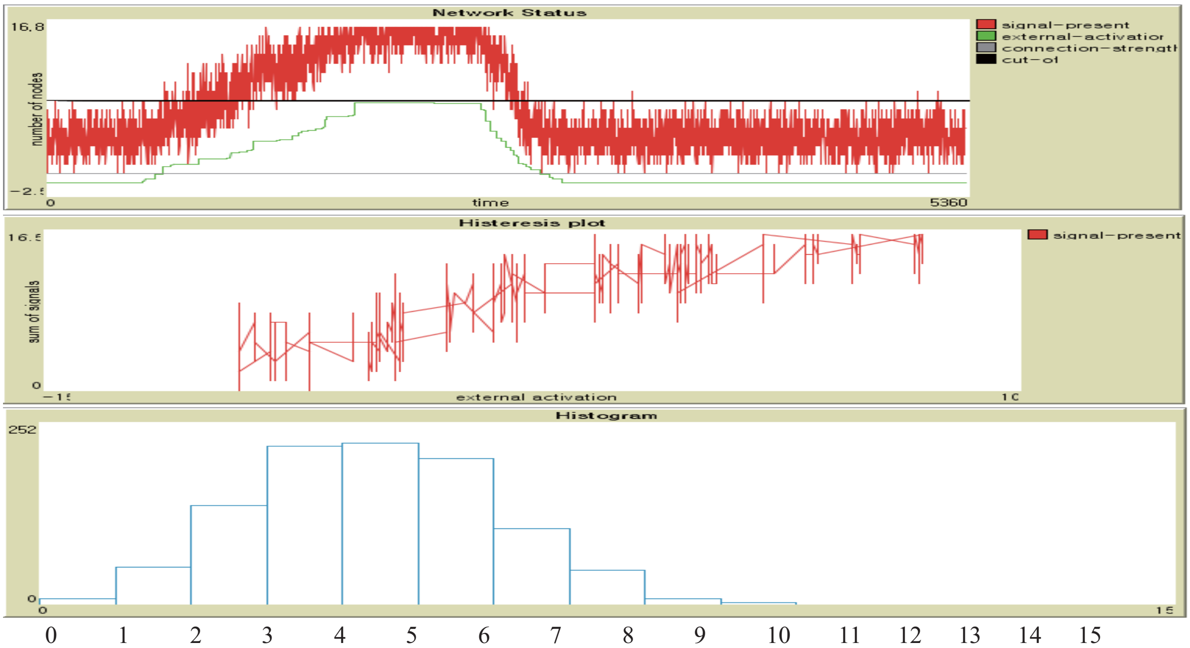

Figure 9. Hysteresis analysis results according to the intensity of connections between the risks (if the connection strength is weak)

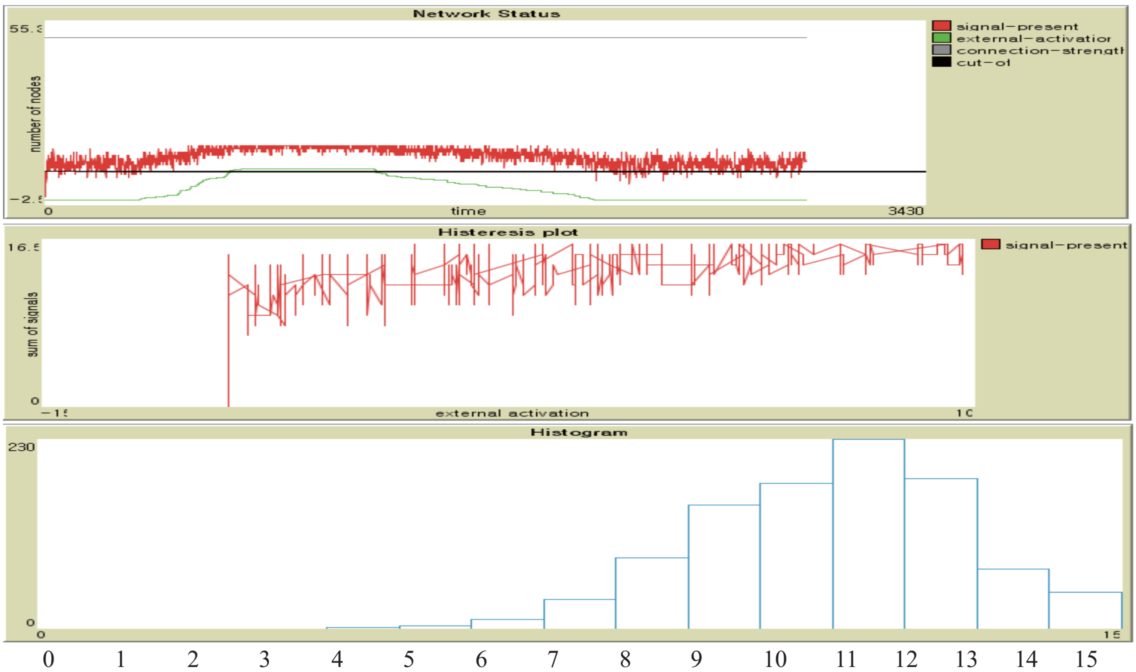

Figure 10. Hysteresis analysis results according to the intensity of connections between the risks (if the connection strength is strong)

The results of the simulation according to the "scenario 3" mean that it is possible to prevent in advance the occurrence of major events through a policy of simplifying the connections between risks.

4. Conclusion and policy recommendations

Based on the results of analyzes, this research concludes with a few policy suggestions. First, the natech (natural-technological) complex disaster management needs to be approached in complex adaptive perspective. Four key policy applied in the bowtie model , based on the analysis results, are as follows (see Figure 11).

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- Strengthening of forecasting for the risk itself
- Requiring cause analysis and preventive measures
- Requiring reduction measures of disaster damage through analyzing impact
- Requiring management of "tendrils group" to reduce a risk and a impact of disaster

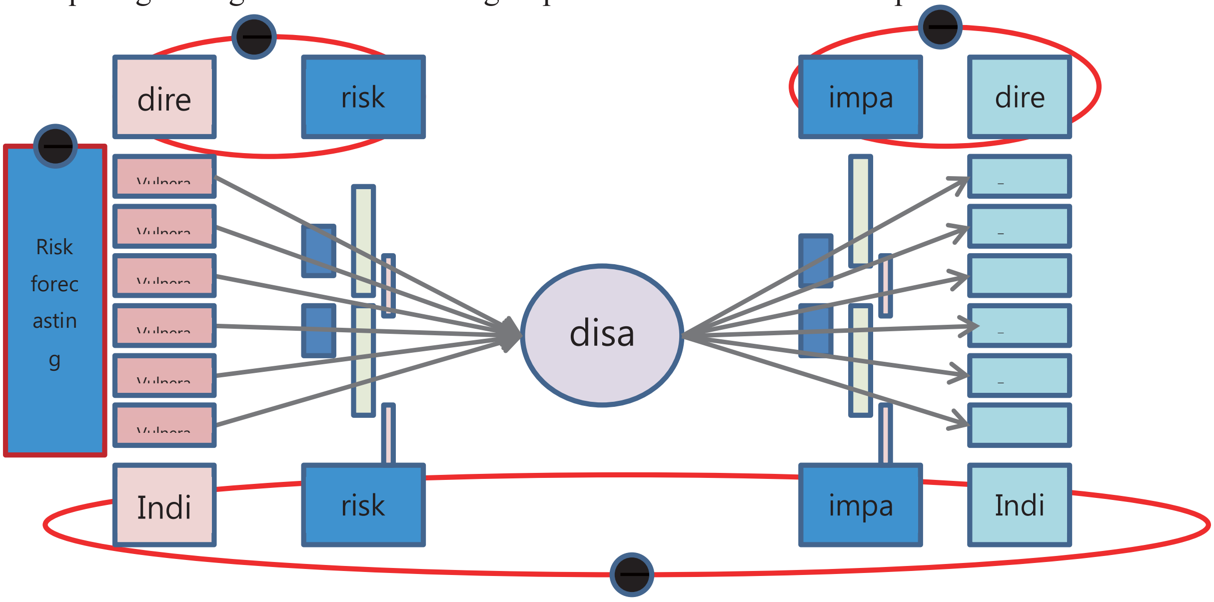

Figure 11. The concepts of disaster management policies applied in the bowtie model

Second, disaster is the outcome of risk, which is a product of physical hazard and human or environmental vulnerability. In the risk relationship, hazards are not hazardous unless they threaten something and people or places are not vulnerable unless something threatens them. By psychological, social network analysis, linking reaction after the disaster, we could cope with the physical disaster similar in the future. Thus, the concepts of hazard and vulnerability cannot be defined independently of one another (Alexander, 2000).

Third, the perception of vulnerability as a "psychological event" implies that disaster has a point of beginning and an end. Therefore, we categorize vulnerability situations regarding the psychological event in focus; before, during and after SCC (Strongly Connected Component) in the bowtie model and determines vulnerability management actions as prevention or mitigation (before), emergency response (during) and long-term rehabilitation and development (after), which together form part of the vulnerability management cycle. When viewed this way, the vulnerability as well as the disaster has periods of onset, development and finally an end.

In conclusion, complex adaptive systems approach to the vulnerability could cause us to change our focus on preparing for the impact of events, and perhaps it should induce us to widen our horizon concerning the dynamics and implications of the natech disaster (see Figure 12).

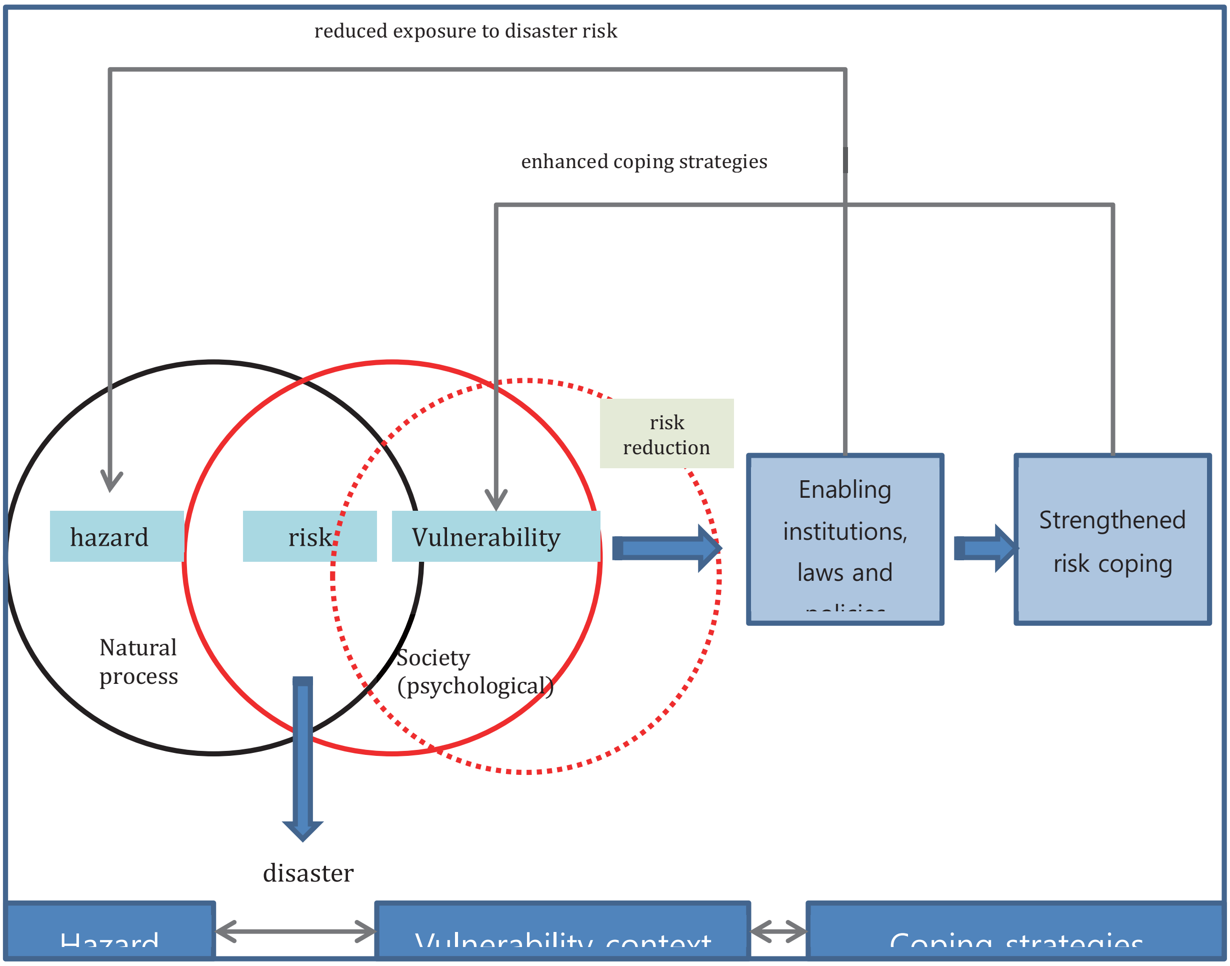

Figure 12. Conceptual framework for sustainable vulnerability management

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http://en.wikipidia.org
http://www.kinds.or.kr

Appendix 1.

The following is social network analysis written by R codes.

```
library(KoNLP)
library(arules)
library(igraph)
library(combinat)
f <-file("c:/rDATA/sewolTitle1.txt", encoding="UTF-8")
fl <-readLines(f)
close(f)
useSejongDic()
#Clean Text
fl = gsub("(RT|via)((?: \ \b \ \W*@ \ \w+)+)","",fl)
fl = gsub("http[^[:blank:]]+", "", fl)
fl = gsub("@ \ \w+", "", fl)
fl = gsub("[ \t] {2, }", "", fl)
fl = gsub("^ \ \s+| \ \s+$", "", fl)
fl <- gsub(' \ \d+', '', fl)
fl = gsub("[[:punct:]]", " ", fl)
mergeUserDic(data.frame(c("????8"," ?Ð?","û????","?ό???","??????"), c("ncn")))
tran <-Map(extractNoun, fl)
tran <-unique(tran)
tran <-sapply(tran, unique)
tran <-sapply(tran, function(x) {Filter(function(y) {nchar(y)<=4&&nchar(y)>1&& is.hangul(y) },x) })
tran <-Filter(function(x) {length(x)>=2 }, tran)
names(tran)<-paste("Tr", 1:length(tran), sep="")
wordtran <-as(tran, "transactions")
#co-occurance table
wordtab <- crossTable(wordtran)
ares <- apriori(wordtran, parameter=list(supp=0.1, conf=0.08))
inspect(ares)
rules <-labels(ares, ruleSep=" ")
rules <-sapply(rules, strsplit, " ", USE.NAMES=F)
rulemat <-do.call("rbind", rules)
ares <- apriori(wordtran, parameter=list(supp=0.05, conf=0.05))
inspect(ares)
rules <- labels(ares, ruleSep="/", setStart="", setEnd="")
rules <- sapply(rules, strsplit, "/", USE.NAMES=F)
rules <- Filter(function(x) {!any(x == "") },rules)
rulemat <- do.call("rbind", rules)
rulequality <- quality(ares)
ruleg <- graph.edgelist(rulemat,directed=F)
ruleg <- graph.edgelist(rulemat[-c(1:16),],directed=F)
plot.igraph(ruleg, vertex.label=V(ruleg)$name, vertex.label.cex=0.5, vertex.size=20,
layout=layout.fruchterman.reingold.grid
```

Developing a Conceptual framework for Knowledge-based Urban Development in Isfahan, Iran

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Abstract

During several years we have witnessed vast economic, social, technological and environmental changes which have influenced patterns of urbanization. Through all these years urban planning has also experienced major reforms. During last two decades, with emergence of knowledge economy it is claimed that the nature of urban development has changed (Knight, 2008), this new notion of development is called knowledge-based urban development. As there is not clear methodology for directing cities development process, this research aims to formulate a conceptual model for cities leadership towards knowledge based urban development. This research will consider the city of Isfahan, Iran as a case study. Finally, a model is proposed according to literature review and using ANP method for analyzing the data gathered from the context. This conceptual model has also prioritized effective factors for KBUD.

Keywords: *KBUD, Knowledge City, Conceptual Model, Isfahan*.

1. Introduction

During the last two decades, a global knowledge-based economy has emerged so called "knowledge economy" which is named variously: "knowledge-based economy", "new knowledge" and "creative economy". In 21st

century, the need for the power of knowledge has reduced the importance of tangible factors and has led to new era in which knowledge dominates (Yigitcanlar, 2011). Moreover, in this new economy, knowledge-based activities, especially creativity as a tacit form of knowledge, has been signified in order to employment and wealth creation and maintaining economic growth and place-making (Friedmann, 2010). Meanwhile, it is claimed that cities have a pivotal role in knowledge economy and the nature of urban development in relation with knowledge sectors needs conditions and environments which differ from commodity-based production (Carrillo, 2004, 2006, 2009; Knight, 1995, 2008; Yigitcanlar, 2007, 2010a,b). This has resulted in an evolving literature that seeks the concept of knowledge-based development in cities as a development approach which goals are creating a place includes economic prosperity, environmental sustainability, a social-spatial order and good governance. This notion has been widely mentioned and accepted especially for competitive cities in knowledge economy (Knight, 1995; Lever, 2001; Yigitcanlar, 2011).

Therefore, it seems that entering knowledge economy to urban arena would have significant consequences for urban planning both practically and theoretically. Although there is consensus among theoreticians and researchers in the field of knowledge-based urban development that the knowledge economy changes the nature of urban development, but there is no precise and clear methodology that clarifies a theoretical framework to lead the development process. It seems that this notion is in the pre-paradigm level and no definite paradigm has been formed. So, still some questions have remained in this field:

- Does this way of development require characteristics and prerequisites in cities or can be adopted in any urban area?
- Which benefits and qualities separate it from the former urban development paradigms?
- What would be the consequences of this notion on the theory and practice of urban planning?

As the notion of KBUD has not been considered much in the field of urban planning in an Iranian context, this paper is going to examine the opportunities and perquisites of Esfahan to act as a knowledge city and also to develop a conceptual model for leading the city towards knowledge-based urban development.

2. Knowledge Economy and Cities

The first delineation of the Knowledge Economy was introduced by the OECD in their 1996 report:" The Knowledge-Based Economy". According to this report, a Knowledge Economy creates, distributes, and uses knowledge to generate value and gives rise to "a network society, where the opportunity and capability to access and join knowledge and learning intensive relations determines the socio-economic position of individuals and firms". Moreover, knowledge and creativity are perceived as the engines of economic growth. In 21th century, the need for knowledge power has reduced the significance of tangible factors and conduced to new era in which knowledge is dominated (Yigitcanalar, 2011). In this new economy, knowledge-based activities, especially creativity has been emphasized as a tacit form of knowledge in order to create employment and wealth, maintaining economic growth and place-making (Friedman, 2010).

In the global knowledge economy, knowledge and information and the social and technological contexts for their creation and communication are now regarded as a solution for economic growth and prosperity (Lever, 2002).The replacement of physical products with intangible forms of production (e.g. information, ideas and knowledge) has significantly increased the role of cities and has led to the formation of knowledge cities (Yigitcanlar, 2010). The reason for this is the city nature that provides a context for knowledge production, supplication and exchange. According to this notion, knowledge cities should be capable to provide a context to promote knowledge production, exchange and innovation (Ergazakis et al., 2004). Therefore, the first linkage between knowledge economy and city is its prominence and position to produce, share, evaluate, renew and update knowledge. Knowledge has always played an important role in economic value creation and has always been in the center of urban development. Nevertheless, only recently knowledge has been recognized as the main factor in leading urban development (Knight, 2008).

3. Knowledge-based development

Historically, knowledge has always been the source of development. Nevertheless, what has been changed is the role of knowledge which has been evolved significantly. Last two decades increasingly witness the importance of knowledge in the development challenges and turnovers. So, the term of "knowledge" has become a prefix in development-related concepts, for example "knowledge economy", "knowledge society", "knowledge citizens", "knowledge-based development", "knowledge city" and so on. Meanwhile, "development" definition (which was economic based), has been expanded to consider social, environmental, political and cultural subjects (Pike et al., in Wang, 2009).

Although there is consensus that the city's knowledge base constitutes the foundation of its future development, but knowledge-based development has been founded on a set of completely different characteristics, which are not only vary by type of culture producing knowledge, but also by place (Knight, 2008).

Carrillo (2002) believes that there are two different perspectives on knowledge-based development; the first is mostly about the increase in the monetary accumulation and productivity based on technology and education. On the other hand, knowledge-based development is known as a dynamic equilibrium between all common value elements in a society namely social-cultural, physical and fiscal ones (Carrillo, 2009). In the current literature on the knowledge-based development the victory is by economic perspectives. Mostly, they see knowledge-based development a powerful strategy for economic growth and post-industrial development of cities and countries to participate in knowledge economy.

4. The evolving process of knowledge-based development

The concept of knowledge based development has not emerged as its current form, but it has been recognized during time and with the evolvement in the concept of “knowledge” and “development”. Carrillo (2004) has studied the relation between and found out that knowledge based development had evolved in three consecutive stages. In the first stage, when knowledge was only an instrument for development, KBD was a method to promote economic growth. In the second stage, when knowledge was recognized as production factor to replace common material capital, KBD improved towards human capital development. Finally, when knowledge deployed for development and included all kinds of knowledge and intellectual capital, KBD transformed to an oriented strategy to social, economic and environmental sustainability in global scale where knowledge society is achievable.

5. Knowledge Based Urban Development and Knowledge Cities

Knowledge based urban development (KBUD) is a term which encompasses a wide range of perspectives on the relation between knowledge, space and place in the context of emerging global debates around knowledge economy and the respective importance of production factors. In its widest level, KBUD indicates this notion that realization of knowledge economy has urban aspects based on place. This will cause significant changes: knowledge based development which has urban aspect; urban development that could be knowledge based or strategies in which knowledge is seen as a symbol, product or process which collecting, harnessing or remembering would have potential advantages in urban scale.

Development changes are widely seen in the changes of development thoughts, theories and approaches . The knowledge based era starts with the success of silicon valley and Cambridge science park in 1970s which has resulted in the aim of urban development with focus on the development of techno poles or industrial parks in order to optimum use of technological resources in 1980s (Castells and Hall, 1994). 1990s witness rapid growth of science and technology parks to promote entrepreneurship and the emergence of "digital cities" as a way to optimize the use of information technology.

With the raise of the idea of knowledge cities emergence in 21st century by Carrillo(2004), many cities all over the world face the promise of predominant changes along with the world progress towards a global information order. In this regard, KBUD was indicated as a mechanism for directing urban development towards knowledge cities.

There is a wide range of definitions that attempt to define knowledge based urban development: KBUD can be considered as an instrument or approach to help to reform and renovate cities towards knowledge cities and their economies to knowledge economy(Yigitcanlar, 2005).Social advantages of KBUD exceed economic growth. On one hand, it is a flexible and special form of urban development realized in a chain of linkages harnessed at local, national and global scales; On the other hand, it is the quality of place and life not only defined by the level of public services(eg. health and education), but also by maintaining and developing cultural, aesthetics and ecological values that gives cities identity and attract or repel knowledge workers. The promise of KBUD is a secure economy in a human context that briefly means smart growth or urban and economic sustainable development (Yigitcanlar and Velibeyoughlu, 2008).

The numerous interpretation of KBUD may be due to insignificant separation between different activity context and increasing porosity of borders between science, knowledge, culture, society, geography and economy (Perry and May, 2010). This has resulted in wide range of inter- and multi- disciplinary manuscripts with different perspectives. From agglomeration, industrial zones, locational theories to increasing concentration on innovative environments, learning regions and economic advantages which has induced to changes from concentration on national innovation systems to regional systems. New ways of knowledge creation have strong local and regional dimensions. Others focus on the relations between science, knowledge and cultural dynamics of city/regions through considering social, cultural and organizational growth needed for economic development at local and regional levels.

6. Knowledge Cities

According to this wide spread of perspectives, various and different definitions have been presented for knowledge cities. The Prominent view on KC believes in evolvement in notions such as “techno-polis” and “idea-polis” toward a more practical, spirituous and sustainable style of urban development. In this perspective the main characteristic of knowledge city is application of local innovation, science and creativity within the urban economic and social texture. In some perspectives, knowledge city is considered an integrated city that has incorporated the functions of a science and technology park with urban and residential functions (Yigitcanlar, 2007).

Edvinsson (2003) describe KC as a city that purposefully has been designated to promote knowledge education and training. Accordingly, it is asserted that in societies that are increasingly get knowledge-based, the nature of urban development changes because the activities in knowledge sector would be more significant and require conditions and environments that differ from those required by commodity production activities (knight, 1995; Yigitcanlar et al., 2007).

Various studies have been performed on current knowledge cities to seek their common qualities. Although they are different in concentration and consideration, but this study has tried to search for similarities and has categorized current notions on KC according to their main characteristics.

6.1. Technology and Networking

So many researchers and scholars that information and communication technologies is a separating factor between developed and under developed countries. Therefore, IT infrastructures provide essential and defining situation for an innovative knowledge cities (Dvir and Pasher, 2004; Ergazakis et al., 2004). Also Maynard (2008), Larsen (1999), Van Winden et al. (2007).

6.2. Culture and Creativity

Some researchers conceptualize knowledge cities by understanding non-material flows and assets (Kunzmann, 2008; Ritter, 2008; Musterd and Gritsai, 2012). Culture and Creativity are dominant factors in creating identity and image of a city and undoubtedly, nowadays it is more probable for urban areas to create new ideas. Knight (1995) also indicates that " knowledge-based development requires strengthening all aspects of cultural foundation of a city". The main reason for emphasizing on culture and society is that places with cultural wealth and consolidation provide external activities and facilities parallel with high-tech industries.

6.3. Human and Social Capital

Educational institutions are effective on creating skills and talents within cities. Universities are considered as innovation engines not only generate skills, but also promote communications and connections among citizens in knowledge precincts (Dvir and Pasher, 2004; Garret Jones, 2007; Perry, 2008; Crossa et al., 2010). Van Winden et al. (2007) demonstrated that evaluation of qualifications, capabilities and academic documents of a knowledge precinct and understanding the immigration movement of knowledge workers will provide criteria for knowledge cities growth and development. It is believed that creative knowledge workers improve the efficiency of local and national economy through providing solutions for problems, all life learning and innovative skills. Human capital is an important element in Florida's(2002) perspective which constitutes the linkage between science, creativity, skills and economic development. Florida's notion of "creative class" asserts that creative people choose their place considering "soft" factors other than just classic "hard" factors.

6.4. Structural and Relational Capital

Knowledge clusters with structural capability for directing innovations and creating new industries, are central places in a knowledge oriented perspective. In other words, there are in a more extensive structure than knowledge production and distribution. Such organizations in knowledge clusters are Universities and colleges, research institutes, state research offices and knowledge-intensive firms (Ever et al., 2010).

Clusters propagation reveals significant insights on the competitive micro economy and role of place in competitive advantage. Although, the aggregation reasons have diminished by globalization, but clusters new influences on the economic competence would be significant (porter, 2002). In some studies, knowledge activities aggregations with the title of "knowledge precincts" are considered as spatial correlations mostly encompass knowledge activities that have linkages with mixed use environments include residential, business, education and entertainment within a semi urban context (Yigitcanlar et al., 2008a; Yigitcanlar and Lonqvist, 2013).

6.5. Innovative Networks and Spatial Communications

Spatial communications provide essential opportunities to communicate and share knowledge in order to create new ideas. More than simple aggregation of economic activities, Gospondiana (2005) considers the role of cultural aggregations in a knowledge city that make them lively and renovate them to cultural hubs.

Consequently, the notion of knowledge city is vague to some extents and several terms have been used to describe to which we can refer as science parks, research parks, techno-polis, innovation centers and science cities. Currently, the concept is developing and evolving to a more practical, lively and sustainable of urban development. According to both Charles and Wray (2008) and Ergazakis et al. (2006) who has investigated the evolving process of knowledge cities although at the beginning these cities were planned and constructed by national Governments to follow fundamental researches. Unlike the first generation, currently KCs are based on coordination and direction through sub-national institutes and organizations participation. These governance networks in sub-national level tend to provide a strategic vision and knowledge city outbreak.

7. Knowledge-based Urban Development Literature Review

According to above mentioned issues, it is revealed that the notion of urban development or reform to "knowledge cities" is widely accepted by scholars and researchers in this field, policy makers and urban practitioners and developers (Carrillo, 2006; Van winden et al., 2007; Knight, 2008; Yigitcanlar et al., 2008b; Ergazakis et al., 2009). Nevertheless, current urban planning and development approaches do not represent a vivid image of planning knowledge-based method. Metaxiotis and Ergazakis (2008) believe that in knowledge economy, urban functions and shape are mostly formed by global market forces rather than urban planning.

In recent years, researchers have begun to concentrate their activities in order to develop frameworks, methodologies, tools, systems and measurements for evolving and developing in the context of knowledge based urban development. Investigating the process of KBUD notion formation has revealed an evolutional trend that has been categorized in three generations. Although we can't draw exact border lines between these categories, but it will help to have a better understanding of the concept evolution process in recent decades.

7.1. KBUD First Generation: Separated and Distinct Contexts

Since the beginning of third millennium, we witness an intense focus of scholars and researchers on the context of KCs and KBUD, that their variation in a short period of time is interesting. During first half of 2000s, several scolars have discussed the concept from different point of view. These studies mostly have a special perspective to the concept and have less attention to its multi-dimensional nature and do not represent a vivid image of how the new development strategies should be formulated to specify the effective use of urban planning mechanism:

Carrillo (2004) represents a theoretical and methodological framework to design, evaluate and measure KCs on the basis of knowledge social capital. Ergazakis et al., (2004) have declared some characteristics and advantages of knowledge cities, principle success factors and also some examples of real life experiences. Gonzalaz Ovalle et al., (2004) provided integrated and organized information related to knowledge cities, region and country innovation. Baqir and Kathawala (2004) have introduced a KC model via creating knowledge homes using futuristic technology building blocks that can help in implementing the concept of virtual Ba to share, manage, and create knowledge. Chen and

Choi (2004) asserted three inter-related process that generate and distribute tacit knowledge to create successful knowledge cities. Garcia (2004) reviews the theoretical background of KCs and KBUD. She asserts that one of the most severe experiences in modeling KC and KBUD is utilization of theoretical variables to measurable equivalent or quantitative criteria. Chatzkel (2004) represents a strategic perspective for better identification of essential elements to create a successful knowledge capital. Dvir and Pasher (2004) investigate the concept of innovation engines (big events, library, museum, university, digital infrastructure, etc.) and their significance for developing knowledge cities. Cheng et al. (2004) provide insights for policy makers in designing or developing global cities through debates about the linkage between knowledge management and knowledge cities growth.

7.2. KBUD Second Generation: Addressing multi-dimensional nature of KBUD

After various prospects were put in KBUD first generation, the related literature witnessed considerable evolvement in the next generation. In this stage of theoretical development, the multi-dimensional nature of Knowledge based urban development has been considered. In this stage of studies, theoreticians mostly have represented their ideas through conceptual models:

Ergazakis et al.(2006) have proposed *KnowCis Model* on the analysis and evaluation of the common characteristics of successful knowledge cities. Its findings are formulated as a framework to design, develop and implementing knowledge cities. Corey and Wilson (2006) have presented *ALERT Model* that is a prescriptive approach and supporting system for local and regional planning practice in global economy and network society.

The *Knowledge-based Urban Development Characteristic Model* by Van winden et al. (2007) introduces seven structural characteristics that make the city adjust with knowledge era essentials. These seven principals include: knowledge base, quality of life, accessibility, urban diversity, urban scale and social equity. Although this model does not provide an instruction for designing knowledge city but represent a framework for analysis.

7.3. KBUD Third Generation: Integrated Models

In this way, KBUD studies are experiencing a kind of convergence which has led to emergence of KBUD third generation. In this phase, that Carrillo (2009) refer to as pre-paradigm stage, there is consensus among theoreticians about four pillars of knowledge based urban development: economic development, social-cultural development, urban development and management.

Knowledge-based urban development analysis model by Yigitcanlar (2008) categorize the requirement of cities have the vision of knowledge based development into four main groups which are society, environment, management and economy. *Knowledge based urban development integrated model* which was represented by Sarimin et al., (2010) added the weight factor to previous model which was neglected before and tried to offer a more integrated and effective model for KBUD.

Comparative analysis of knowledge-based urban development by Yigitcanlar (2010c) has been formulated based on this notion that KBD evaluation in knowledge cities in order to determine the performance of KBD and city ranks and determination of their accessibility criteria to KBD is necessary. This is also essential for making awareness for decision making as it refers to strategic guidelines that help to identify a development that is more sustainable and knowledge-based. Again in this model four pillars of KBUD are: economic, socio-cultural, environmental-urban development. This model also represents 8 criteria and 32 indicators for these four pillars which are chosen based on different factors including measurement ability, analytical appropriateness, comparativeness, location coverage, accessibility to data and inter-relatedness. *Sustainable development Conceptual frame work* by Fernandez-Maldonado and Romein (2010) has special attention to sustainability and mention economic, social and organizational quality development as main benchmark for knowledge based urban development.

8. Theoretical Framework of the Research

Investigating theoretical literature on knowledge based urban development and knowledge city reveals that knowledge based urban development is a development approach which aim is making a place that encompass economic prosperity, environmental sustainability, a social-spatial order and urban good governance. It is accepted that this notion is widely appropriate for competitive cities in knowledge economy (Knight, 1995, 2008; Lever, 2002; Yigitcanlar, 2011, 2013a). This development notion embraces the following prominent qualities:

- Knowledge-based urban development has purposefully been formulated for reasonable economic, social, cultural and environmental development in a sustainable way based on the use of knowledge economy capabilities.
- Clustering thought in knowledge-based development in contrast with industrial policies, not only considers the significance of innovation and competitive advantage at local and regional levels, but also demonstrates this reality that more sections of government have effects on competitiveness.
- In this development notion, there is much attention to human values and social and cultural dimensions. Human capital constitutes an important factor; Moreover, equity and social inclusion are significant qualities in this way of development. Therefore, equal opportunities (public accessibility to knowledge) both for individual development and social development.
- Networking has a considerable position in this notion that provides suitable condition for exchanging knowledge and new knowledge production. These communication networks are not confined to government, scientific, occupational and formal networks, but also include all social and informal networks. Knowledge which is discussed in KBUD is not just technical knowledge and encompasses all kinds of knowledge. Accordingly, continuous and mutual communication among different economic, social, scientific and government departments and consequently, related infrastructure are necessary.
- Knowledge based urban development is a complicated project that needs numerous resources, skills and organizational models. This will require organizational routines and models which are practically flexible enough to adjust with existing terms. Therefore, KBUD creates pervasive influences within organizational structure of local governments. Planning for KBUD is a long and sophisticated process that is not a straight line from beginning to end. Over time, economic, social and political conditions change that would have wide spread consequences for planning process. Therefore, the role of guidance and leadership in development is vital and determinant.

- KBUD realization undoubtedly requires a planning approach which is strategic and based on urban privileges and assets for endogenous development. So the role of planners is to study and identify urban resources and potential qualities in all pillars of KBUD, meanwhile cooperating with other organizations.
- A transition is needed from hierarchical government-based methods with the logic of dominance to governance methods based on networks with the logic of negotiation. As in the age of knowledge economy, the role of local institution in development has been signified, mutual governance both up-down and down-up is essential. Therefore, government structure renewal is required to for coordination and effective knowledge synergy for urban development.
- Although, some specifications like the existence of universities and research centers and scientific, cultural and historical image of the city may be important factors that improve the position of cities in KBUD process, it seems that factors such as quality of life and quality of place which was emphasized by Florida as a pre-condition for development and an effective element in attracting creative class (human capital) are mostly the consequences of development rather that a precondition.
- Therefore, in order to follow knowledge based urban development it is essential to make a connection between knowledge-based economy system and local planning system. Joint proceeding between these two systems in order to benefit from the capabilities of both systems is necessary.

According to these findings the following diagram shows the proposed model for leading knowledge based urban development.

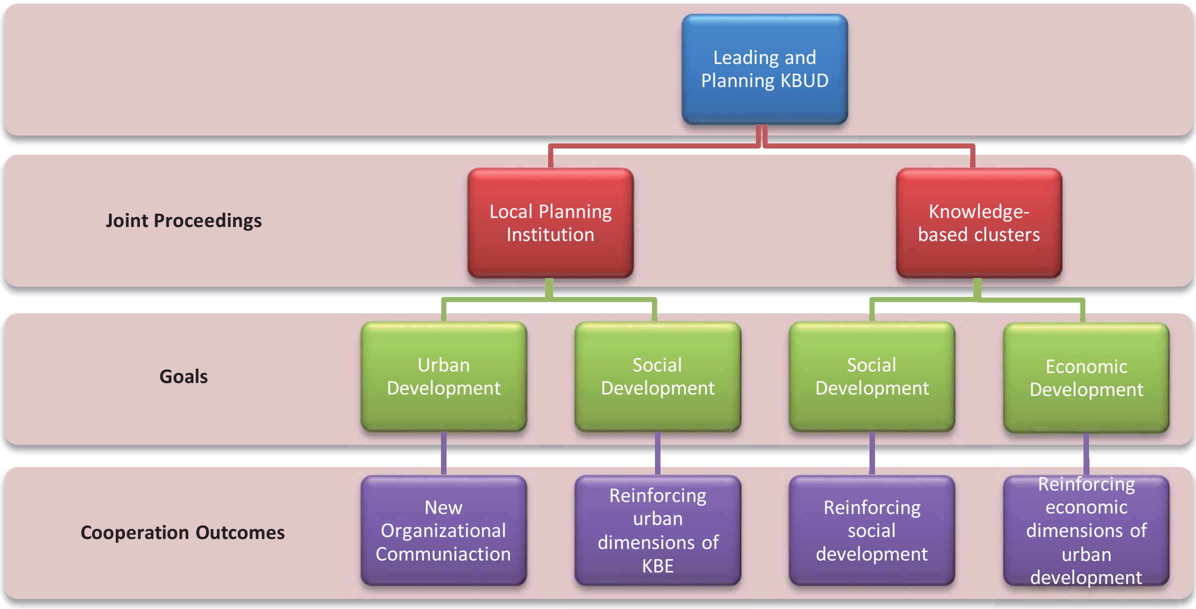

Figure 1- The Proposed Model for Leading KBUD

9. Case Study: Isfahan

9.1. Historical, Scientific and Artistic Background of Isfahan

Geographic position of Isfahan near the river of *Zayandehrood* caused the city become a center of human civilization. The city of Isfahan always has been a major city of Iran through history and in three historical eras it was the political, cultural and civilization center of Iran and in 17th century it became a city with global communications and currently, it is also the interest focus of thousands of international tourists.

One of the honors of Isfahan is its civilization and artistic prosperity. This city has had several architectural artworks before Islam and in Islamic era. This city also has been origin of scientists and intellectuals that have had inevitable impression in different scientific areas, culture and human knowledge. Isfahan is registered as one of the seven historical cities in the world by Unesco.

  

Picture1-40 sotoon, Isfahan **Picture2- 33 pole, Isfahan** **Picture3-Aalighapoo- Isfahan**

Picture4-Imam Mosque

9.2. Knowledge-based Urban Development Pillars in Isfahan

According to the findings from theoretical studies and the formulated theoretical framework for leadership towards knowledge-based development, at first it is essential to investigate urban planning system and knowledge based economic system in Isfahan. According to Iranian planning system, municipalities, as local institutes, are responsible for urban planning. So at first we engage in reviewing Isfahan municipality approach in urban planning and strategic thinking and then Isfahan science and technology town (ISTT) will be introduced as a complex which mission is knowledge-based economic development through supporting innovative firms, promoting entrepreneurship culture, creating science and technology parks and incubators and facilitating knowledge flow among universities, scientific centers, knowledge-based firms and the market.

9.3. Planning system in Isfahan Municipality, the opportunities and constraints

Isfahan municipality is one of few Iranian metropolises which has been able to prepare and execute four physical, cultural and social strategic programs, " Isfahan22+, Isfahan85, Isfahan90 and Isfahan95) rather than conventional master plans. In a concentrated planning system, as Iran is, the most important policies and programs, whether national or local, are determined in country political center. In this condition, local organizations like municipalities have few impressions in governing local affairs and are mostly the implementers of major policies adopted at national level. In such a situation, Isfahan urban managers have intended to make changes in urban planning and management method that demonstrates a positive evolution in urban management thought. On the other hand, inconsistency among different organizations involved in urban management and interference in their responsibilities are serious barriers in urban development.

9.4. Isfahan Science and Technology Town

Science and technology parks in Iran are one of effective social institutes in technology development and consequently knowledge-based economic development. Science and technology parks are appropriate environments for SMEs, industries research and development units and research institutes establishment that are interacting together and with universities. Isfahan science and technology town and incubators founded in 1993 in order to coordinate the scientific and technical capabilities of research, academic and industrial centers in Isfahan.

In 2010, Islamic Development Bank prize went to ISTT. This selection was due to the town's activities in economic development, creating more than 300 knowledge-based firms, registering more than 179 patents, innovations and their commercialization, and continuous and productive relations with industries.

Isfahan has several advantages for broadcasting knowledge economy: the existence of science and technology parks, three premier universities of country, 26 non-profit universities and benefitting 11% of country's researchers.

10. Conceptual Model for Isfahan KBUD

After data acquisition through documentary studies and observations, this research has performed several in-depth interviews with identified informed individuals in both Isfahan municipality and ISTT. From analyzing data achieved through this process and by using the technique of *pattern matching*, which compares the pattern achieved based on experience and the model resulted from theoretical surveys (Yin, 2003), the conceptual model for Isfahan KBUD has been formulated.

According to findings from theoretical framework, effective factors in KBUD are categorized in 4 main pillars of economic development, urban planning and development, social-cultural development, guidance and leadership. In this step, we have attempted to categorize the data achieved through interviews in these four groups and the model has been proposed as follows:

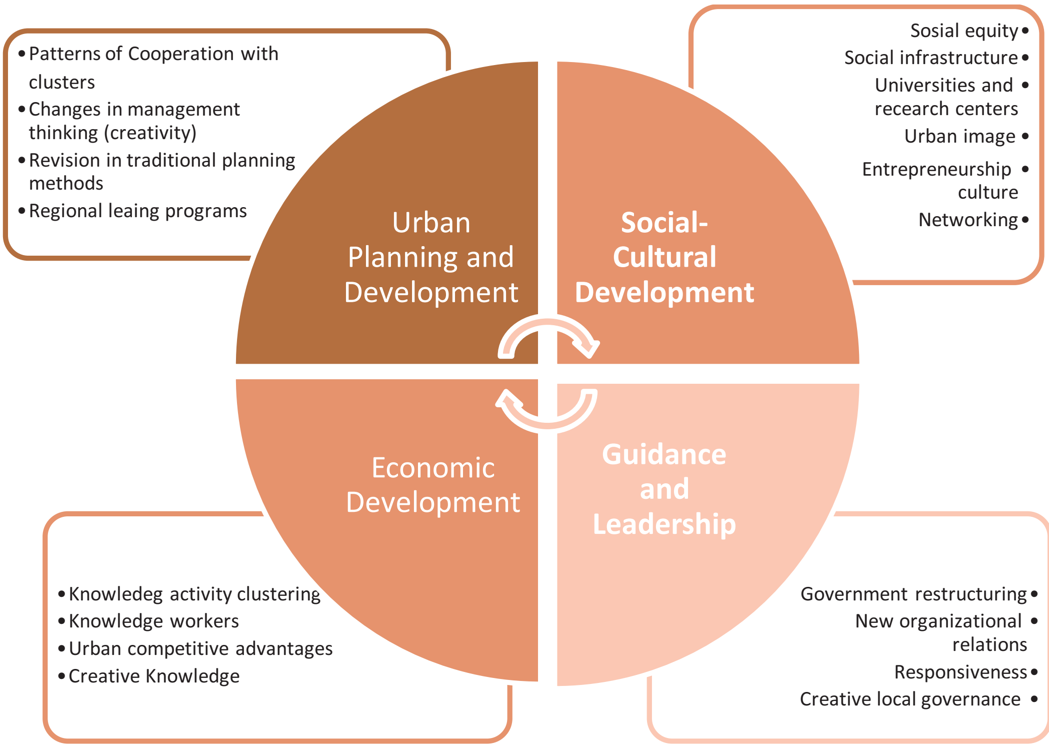

Figure2- Conceptual Model of affective factors on Isfahan Knowledge-based Urban Development

The above pattern is the result of integrating findings from theoretical studies and case studies. Accordingly, the findings from the analysis are as follows:

- In KBUD, none of the development principals are independent and the main point is the balance between all dimensions of development. The inter-relations of development factors are inevitable.
- In social, human and cultural development, factors such as social equity are effective in just distribution of all facilities especially knowledge accessibility. Therefore, social infrastructures, universities and research centers will have an important role. Also citizen's image of the city as a soft dimension is considered. Entrepreneurship culture and creativity is also considered. Networking for knowledge and idea transaction is also of importance.
- In urban planning and development, it is believed that in current situation of increasing complexity, policy system and local planning lack resources (information, skills, capital and legitimacy) to organize the process of KBD. So, participation and aggregation are significant elements in successful knowledge economy. This differ with conventional planning methods, therefore there is a need to make change in urban planners and managers thoughts.

- In economic development, Knowledge workers, Knowledge-based clusters and addressing urban competitive advantages are effective factors of development. Moreover, considering all kind of knowledge, not just technical ones is essential.
- In KE, economic development policy has been transformed from a linear project management to a holistic project in which the nature of leadership has changed and required guidance and participation of different interests. So, creativity in governance, responsiveness, new organizational relations and the essence of government restructuring are important elements in this process.

11. Analyzing the Proposed Model Using *ANP*[1] Method

Currently, in order to either test the reliability of the model or identifying the priorities of different factors in the proposed model, considering its network structure and inter-relation of different factors of the model, *ANP Method* has been used to prioritize the effective factors of development in order to finalize the model formulation. ANP method demonstrates the complex relations between among decision elements through considering the network structure of these items. So, a questionnaire has been designed for comparing every two elements of the model. These questionnaires are filled by all who were interviewed. In order to analyze the achieved data, *Super Decision* software (ver. 2.0.8) has been used. The final importance coefficient of every factor in relation with the goal of knowledge based urban development is achieved as follows:

Criterion	Creative local governance	Government Restructuring	New organization al relations	Responsiven ess	Competitive advantage	Creative knowledge	Clustering	Knowledge workers	Entrepreneur ship culture
coefficient	0.40346	0.28382	0.08815	0.22457	0.14151	0.12934	0.44569	0.28346	0.32278

[1] Analytical Network Process

Criterion	Social equity	Urban Image	Networking	Social Infrastructure	Universities	Cooperation model	Creativity for planners	revision in planning methods	Superior regional plans
Coefficient	0.16736	0.00000	0.10586	0.31424	0.08975	0.38851	0.57917	0.03232	0. 00000

Table1- The Final importance coefficients

According to the results achieved from ANP analysis, two elements of urban image and regional superior plans are eliminated from the model.

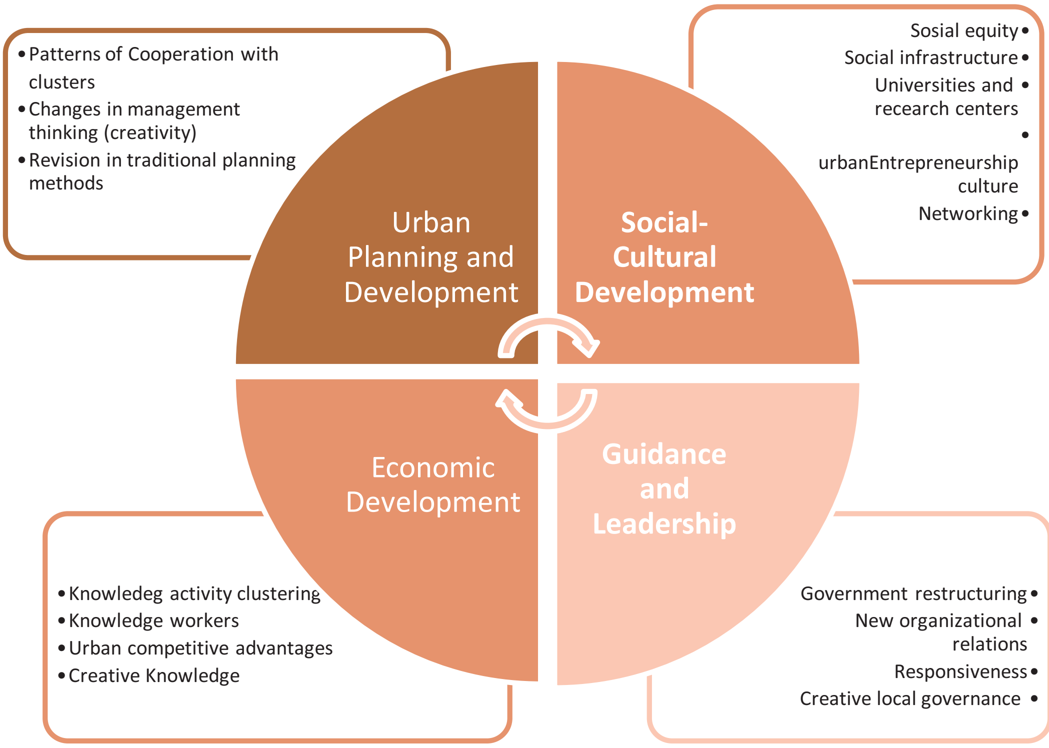

Figure3-The Final Conceptual Model of affective factors on Isfahan Knowledge-based Urban Development

12. Conclusion

According to theoretical studies it has revealed that KBUD have close relationship with sustainable development and smart growth. Besides balanced and sustainable development, what makes it interested for urban planners is the connection it makes between planning theory and practice. Considering human and cultural aspects also got importance during last decades in planning theories. Knowledge based urban development concept is an end to positivist notions in urban planning and opens a new window to urban planners.

KBUD also introduces local and regional layers, as effective factors on competitiveness in KE, that make it possible for planners to get involved in economic issues. Joint proceeding between local knowledge-based system and local planning system will make Isfahan to benefit from knowledge synergies.

The effective factors for KBUD and their priorities are determined through the formulated conceptual model. The results show that the role of local and regional governments in planning is increasing, so government restructuring and creative local governance is essential. Therefore, a wide transition from hierarchical approach to network-based governance is needed.

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Society of Open Innovation Technology, Market & Complexity

June 15 (Monday)

R# : 203 International Conference Hall

Special Session 3

"Start-ups, Open Innovation, and Knowledge City"

■ **Session Chair: ChoongJae Im**(Keimyung University)

- Paper 1: "Open Innovation in Supply Chain Management for Creative Economy" by **Taeho Park (San Jose State University, USA)**
- Paper 2: "The Study on the Innovation of SMEs Affecting on Corporate" by **HyeMi Oh (ChungAng University), WooJin Lee(Kookmin University), ChoongJae Im(Keimyung University)**
- Paper 3: "Study on the effects of open innovation ability to the growth of the company" by **WooJin Lee(Kookmin University), ChoongJae Im(Keimyung University)**
- Paper 4: "Study on the establishment of start-up marketing strategy through social network analysis" by **Byoung-Kug Kim(Keimyung University), ChoongJae Im(Keimyung University)**
- Paper 5: "The cases of open innovation in the Roman era" by **Jeong-Hwan Jeon(Gyeongsang National University) and Sung-Kyu Kim(Gyeongsang National University)**

Open Innovation in SCM for Creative Economy

Taeho Park
(San Jose State University)

Abstract

Since the concept and terms were introduced by Henry Chesbrough, open innovation has been widely spread out in a variety of industries. Open innovation has received increasingly attention by companies which aim for launching innovative products, reducing R&D cost and product introduction cycle, and improving product quality. It has been evolved throughout a supply chain in a company beyond just R&D for product development innovation. This study discusses activities in the supply chain which can be innovated/improved through open innovation, and stakeholders involved in the supply chain who can participate in the open innovation.
iding products and services in open innovation.

The Study on the Innovation of SMEs Affecting on Corporate Innovation(Product/Process/Organization)

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Abstract

In order to respond to rapidly changing environment, the technology and ability of a single corporate is not enough. Therefore recently the open innovation becomes the major topic in relation to the R&D strategy. Accordingly, the various technology departments of ventures and SMEs can take advantage of increasing the opportunity and the open innovation has become more key condition.

In the process of corporate innovation, the advantage of a variety of knowledge appeared a significant effect on the innovation(Laursen and Salter, 2006).
Earlier studies of corporate innovation in product or service that focuses on the studies are mainly, but the corporate innovation is a newly launched service and product innovation, as well as the new systems, policy, programs such as Organizational Innovation and Process Innovation of the various aspects should also included the change(Zaltman, Duncan, and Holbek, 1973; Daft, 1982; Damanpour and Evan, 1984; Damanpour, 1991).

The objective of this study is to examine the impact on the SMEs of the products, organization, process of innovation through Open Innovation.

Study on the effects of open innovation ability to the growth of the company

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Abstract

In the era of the creative economy of the 21st century, corporate innovation process should be innovative on market analysis, feasibility assessment, idea development planning, substantial design and test, production, distribution, marketing, and pre/post service even though corporate innovation process of the 20th century stayed in the development of a simple product.

Open innovation is defined as to utilize inside and outside knowledge with having the purpose of promoting internal innovation, linking outside innovation to inside, and broaden the market.

Thus, depending on the open innovation ability of entrepreneur, entrepreneurial company is intended to be displayed different performance and growth of the company. Open innovation is composed of Inventive Capacity, Absorptive Capacity, Transformative Capacity, Connective Capacity, Innovation Capacity and Descriptive Capacity.
Therefore, in this study we investigated the relationship between entrepreneurs of open innovation ability and corporate growth.

Keywords: open innovation, entrepreneur, innovation, open innovation ability

Study on the establishment of start-up marketing strategy through social network analysis

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Abstract

The success factor of start-up is based on the profitability, marketability, technology excellence, but clear information on trends can provide important implications for the preliminary start-up founders to prepare. Previous research about marketing strategies of start-up is based on most research on traditional marketing techniques and study on language relevant information analysis among humans in social communities was not found.

This study defines the language relevant information in social communities as degree keyword, betweenness keyword, closeness keyword. We identify the nature of the relationship between language based on the extracted language relevant information and propose to establish a useful direction for marketing in start-up companies.

The methodology of this study will be applied to discover the business opportunities by finding the useful information on trend analysis and marketing strategy establishment from start-ups to a variety of businesses category.

The cases of open innovation in the Roman era

Jeong-Hwan Jeon* and Sung-Kyu Kim**

As a result of the open innovation dissemination, the necessity of open innovation is being magnified in the theory of national innovation. Nevertheless, research on the relationship between the open innovation and national innovation system is insufficient so far. Therefore, this research aims to grasp the relationship between the open innovation and national innovation system by analyzing the Roman era. We discovered and analyzed the case of Roman era such as In-sourcing, Collaboration, Purchasing and Opening type among the several type of open innovation. We expect that this research can help the establishment of future national innovation policy.

June 15 (Monday)

R# : 203 International Conference Hall

General Session 1

"Creative Economy & Open Innovation"

■ **Session Chair: MinHwa Lee**(KAIST)

- Paper 1: "The Platform Business Model and Business Ecosystem: Quality Management and Revenue Structures" by **Junic Kim(University of Manchester, UK)**
- Paper 2: "A Case Study on the Motivational Effects of Platform Systems based Hardware Startup on Open Innovation" by **So-Young Lee, Ph.D.(KCERN), MinHwa Lee(KAIST)**
- Paper 3: "Fintech, the Open Innovation to Unbundling Financial Industry and the Next" by **Myungho Lee(KCERN)**
- Paper 4: "A Study on the Direction of Korea's Open Innovation Technology Market" by **Ae-Sun Kim(KCERN), MinHwa Lee(KAIST)**
- Paper 5: "O2O Convergence trend and Gamification that stimulates open innovation: Focused on crowd souring" by **Kyungju Choi(KCERN), MinHwa Lee(KAIST)**

The Platform Business Model and Business Ecosystem
: Quality Management and Revenue Structures

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Manchester Institute of Innovation Research, Manchester Business School,
University of Manchester, Manchester, United Kingdom

Abstract

A platform is a two-sided market. It is an environment established to allow multiple groups such as suppliers and consumers to participate in order to exchange the values that each group desires to obtain through fair transactions. On that account, it evolves through the connection and interaction of platform participants, and it has the intention of being an ecosystem of coexistence that can provide new values and benefits to all participants. Therefore, building the business ecosystem is very important to stabilise the platform business model successfully.

This research indicates how to complete the business ecosystem through the analysing the quality management and revenue structure, which are core elements in the platform business model having a distinct group of users on both sides. Through 21 strong case studies with 30 in-depth interviews and 2 strong focus group interviews, this research suggests the 12 different types of quality management and revenue structure strategies and triple helix formation. These will serve as the conceptual framework to build the platform business model ecosystem.

Keywords: platform business model, business ecosystem, quality management, and revenue structure

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1. Introduction

The term 'Platform' is referred by industrial managers and researchers in various industries, especially in ICT business industries. The reasons are that platform strategy creates value in various ways through the interactions between two or more different affiliated users due to the 'two-sided market', and it is likely to continue to grow consistently (Evans et al., 2006). It emerges as a new potent organisational strategy for innovation and business transactions in a number of industries. Thus, the platform whose nature can be characterized by these two keywords "two-sided market" and "network" has become the most important keyword of today's market that can also be called the network era built with Internet and mobile network. That is to say, the platform is emerging as an essential element in determining the competitiveness of corporate ecosystem. On this account, some people began to define the platform as "the collection of solutions by the access channels or interfaces related to the problems that the entities belonging to an ecosystem" in relation to business ecosystem (Iansiti and Levien, 2004)

However after completing the two-sided market, most of the platform providers confront strong problems to continue their business in the market. The reasons are that in order to stabilise the platform business model successfully, building the business ecosystem is very crucial. In today's business world, the competition over business ecosystem is fiercer than ever. The complexity of goods and services is on the rise. Also, the network effect between producers and consumers is growing. As a result, the competitive landscape is moving toward competition between corporate ecosystems from competition between corporations. Network effect refers to a phenomenon that the more suppliers who supply a particular product, the more valuable this particular product is to each consumer and also that the more consumers who use a particular product, the more valuable this particular product is to each supplier. When a network effect is present, the collective competitiveness of all companies participating in the supply of relevant products is more important than the competitiveness of each individual company.

Therefore, after choosing the platform business, building two-sided market, and igniting the network effect, business ecosystem based on platform business shall be lastly completed. According to the Oxford Dictionary, ecosystem is 'a biological community of interacting organisms and their physical environment.' In other words, it is the 'ecosystem' of organisms living in the same place and interacting with others while establishing the independent system. As such a concept of the ecosystem was applied to various fields; the term of business ecosystem was created (Moore, 1993). Moore (1993) defined the business ecosystem as the network of interdependent existences when economic subjects configure the self-conscious groups where their managerial activities of business ecosystem largely depend on the destiny of the entire group. Iansiti and Levien (2004) defined the business ecosystem as the network of companies influencing on the provision of value for each individual company and also influenced by them such as suppliers and producers of the related products and services, technical suppliers, distributors, and outsourcing companies. Peltoniemi (2006) defined the business ecosystem as the heuristic group that many of the behaviours maintain the interdependent connection and take an interdependent attitude for survival and domination in the market. At last, business ecosystem is a system that platform providers, value suppliers, and consumers interact with one another through the means of platform (Simon and Joel, 2011).

Therefore, platform will fail if participants do not continuously support it even if it has already been established in the market. And, it is needed to establish business ecosystem for win-win of all the participants in platform business by building profit models and continuous quality management, which are core elements of the platform business model having a distinct groups of users on both sides. Apple has succeeded to establish ecosystem platform through iTunes and AppStore, and Amazon has successfully established ecosystem platform in the field of book sales. In addition, eBay has successfully established ecosystem platform in the field of open market platform. Therefore, they were able to continuously grow and expand with leadership in the market. In other words, establishment of business ecosystem is the most important stage for making platform business stable in order for the platform to continuously grow and expand. Therefore, platform providers shall (1) manage the quality of platform considering whether to improve loyalty of participants or (2) how to deal with profit models for participants and platform to grow at the same time. Therefore, this research is designed to support the platform companies to complete the business ecosystem from the two-sided market.

2. Literature Reviews

2.1. The importance of Platform Business Model

Platform business has become the leaders of various areas including open markets, operating systems, social networks, and transaction systems. Evans and Schmalensee (2007) pointed out that platforms have not only a definitive role in the ICT industry, but also in other industries such as media, finance, and distribution. Gawer and Cusumano (2002), Cusumano and Gawer (2002), Evans et al. (2006), Eisenmann et al. (2006), and Eisenmann et al. (2008) also proposed strategies to utilise platforms to take the lead in industries. In particular, a new research theory called *Two-sided Markets* has been introduced in industrial economics (Rochet and Tirole, 2003; Caillaud and Jullien, 2003; Roson, 2005; Armstrong, 2006). The platform also provides an essential, or 'core' function to an encompassing system of use. It is the set of components and rules engaged in most user transactions (Boudreau and Hagiu, 2009). Components consist of hardware, software, and service modules, along with an architecture used how they fit together (Henderson and Clark, 1990). Rules are employed to manage platform participants' activities (Baldwin and Woodard, 2009). And it needs 'network effect', which tend to radically strengthen advantages of platform itself as well as participants (Evans et al., 2006). Also, a platform typically emerges in the context of modular industries (Baldwin and Woodard, 2009) or industry ecosystems (Iansiti and Levien, 2004) in order to generate revenue and to continue growth. Therefore, the platform has emerged as a new, potent organisational strategy for innovation and business transactions in a number of industries. For these reasons, platform innovation has become the best strategy by which to achieve a sustainable revenue source, particularly in the ICT and mobile industries. Many significant cases exist. Having adopted a platform business model, Apple, Amazon, Facebook, Twitter and Google became the most wealthy technology corporates in the world. These companies knew how and where their platforms were supplied to the market. Regardless of the size of the companies, platform providers build a transaction place and provide various contents and services, for personal computers, mobiles, tablet PCs, and other electronic devices (Gawer and Cusumano, 2013).

2.2. Business Ecosystem

Business ecosystem is very important for the platform providers. Evans, Schmalensee, and Hagju asserted that platforms in the ICT industry are at the centre of a business ecosystem (Evans et al., 2006), and after the construction of the business ecosystem, innovation occurs on the platform. Gawer and Cusumano (2013) said that platform develop the complementary innovations through the business ecosystem. Then, what is the business ecosystem? According to Moore (1993), business ecosystem is that "an economic community supported by a foundation of interacting organizations and individuals—the organisms of the business world". In other words, Moore provides a definition of a "competition ecosystem"; the key logic of the business ecosystem is the study of the reciprocal relationships among companies and the surrounding business environment, such as the biological environment (Han et al., 2007). The ecological perspective does not view the economy as a machine; on the contrary, it argues that the market economy is best understood as a living, evolving ecosystem (Rothschild, 2004). The notion of the ecosystem, emerging from the biological concept, began to be adopted in the disciplines of Business and Social Sciences fields in the 1980s (Kilduff and Tsai, 2003; Schwab et al., 2007) and it emerged as a key business concept for startups and venture companies in particular. According to Townsend (2009), "business ecology" is the relationship between a business and its environment. The crucial goal of business ecology is consistency through the ecological synchronisation and business combination under the sites that it uses and affects (Townsend, 2006). In a business ecosystem, companies occupy the correct position, just as ecological species do within a natural ecosystem, and various stakeholders of the ecosystem evolve and then tend to align themselves (Gobble, 2014). From the literature review in this study, especially I found that business ecosystem is core strategy to do successful business for platform providers which completed two-sided market model, although revenue structure (Nachira et al., 2007; Teece, 2010; Amit et al., 2012) and quality management (Riedl et al., 2009; Boudreau and Hagiu, 2009; Hagiu, 2009) are crucial factors to build and retain the business ecosystem. Firms seek to adopt a platform business model in order to encourage continuous innovative development of complementary products.

2.3. Literature Gaps

1. Majority of the studies on platform business have tended to focus on building the two-sided or multi-sided markets, not business ecosystem after building two-sided market.
2. A lack of platform studies has focussed on the revenue structure and quality management in the platform business model and its business ecosystem

3. Methodology

This study selected case studies as a detailed research strategy, which includes documentation, archival records, observations and in-depth interviews with subjects who are familiar with the strategy of the case study company, such as industry experts, corporate managers and consultants. There are two main reasons for choosing the case study as the main research methodology: (1) the research aim, and (2) the volume of research data. According to Yin (2009), a case study is a research method used to investigate real-life and contemporary events using multiple data sources. Hartley (2004), states that the aim of a case study is to provide an analysis of the context and processes that illuminate the theoretical issues that are being studied. In addition, the appropriateness of adopting a case study approach depends on the nature of the research, which is derived from the research problem and the objective (Ghauri and Grønhaug, 2005). As the aim of this study is to obtain a deeper understanding of the quality management and revenue structures of platform business to build the business ecosystem, it was felt that the case study research methodology would be valuable as it would provide more than simple explanations. Furthermore, because this research covers a large number of variables and different aspects of a business phenomenon, case study research is valuable in developing and refining the research concept (Cavaye, 1996). Hartley (2004) indicates that the case study methodology is particularly appropriate for research questions that require a detailed understanding of organisational processes in business because of the rich data collected in that context. This research provides rich details of the impacts platform business has had on the industry. To deal with the research purposes, a case study of the platform-based ICT firms as well as the relevant institutions and organisations hase been chosen.

3.1. Research Questions

The aim is to explore the complicated factors surrounding the central phenomenon and propose various points of view perspectives or meanings that research participants and companies hold. In qualitative research, the intent is to explore the complex set of factors surrounding the central phenomenon and present the varied perspectives or meanings that research participants have. That is, in this thesis, I present the research questions corresponding with the emerging qualitative methodology, as a general issue in order to not limit the research inquiry (Creswell, 2013). Each central question involves associated sub-questions, which enable to become specific questions used during case study research. Huberman and Miles (2002) recommend that researchers write no more than a dozen qualitative research questions including both central and sub-questions (Table 1).

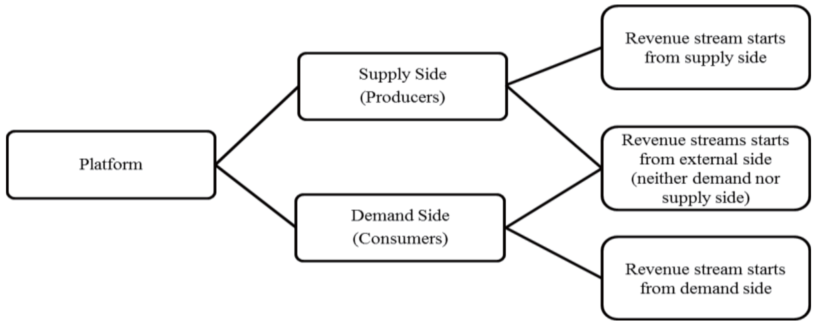
<Table 1> A central research question and sub-research questions

Central Question ***How to complete the business ecosystem through analysing the quality management and revenue structure?***
Sub-Question 1 *How to design the quality valuation basis and control the quality management of the platform business model?* **Sub-Question 2** *How are revenue structures composed in the platform business model and how to design the revenue model?*

3.2. Theoretical Propositions

Research theoretical propositions let a researcher understand what data to focus on and which to ignore. Furthermore, theoretical propositions configure the overall framework of the entire case study and influence to derive the explanation as an alternative. Thus theoretical propositions explain the cause-and-effect relationship and answer the questions of ‘how’ and ‘why’, thus leading the overall direction of case analysis studies. Therefore, propositions were derived in this study according to the above central question and each of the sub-questions before proceeding with the case. This study is based on the theoretical propositions (see Table 2) under the aforementioned research questions.

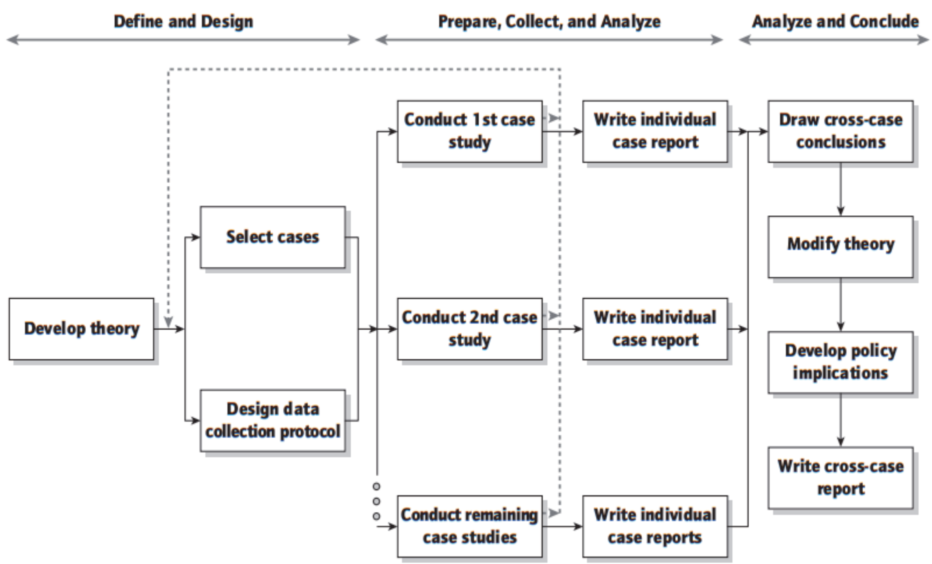
<Table 2> A central proposition and sub-propositions

Central Proposition ***According to the unique nature of platform business model and business ecosystem, the quality management and revenue structure are crucial factors to build the business ecosystem.***
Sub-Proposition 1 *The quality valuation basis might consist of regulation time and quality certification.* **Sub-Proposition 2** *According to unique nature of the two-sided market, there might be three different types of revenue strategy in platform business model (see Figure 1).* <Figure 1> Three types of revenue model in platform business model, according to the direction of revenue streams. 

4. Research Design: Multiple-Case Study

This study aims to conduct an analysis by using multiple-case design among various types of case studies. It includes two or more cases in the same research with multiple-case design. Multiple case design is on the rise in the recent years (Yin, 2009). The reason for selecting multiple-case design rather than single-case design is that multiple-case design is generally regarded as a more persuasive and elaborate case design than single-case design (Herriott and Firestone, 1983). In particular, the logic of replication occurred in multiple-case design is similar to the one of multiple experiment (Herson and Barlow, 1976) ; thus, it can evolve into an even more solid research. This study was conducted as shown in Figure 2 pursuant to the method of multiple-case design proposed by Yin (2009). As the first step of this study, a theory was developed. The cases were selected and the data were collected in the following step of this study. Then, the reports for each case study were created while performing the case studies. This study aimed to deduct a comprehensive conclusion after comparing all the cases. During this process hereof, the theory was being constantly modified. The policy implementation measures were derived before the comprehensive case study was reported. Lastly, the comprehensive report of the case study was created.

<Figure 2> Case Study Method



Source: Yin (2009)

4.1. Data Collection and Analysis

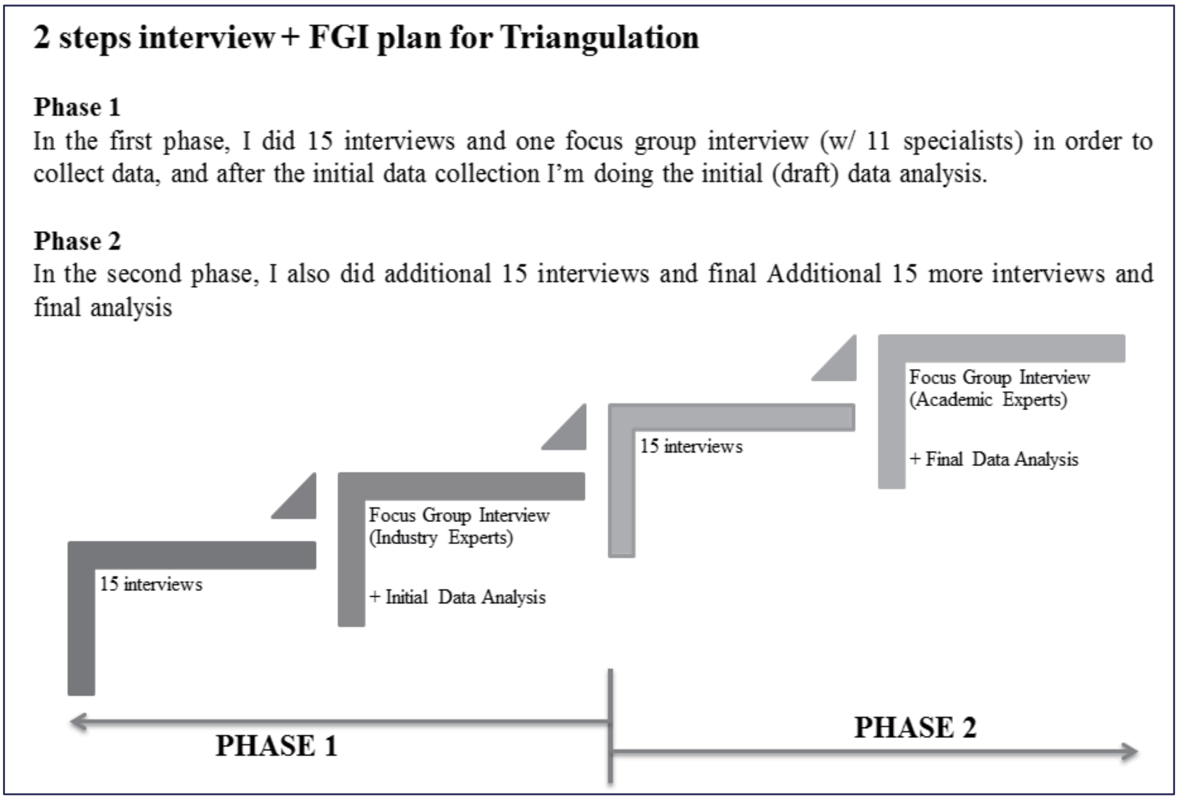
The selection of a sample in a qualitative research is implemented with the intentional and premeditated method known as ‘purposive sampling’. The purpose of selecting a particular research unit is to secure data collection unit that has the highest relevancy with a research theme and also that can provide a rich set of data. In this study, the data collection was performed through the snowball sampling method that selected new data collection unit derived from those already-chosen data collection units. All the data are new in this research. I used documentation and archival records to gather the secondary data and conduct the interviews and focus group interview with industrial managers and business experts from August 2014 to January 2015 in order to gather the primary data. Since the focus of this thesis is on the value chain and platform business strategy with the dynamic approach, I employ a multiple-case approach.

In particular, this study aims to reduce failure by presenting the right guidance to platform companies that are required to build the business ecosystem successfully. Also, this study aims to make public that it will be possible to continue platform business sustainably. In particular, this study analysed platforms from numerous fields. Just to name a few, this study analysed market platforms from companies such as eBay, Google Play, KT App Store, Hyundai Home Shopping and Apple App Store; service platforms from companies such as Samsung Wallet, Daum Map, Nintendo game console, SKT T-Phone, Amazon Kindle, Dell PC, Quirky, Yahoo Answers, Microsoft (Windows and MS Office) and Naver Webtoon; advertising platforms from companies such as Samsung AdHub and Google AdWords; and SNS platforms such as Instagram platform, RecordFarm, YouTube and Blogger. Moreover, the validity of this study was enhanced through in-depth interviews with the corresponding industry experts.

In order to analyse 21 strong case studies, the 60-minute recorded interview was conducted with 30 interviewees. This study also conducted the focus group interviews twice. As for the interview, this study conducted the semi-structured interview in order to comprise various thoughts and opinions of interviewees as much as possible within the research theme. In particular, the interviewees were placed in Phase 1 and Phase 2 with 15 interviewees in each phase for the 30-minute interview. Moreover, the focus group interview was conducted when each phase ended. Thus, the data were analysed in the intervals. Also, the participants of focus group interview were asked to evaluate the interview and share their opinions. This was the strategy leveraged to complement the weaknesses of interview data (see figure 4) proposed by Yin (2009). The purposes thereof were to minimise bias and prevent data loss and also to analyse the data more elaborately through triangulation.

For the first focus group interview, a total of 12 participants were sub-divided into the following four groups: MNE, SME, Research Centre and Venture Capital, each of which had the three participants. For the second focus group interview, its purpose was to review the primary analysis data for the last time based on the secondary data, the interview results with the 30 interviewees and the first focus group interviews. The participants were sub-divided into the two groups: industry and academia. The second focus group interview was conducted based on the outcomes of the first focus group interview. Especially, the four participants of the second focus group interview had a Ph. D. degree (two from Industry and two from Academia) in order to make the outcomes of this study more robust.

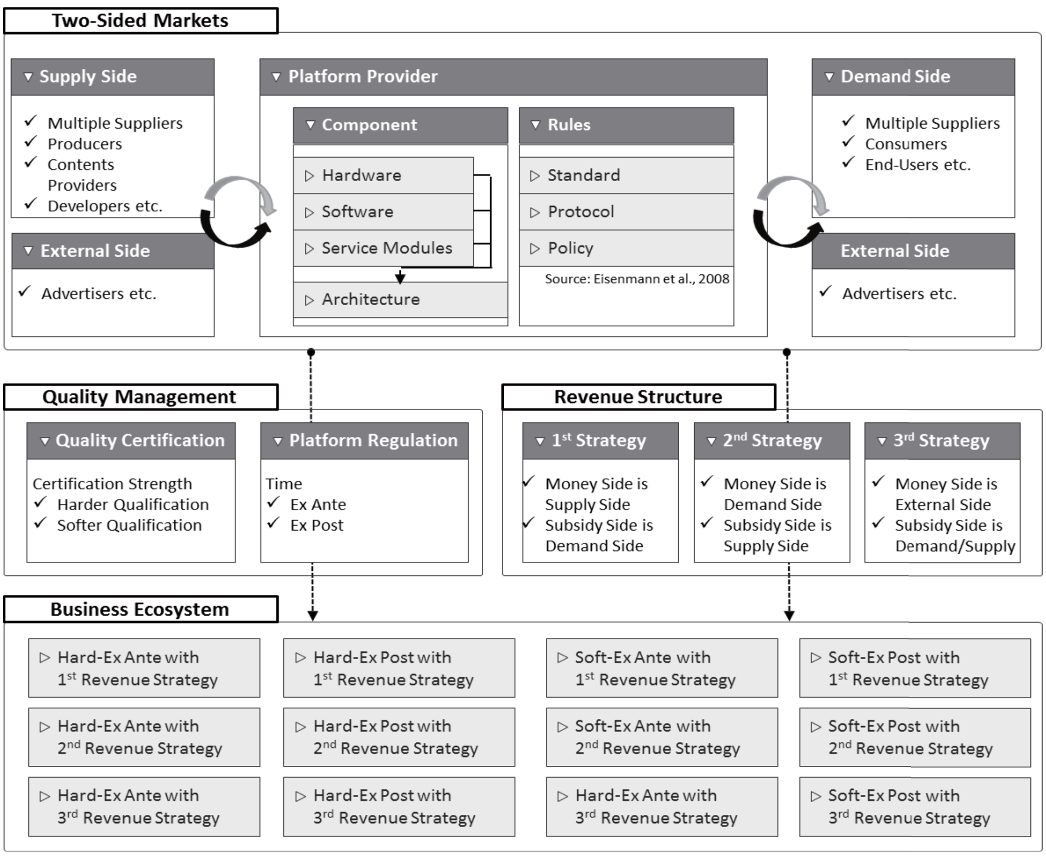
< Figure 3> Two-Step Data Collection Strategy



4.2. Conceptual Framework

Conceptual framework based on logic model is very useful for research investigation related to evaluation and is emphasised with importance of it (Mulroy and Lauber, 2004). Conceptual framework is a heuristic frame of the cause-and-effect relationship that is described in the logical relationship of the concept used when identifying or explaining the conditions or objects or the concept itself and hence creates complicated connection of cases. Cases tend to repeat the pattern of ‘cause-result-cause-result’. This makes dependent variables in the beginning phase as independent variables in the next stage (Rog and Huebner, 1992; Bickman and Peterson, 1990; Peterson and Bickman, 1992). In addition, when conceptual framework is cooperatively developed, advantages of conceptual framework can be maximised. Cooperative development of conceptual framework indicates that program logic model is to be specified through the evaluation of people applying the program and also evaluator (Nesman et al., 2007). This procedure will support for a group to clearly specify the mission and goal and explain how an order of planned behaviours influences on achievement of goals. Hereupon, this was maximised through focus-group interviews in this study.

<Figure 4> Platform Business Model and Business Ecosystem Conceptual Framework



5. Findings

5.1 Platform Quality Management

It is needed to increase the number of participants so that the network effect is to be improved to create powerful platform. For this, it is required to attract more of participants depending on the each type of platform business models in order to critical mass and promoting to use the platform. The issue is that merely increasing the number of participants might cause an increase in the number of unwanted type of participants or opportunistic behaviours of participants that end up degrading the quality of platforms. This is the market for 'lemons' (Akerlof, 1970)[2]. Therefore, if the quality of the platform is degraded, participants of the platform might be disappointed and end up leaving it. Hereupon, platform business ends up failing even if the two-sided market has already been established, and critical mass was reached. Especially, platform business establishing supply side and demand side by participant has a high chance to face the market for 'lemons'. Thus, platform business is required to counteract the effects of quality uncertainty.

'Lemon problem' is easily confirmed in YouTube as the most representative platform business. YouTube, the biggest worldwide video sharing website, is always exposed to the risk of degraded quality. According to the official website of YouTube[3], there are about thousand million users that invest hundreds of millions of hours just to watch video clips from YouTube every day and hence producing billions of views. In addition, 300-hours of video clips are being uploaded per minute, and the time of users watching the video has been increased by 50% compared to the previous year. Among this massive amount of contents, there might be contents that are inappropriate to watch due to an issue of violating the copyrights, excessive violence, or lewd scenes. If failing to filter them out correctly, users and advertisers will end up leaving. Hereupon, YouTube has been trying to solve an issue of degraded quality of platform after initiating to provide the service in 2005.

[2] "The market of lemons relates quality and uncertainty which are institutions of the business market" Akerlof, G. A. (1970) The market for" lemons": Quality uncertainty and the market mechanism. *The quarterly journal of economics*, 488-500.
[3] https://support.google.com/youtube/answer/2797370?hl=en-GB

There are two core issues of quality management of YouTube. First of all, it is a self-filtering. YouTube has developed the innovative copyright protecting system named ‘Content ID[4]’ that can automatically detect illegal video clips that violated copyright. As for operating principles, it uses the unique sound and video signal patterns, in other words; video fingerprint, for all the video clips just like how the criminals are caught by fingerprint investigation. Hereupon, when the video files which a person with copyright wants to protect are uploaded, YouTube detects the video fingerprint and save it on the database[5]. In addition, YouTube filters when the video clips that fingerprint is turned out to be identical, in other words, YouTube filters video clips that violate the copyright by contrasting with video fingerprints uploaded by users on YouTube. Secondly, it is when users filter them directly. Users are able to press flag button when they see the contents that are inappropriate in particular age groups, repellent, or violate copyright reporting them to YouTube. Video clips reported much hereof are reviewed and blocked[6]. Such a self-quality management tends to provide reliability to platform participants, and YouTube is now the biggest media channel in the world after being established 10 years ago. In other words, ‘trust’ is the most important element to solve lemon problem (Akerlof, 1970). This phenomenon is happened not only for YouTube but also for other platform services in common. About 21 cases in this study also figure out the ‘lemon problem’ by providing the ‘trust’ to platform users in both supply and demand sides.

Therefore, it is a required strategy for managing the qualities of platform for providing ‘trust’ to participants in order for platform to grow continuously. Hereupon, ‘platform regulation (Boudreau and Hagiu, 2009)’ as to whether to review ‘ex ante’ or ‘ex post’ of platform and ‘platform quality certification(Hagiu, 2009)’ from the harder certification that limits the participation if particular criterion is not met, or softer certification that consumers select are important for platform quality management.

5.1.1. Platform Regulation: Time

Boudreau and Hagiu (2009) emphasised the regulation in the platform, in other words, ‘platform regulation’ was needed for the platform quality management. They insisted that

[4] https://support.google.com/youtube/answer/2797370?hl=en-GB
[5] http://www.wsj.com/articles/SB118161295626932114
[6] https://www.youtube.com/yt/copyright/en-GB/

platform regulation is divided into the case when managing the control and adjustment of behaviours after the advancement as well as whether platform makes advancement at 'ex ante' or 'ex post' depending on the time for managing platform regulation. As for App Store from Apple, it is possible to register proved applications after internally reviewing them through quality regulation in advance[7]. On the other hand, as for Google Play as a competitor in the mobile application store, when an application is developed and registered by a developer, the relevant application is firstly registered in Google Play evaluating the activities or products that have an issue of copyright after participating in the platform in the future for follow-up management

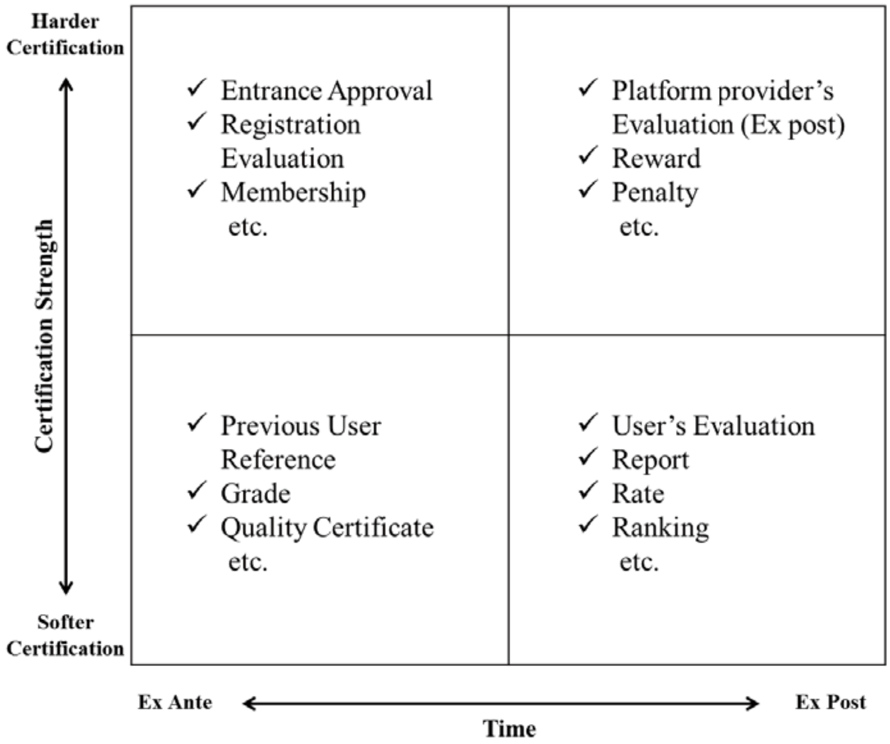
5.1.2. Platform Quality Certification: Certification Strength

Hagiu (2009) tried to solve the quality issue with 'quality certification' in the platform. He suggested 'hard' and 'soft' methods. 'Hard' method is to limit the advancement of platform or activities if a certain criterion is not met, and 'soft' method is to provide information of satisfaction on the products or reliability evaluation making consumers select them. As for Hyundai Home shopping platform, they manage the level of products to be supplied or characteristics of participants by harder certification regarding if sellers have enough stock prior to participating in homes hopping platform, how their previous users' preference was, or if they are competitive in the current market. On the other hand, RecordFarm, the social-audio platform, is proceeding the management with softer certification that evaluates the audios freely uploaded by users and provides the score of them.

Therefore, it is possible to prevent the quality from being degraded through 2 x 2 matrix comprised of 'Hard-Ex Ante', 'Soft-Ex Ante', 'Hard-Ex Pos,,' and 'Soft-Ex Post' by solving the issue of 'the market for lemons' that platform might face (see figure 5). Only one of them can be used according to the situations of platform. However, it is still possible to use them in combination.

[7] Average iOS App Store review times have been within a range of 5-10 days (http://appreviewtimes.com)

<Figure 5> Platform Quality Management



Source: Author's Elaboration based on Hagiu (2007) and Boudreau and Hagiu (2009)

5.2 Revenue Structure

Final goal is to produce profit in any types of business. Platform business is not an exception. Even if the platform is developed and grown, platform business cannot be maintained if profit is not stably produced. Therefore, "The platform leader must create economic incentives for ecosystem members"(Gawer et al., 2012). However, since the growth of platform might be slowed down when creating profits, it is an important but difficult issue to design the profit model from the platform strategy. When setting the price, participants' willingness to pay or expenses of the companies are the core element for platforms to grow.

For this, firstly the platform business holders need to determine who is the money-side and subsidy-side in the platform business (Eisenmann et al., 2006). For this, how much each of the user groups is sensitive with price sensitivity is considered. Money-side comprises platform participants paying for the service and hence is a group that has relatively low price elasticity. On the other hand, subsidy-side comprises users benefited from the platform and hence is a group that has relatively high price elasticity. The reason why the money-side and subsidy-side are important is how they create different indirect network effect, in other words, cross-side network effect. If platform providers are attractive enough to subsidy-side, money-side tends to have a willingness to pay for their access; in this case, cross-side network effect occurs. This is the same in case of vice versa. As there are more of money-sides, subsidy-side tends to be attracted more in platform. Therefore, they more likely participate in it. Therefore, platform companies design the price structure imposed to members and hence make the entire business ecosystem grow continuously while producing profits on their own.

As for money-side, there are three categories. First one is the supply-side. eBay or Nintendo is the representative example of it. As for eBay or Nintendo, demand-side cannot produce profits, and the price sensitivity from supply-side is different. Therefore, money-side in eBay that is supply-side is the seller, and money-side in Nintendo that is demand-side is the purchaser. Most of the purchasers are individuals who pay for the products or services from the supply-side. Therefore, they tend to be very sensitive with additional prices to be paid to platform providers, while sellers are mostly companies and are less sensitive to make an additional payment since they produce profits by selling services or products. Efficiency is created by trading the products or services in the platform. However, supply-side is less sensitive in terms of additional payments on them than demand-side. If imposing commissions on both the sides, only supply-side will participate in it, while demand-side will not. Therefore, balance will eventually be broken by stopping the trade in the platform. Here, demand-side is subsidy-side.

Second one is the demand-side. MS Windows, the PC operation system, is the representative example. As for MS Windows, profit is created not by supply-side but by demand-side that is PC purchasers unlike the first case. If the number of programs is small, PC purchasers tend not to see the value for using MS Windows, and the entire platform will be degraded. Therefore, it is important to acquire various programs and software more than anything else to pre-occupy dominating position at market in the beginning. For this, related programs were acquired by providing SDK and development tool kits of MS Windows to developers for free and also PC purchasers as a subsidy-side based on them. Here, supply-side is subsidy-side.

Lastly, it is external-side. Companies or individuals paying for the expenses instead of supply-side or demand-side are called as external-side(sponsors), and according to Casadesus-Masanell and Zhu (2013), the models deriving profit from them are sponsor-based business model. This model is appropriate when the competition is keen, or to platform providers when both supply side and demand side have high price elasticity. Especially, this model is used when the competition is keen, or for the platform business where supply-side and demand-side are mostly configured by individuals. As for representative examples, there are free applications from KT App Store or Facebook. As for KT App Store, both free application developer (supply side) and end-user (demand side) become subsidy-side, and advertisers are of a money-side that pay for the advertisement in exchange for using platforms and services. Similarly, as for Facebook, SNS users are of subsidy-side, and advertisers are of money-side that provide the advertisement to Facebook and pay for them.

<Figure 6> Pricing Structure Strategies

Pricing Structure	**Money-Side**	**Subsidy-Side**	**Cases**
1st Strategy	Supply Side	Demand Side	eBay, Google Play, KT App store, Hyundai Home shopping, Apple App store, Nintendo game console, Amazon Kindle, Samsung AdHub, Google AdWords, Samsung Wallet, and Quirky
2nd Strategy	Demand Side	Supply Side	MS Windows, MS Office, and Dell PC
3rd Strategy	External Side (Sponsor)	Supply Side Demand Side	Daum Map, SKT T-Phone, Yahoo Answers, Naver Webtoon, Instagram platform, RecordFarm, YouTube, and Blogger

Source: Author's Elaboration

Therefore, it is important to determine the money-side and subsidy-side depending on the price elasticity maintain the balance on both the sides and improve the trade from the platforms. Especially, economic efficiency is created when the cross-network effect is internally applied to the platform in the platform business. Therefore, platform business providers are in need of setting the price structure optimised in customer groups in both the sides and promote the trade. Therefore, establishing the profit structure model is an important strategy for building and promoting the virtuous cycle of business ecosystem.

6. Conclusions

For successful platform business model, it is a core procedure to manage quality of platform through platform quality management and complete the business ecosystem by improving the profit structure through revenue structure. Through this study with 21 case studies, in order to build the successful business ecosystem, it is found that platform companies need to manage the platform quality and make revenue models to distribute the profits with stakeholders in the platform. In particular, on the basis of their business characteristics, they maintain their business ecosystem with 12 different strategies, and they are likely to choose more than one according to their service. Therefore, how to select participants for platform business ecosystem, how to promote activities and improve loyalty of participants, and how to create revenue structure to make platform and participants grow together need to be considered.

First, it is required to control the platform depending on the 'time' and 'regulation' through the platform quality management and solve lemon problems that can occur in the platform business due to imbalance of information for acquiring reliability of participants. Therefore, this study has completed 2 × 2 matrix based on 'Platform Regulation (Boudreau and Hagiu, 2009)' 'Platform Quality Certification (Hagiu, 2009)' and analysed how it was needed to proceed quality management appropriate for each of the platform businesses. Platform providers are in need of confirming whether to manage the adjustment and control in priority on the 'ex ante' or on the 'ex post' and determine whether to develop 'hard' regulation for controlling the advancement of platforms or activities if the certain level of criteria are not met or the 'soft' regulation that consumers are in charge of controlling.

Then, revenue structure in the platform business is important. Hereupon, this study was intended to establish profit structure in the platform through 'Money-side and Subsidy-side' suggested by Eisenmann et al. (2006). Two-sided markets tend to have money-side and subsidy-side co-exist according to the characteristics. Therefore, it is needed to separate 'money-side' users imposing the service usage fee when it is needed to establish revenue structure for acquiring the profit model in the platform and 'subsidy-side' users contributing to improve the platform value. Hereupon, this study has classified the group with relatively low price elasticity into money-side and the ones with higher price relativity into subsidy-side and suggested three major strategies. First one is when the money-side is supply-side. In this case, subsidy-side becomes the demand-side. eBay, Google Play, KT App Store, Hyundai Home Shopping, Apple App Store, Nintendo Game console, Amazon Kindle, Samsung AdHub, Google AdWords, Samsung Wallet and Quirky are the representative examples of it. Second strategy is when money-side is supply-side. In this case, subsidy-side becomes supply side. MS Windows, MS Office and Dell PC are the examples of the second strategy. Third strategy is when money-side is not from supply-side or subsidy-side but from the externa-side (sponsor) just like the sponsor-based business model. In this case, both supply-side and demand-side become subsidy-side. Daum Map, SKT T-Phone, Yahoo Answers, Naver Webtoon, Instagram platform, RecordFarm, YouTube, Blogger and Android's free application are the representative examples.

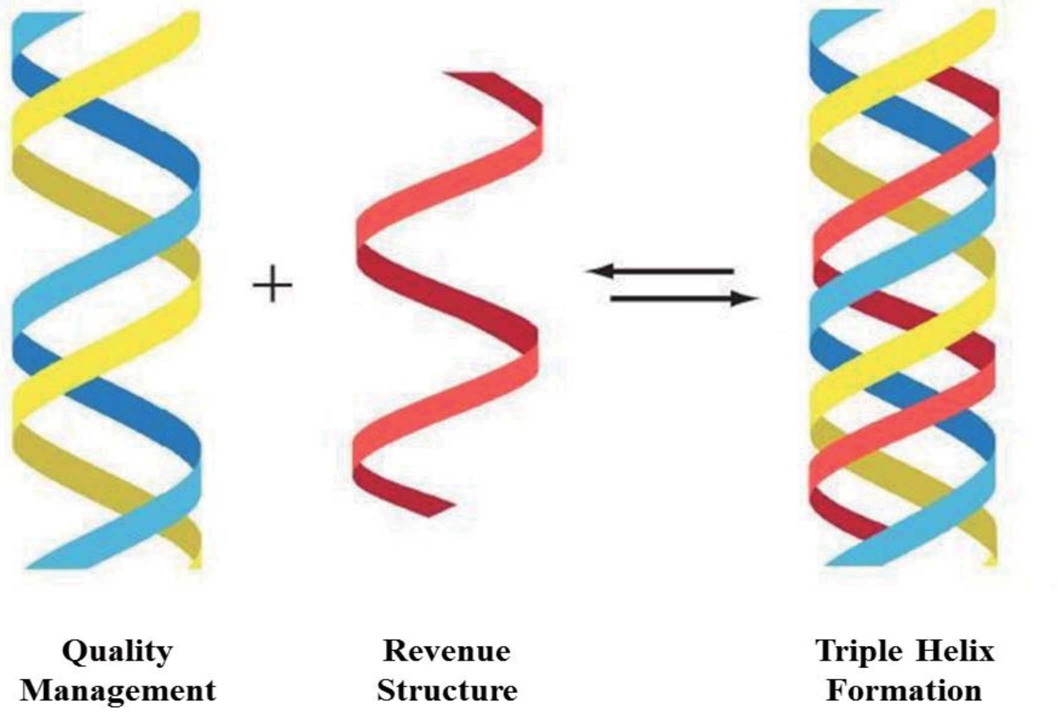
This study well understands how platform providers which completed two-sided market complete the business ecosystem through analysing the quality management and revenue structure. Especially through 21 strong case studies with 30 in-depth interviews and two strong focus group interviews. This research suggests the 12 different types of quality management and revenue structure strategies (see figure 7 and 8). And these will serve as the conceptual framework to build the platform business model ecosystem. This study is expected to be a crucial guidance to platform business companies that will build the business ecosystem how to design the quality valuation basis and control the quality management of the platform business mode as well as how revenue structures are composed in the platform business model and how to design their revenue model.

<Figure 7> 12 Different Types of Quality Management and Revenue Structure Strategies

	Hard-Ex Ante	**Hard-Ex Post**	**Soft-Ex Ante**	**Soft-Ex Post**
1st Pricing Strategy	**Cert. Strength**: Hard **Regulation Time:** Ex Ante **Money Side:** Supply Side	**Cert. Strength:** Hard **Regulation Time:** Ex Post **Money Side:** Supply Side	**Cert. Strength**: Soft **Regulation Time:** Ex Ante **Money Side:** Supply Side	**Cert. Strength**: Soft **Regulation Time:** Ex Ante **Money Side:** Supply Side

2nd Pricing Strategy	**Cert. Strength**: Hard **Regulation Time:** Ex Ante **Money Side:** Demand Side	**Cert. Strength**: Hard **Regulation Time:** Ex Post **Money Side:** Demand Side	**Cert. Strength**: Soft **Regulation Time:** Ex Ante **Money Side:** Demand Side	**Cert. Strength**: Soft **Regulation Time:** Ex Ante **Money Side:** Demand Side
3rd Pricing Strategy	**Cert. Strength**: Hard **Regulation Time:** Ex Ante **Money Side:** External Side	**Cert. Strength**: Hard **Regulation Time:** Ex Post **Money Side:** External Side	**Cert. Strength**: Soft **Regulation Time:** Ex Ante **Money Side:** External Side	**Cert. Strength**: Soft **Regulation Time:** Ex Ante **Money Side:** External Side

<Figure 8> Schematic Representation of the Triple Helix Formation for Business Ecosystem



In the quality management, the platform regulation and quality certification are shown in blue and yellow, respectively. The revenue structure, which have three different strategies, is indicated in red.

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A Case Study on the Motivational Effects of Platform Systems based Hardware Startup on Open Innovation

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Abstract ...

Recent IoT, wearable, virtual reality, 3D printer market and technology trends, such as hardware-based intelligent robots are pouring out with positive prospects alongside the growth of the mobile market. Fifth generation communication and state of the art technology provides new opportunities for startup ventures by lowering the bar for production that was only possible with industry scale R&D, personnel, and manufacturing plants. The introduction of open source hardware and 3D printers offers huge advantages for hardware startups by cutting production costs and time and generating specialized hardware accelerators. These factors allow for business to increase efficiency, utilize two-sided market for consumers and producers, and enter a platform ecosystem that aims to lower costs and spur value creation. This study analyzes factors that amplify the Open Innovation effect in the context of hardware startups and platform systems. Ultimately, this study will become the

bases for an innovative business model that addresses problems of imbalance between increasing R&D investment and price competition.

Key words: Hardware Startup, Platform System, Open Innovation, Business Innovation Model

1. Introduction

In recent days, the competition among products that are based on new technology and price competitive have become more severe. Hence, companies are burdened with increasing investment costs and ever decreasing product life spans. In attempts to relieve themselves of this burden, companies have adopted strategic business models and open innovation. This liberalization of technology innovation in research, development, and commercialization have been applied in the innovative process, reducing the costs of innovation and maximizing value added (Kim, 2014). In other words, in the past companies have benefitted from a closed and vertical innovation. However, due to recent developments in knowledge mobility and exchange, utilizing resources only within the company have become inefficient. The prospects of the internet, formation of venture capital markets, and broad cooperation with external suppliers have made it impossible for companies to solely rely on traditional means of innovation (Chesbroughh, 2003). Due to globalization of IT technologies and innovations, these movements are becoming more active.

So far, IT innovation companies so far have largely referred to themselves as software companies. In particular, because services provided by software startups can be accessed anywhere via the internet, they successfully formed a single market. However, this saturated market is becoming a red ocean due to a large number of companies that provide similar services. On the other side, hardware startups create manufacturing-related jobs and increase the value of related industries. In terms of R&D, hardware companies contribute to the national economy and is becoming a blue ocean.

In the past, a certain scale of R&D personnel and manufacturing facilities were required to compete in the hardware business. However, 5^{th} generation communication technology and recent inventions are providing hardware based startups a new opportunity. With the introduction of open source hardware and 3D printers, manufacturing costs and production time have decreased significantly. Hardware startups leads Open Innovation and will become the bases for innovative business models.

This study will research factors that enhance the innovation effect and propose several implications of domestic hardware startups, focusing on case studies of domestic and foreign hardware startups. These case studies will become the bases for future strategic and innovative business models that will reduce startup costs and provide high quality service design.

2. Literature

2.1 Hardware Startup

2.1.1 Definition and Status of Hardware Startup

The name Startup signifies an economic organization that creates value in uncertain environments and is synonymous to ‘ventures’, the more commonly term used domestically (Kim, 2014).

Table 1: The Definition of startup

Rises(2011)	An organization of people formed to create new products and services in extremely uncertain situations
Steve,B(2012)	A new temporary organization designed to explore possible business models in their product development and market research stage to replicate or expand

Table 2: The various Definition of vanture

USA	Despite high risks, a new enterprise founded on idea or new technology that if successful generates immense profits
Japan	According to ‘Temporary Measures Law on the Promotion of SME creative business activities’, an SME whose R&D investment ratio is greater than 3% of total sales, less than five years after startup
OECD	“A company whose R&D is highly concentrated” or “a company in which technology innovation or technological superiority is paramount”

Source : Kim(2013)

Software startups, which represent the majority of startups, have great advantage in terms of flexibility. Software engineers via programing could realize their ideas comparatively easily. In contrast, it is difficult for hardware startups to see the final product before its production and to change the product once made. The costs of making a prototype is more expensive, and also it is more difficult to manage inventory, A/S, and delivery. For these reasons, hardware based startups have had difficulty finding investors. However these burdens have been relieved or overcome by alternative means such as crowdfunding and venture capital. In addition, crowdfunding has the advantage of connecting with potential customers.

These days, Chinese and other major industrialized countries' hardware startups are growing fast in Silicon Valley. Hardware startups are overwhelming multinational companies with creative ideas, mature products, and new marketing strategies. Several factors contributed to the growth of hardware startups. 3D printing technology significantly lowered market entrance costs. Accelerator programs help startups avoid earlier problems with open source ecosystem, resource, and experience. With IoT and the advent of wearable devices, the M&A market is also rapidly expanding, providing startups diverse exit strategies. After the dot com bubble burst, US software startups exceled in global competition for venture capital funding. However, after 2013, investment towards hardware startups increase by two fold compared to the previous year and is reaching the level of investment towards software startups. Whilst manufacturing employment in the United States is rapidly decreasing because of the financial crisis and plants moving to China, in 2012, as hardware startups gained momentum, employment in the manufacturing sector increase by 65 hundred thousand and this impact is to be expected in other industries as well (Hong, 2014).

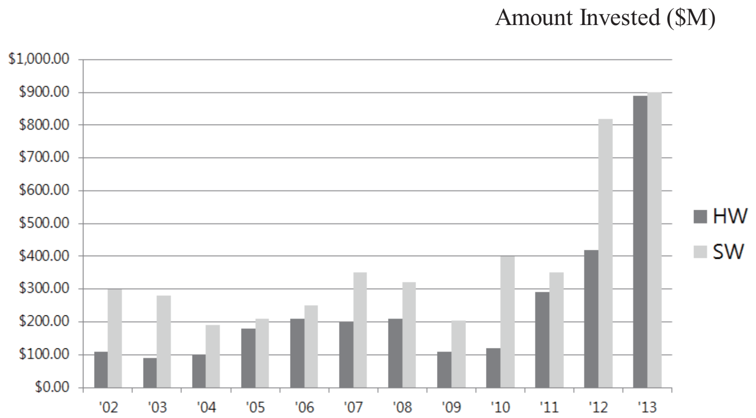


Figure 1: USA HW & SW Startup Investment Trends (Source : KT Digieco, 2014)

China and other advanced developing countries are competing for better manufacturing technology. With the advent of networked IT developments, new process technologies such as 3D printers, and the absence of a dominant manufacturing country, manufacturing based economies are gaining interest in high value products that fuse hardware and software (Lee, 2014). This background has propelled various national support measures such as the US's

“State-of-the-art Manufacturing Methods Strategic Plan“, Germany’s “High-Tech Strategy 2020” and “Industrie 4.0”, and Japan’s “Japanese Industrial Revival Plan”. With even China’s announcement of five key projects of the “2025 China Manufacturing”, hardware startups are expected to take place globally.

2.1.2 The Technology Sector of Hardware Startups

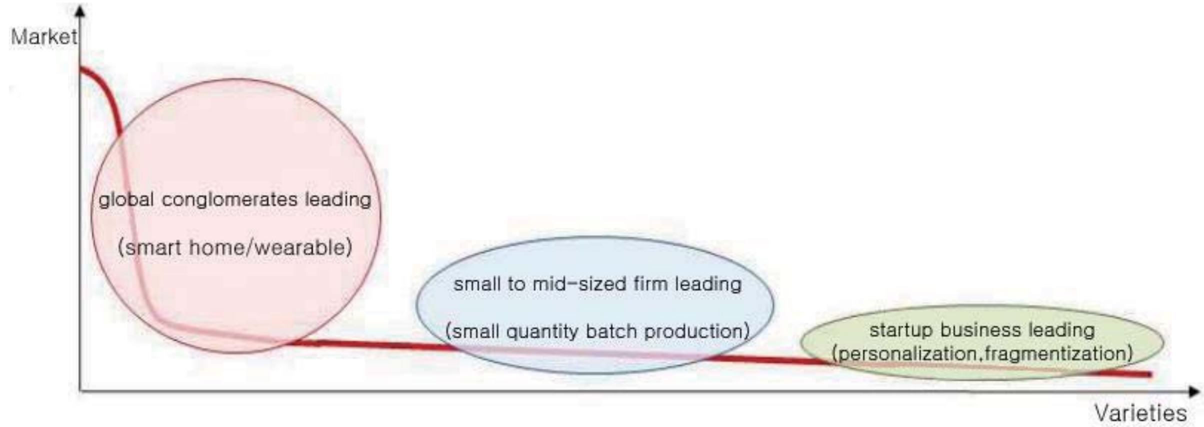
Hardware startups have succeeded with innovative ideas, products, and marketing strategies that overwhelmed even multinational companies. Recent notable hardware startups are making a wide variety of products including smart watches, 3D printers, temperature control devices and fire alarms, set-top boxes, game consoles, action camcorders, headphones, controllers, and power strips (Hong, 2014).

3D printers and open source ecosystem are among other technology based factors that lower the costs of hardware startups. 3D printing works by stacking levels on top of each other. Similar to how a 2D printer works, by dispersing ink, a 3D printer prints a digital version of the 3D product by stacking 2D cross-sections on top of each other. Subtractive manufacturing entails cutting or shearing materials as means of production whereas additive manufacturing entails layering cross-sections such as 3D printers (Oh, 2014). The blueprint technology for 3D printers have been around for 30 years. However, due to patents and extraordinarily high costs, the use of 3D printers have largely been limited to medical and aerospace industries. One reason why this technology is starting to attract attention is the expiration period of 3D printing technology patent. As the patent expired, prices fell, and now even startups are easily able to afford and use 3D printers. Hence, with just an idea and a blueprint, people could make whichever products at relatively low costs (Park, 2014). As the 3D printing technology patent expiration date nears, many products that mimic its function are coming out, and 3D printing is becoming a general-purpose equipment as opposed to strictly a manufacturing one (Lim, 2014). In 2014, Gartner[1] included 3D printing in his presentation in at the World Economic Forum and as one of the top 10 products that will come to dominate the IT trend. 3D printers have been used for medical purposes such as producing a customized artificial skull. It has also been used in the entertainment sector as well to create animation figures and even musical instruments. By reducing the trial and error process, 3D printing minimizes input costs such as raw materials. But more important than production and cost efficiency is that 3D printing may come to replace industry scale

[1] http://www.gartner.com, “Gartner's Top 10 Predictions for 2014 : Plan for a Disrupive, but Constructive, Future”

manufacturing and eventually the 20^{th} century industrial paradigm. 3D printing produces highly personalized products that better satisfy customers' personality and needs, important considerations that are now outweighing merely cheap costs (Oh, 2014). The initial costs for designing a schematic required for hardware production has also reduced thanks to the open source ecosystem. According to Wikipedia, open source refers to a software or open source license that ensures the rights of hardware or software producers while allowing anyone to view/ edit the original code. Recently, open source hardware is receiving attention as a new innovative technology trend following open source software (Yu, 2013). Open source hardware refers to the HW's circuit configuration, materials list, blueprint of circuit board, and other matters necessary for the production of the electronic device that are released to the public. There is no patent license for the production fo the hardware, and all the resources needed for the manufacturing of the product is public. Hence, startups and people utilize their knowledge and ideas to produce new products at affordable prices (Industry Promotion Agency, 2014). The reason why open source software and open content were able to be so rapidly established and spread is that merely making the sources public makes possible for replication. In other words, contents whose sources are revealed can be replicated and distributed free of charge. However, since hardware has shape and form, even if its source is public, there is a cost to replicating the product. Therefore, even people and companies that advocate for open source hardware cannot realistically provide unlimited products for free. Nonetheless, the essence of the product rests on the design, and hardware construction and manufacturing processes can be digitally recorded and distributed. Consequently, the ultimate goal is to share all information regarding open source hardware via open licensing and communication among users. The core benefits of open source hardware are amplified as more knowledge and ideas are shared. The purpose of open source hardware is to disclose the source codes, design, and information in order to develop more innovative products (Yu, 2013).

Meanwhile, IoT and wearable devices are two technologies that are popular among hardware startups. IoT is defined as a smart infrastructure based on communication technology that connects objects to objects and people to objects and facilitates exchange of information (Kang & Kim, 2014). According to BI Intelligence(2015), the IoT market, in particular the B2G, B3B, and B2C markets are going to expand significantly at similar rates simultaneously. Beginning with Cisco's network gears and more recently Intel and Qualcomm's semiconductors are enthusiastically spreading IoT. Various manufacturers including Samsung Electronics and Apple are releasing blueprints and platforms for IoT products. Companies such as Google and Amazon are leading the IoT market with internet and cloud based platforms and diverse technologies and services. IoT combines embedded, mobile, web technology on top of service for users. IoT also often requires the assistance of previous generation industries. Since the development of IoT, various domains and services sprouted, and the market is becoming more personalized and fragmented (Jung, 2015).



Source : Internet of Things Joint Interagency Plan (2014.5.8.)

Figure 2: Market Size and Characteristics of Internet of Things

2.2 The Definition of Platform System

There is no single definition of what a platform is. However, in general, a platform is a comprehensive ecosystem that governs users, customers, venders, and partners in relation to platforms and rules that connect company activities. (Korea Creative Economy Research Network, 2015).

Eisenmann and Parker(2006) defined a platform as the union of component and rule. In other words, a platform is constructed when software components become connected to rules (Kim, 2014). These days, global companies such as Apple and Google lead the ICT ecosystem with platform systems. In particular, platforms are more important in the ICT industry than any other. Accordingly, the importance of platform research is becoming widespread.

2.3 Open Innovation

2.3.1 Background and Definition of Open Innovation

According to Chesbrough(2003), the complexity of future technology is becoming more and more convoluted, and as convergence technology becomes widespread, companies in isolation are facing difficulty adjusting to the rapidly changing market. As a response, companies procured needed technology from outside and shared inside technology to develop new services and products. This was presented as the background for Open Innovation. Open Innovation refers to companies opening their innovation process including research, development, and commercialization to utilize external resources (Jun, 2013).

The background for the emergence of Open Innovation is the diversification of knowledge sources through the increase in capacity of research institutions in terms of knowledge production, the development of venture business, the influx of qualified foreign works, and the emergence of intermediary think tanks. The second background is the limitations of proprietary technologies, the increase in workforce mobility, and the development of venture capital. Third is the increase in technology development costs and reduced product cycle, a sustainability problem that can be overcome with Open Innovation (Kim, 2011).

According to Dahalander(2010), technology purchase, joint research, commissioned research, long-term support agreements, joint ventures, venture capital, acquisitions, crowdsourcing, solutions collusion, user innovation, collective intelligence, M&A, technical asset sales, technology sales, decentralization, public platforms, research consortiums, and the like are all different types of Open Innovation.

2.3.2 Motivation of Open Innovation

Vrande et al(2009) conducted a survey on 605 SMEs based in Netherland and found various factors that motivated open innovation. The findings are organized below in <Table 3>.

Table 3: Motivation of Open Innovation activities from Vrande et al.(2009)

Motivational Effects	Contents
Control	An efficient organizational structure is necessary to control a company's complex processes and increased activities
Focus	It is necessary to focus on a company's business activities to increase appropriateness of core competencies
Innovation Process	To innovate the processes and markets, integrate new technology, and improve product development
Knowledge	Expand knowledge and secure inflow of expertise to a company

Cost	Enhance profitability and efficiency
Capacity	Compensate for the lack of capacity
Market	To adhere to current market position, develop new markets, and identify and satisfy customer needs
Utilization	Optimize employee talent, knowledge, and capacity
Policy	No reluctance towards adopting open innovation as company's philosophy
Motivation	Employee involvement in the innovative process increases motivation and commitment

Source : Vrande et al.(2009)

<Table 4> shows factors that motivate open innovation based on above prior research (Jun, 2013).

Table 4: The Motivational Effects of Open Innovation activity

	Motivational Effects	Contents	Reference
Cost Factors	Reduce development speed and costs	Perform Open Innovation to shorten market entrance time and reduce costs	Vrande et al.(2009) Ahn et al.(2008) Kim(2009)
Knowledge Factors	Excavate new products and services	Develop new products and services for sales expansion. Discover new products and services through ventures, foreign enterprises and joint development, M&A, and licensing partnership	Vrande et al.(2009) Ahn et al.(2008) Kim(2009)
	Existing industries enter maturation and enter new business markets	Explore possible areas for sustainable growth of businesses and market expansion Discover new products and services through ventures, foreign enterprises and joint development, M&A, and licensing partnership	Chesbrough(2003) Vrande et al.(2009) Ahn et al.(2008) Kim(2009)
	Cope with	Adapt to rapid market changes by	Vrande et al.(2009)

	convergence technology Ex. electrical, electronics + IT	joint research and development with industry related organizations, university research institutes, and overseas partnerships	Ahn et al.(2008) Kim(2009)
	Quantitative and qualitative expansion of professional and technical personnel	Joint research and development with industry related organizations, university research institutes, and overseas partnerships in order to acquire knowledge	Vrande et al.(2009) Ahn et al.(2008) Kim(2009)
	Lack of capacity to sustain internal R&D	Open innovation is necessary, for no one industry could satisfy the diverse capabilities that industries need including abundant venture resources and various knowledge	Vrande et al.(2009) Ahn et al.(2008) Kim(2009)
	Consumer participation in idea development is perceived fundamental	Expand knowledge and identify/ satisfy consumer needs via communication and utilization of collective intelligence and user innovation	Vrande et al.(2009) Ahn et al.(2008) Kim(2009)
Institution Factors	Linkage reinforcement and coexistence within Value Chain (Corporate Customers, parts manufacturers, etc.)	Reinforce linkage within value chain by joint development with consumer oriented companies and parts manufacturers	Ahn et al.(2008) Kim(2009)
Market Factors	Global competitiveness Ex. To secure overseas markets and positioning	Securing foreign markets and resources by utilizing foreign companies, universities, and research institutions	Ahn et al.(2008) Kim(2009)
	Expansion of	Standardization and industry	Vrande et al.(2009)

	standardization and industry dominance	dominance through joint development with related organizations and business in the industry	Ahn et al.(2008) Kim(2009)

2.3.3 Impediments to Open Innovation

Vrande et al. (2009) conducted a survey on 605 SMEs based in Netherland about impediments to open innovation. The results are sown in <Table 5> below. The most impeding factors in pursuing open innovation are communication problems, partnership issues, imbalance between innovative and day-to-day work, and company culture/ atmosphere (Jun, 2013).

Table 5: Impediments of Open Innovation

Impediments	Contents
Administration	Bureaucratic, administrative burden, restrictions of the law
Finance	Securing financial resources
Knowledge	Lack of technical/ legal/ administrative knowledge and qualified personnel
Marketing	Lack of marketing knowledge and familiarity of the market, problems relating to marketing products
Organization/Culture	Balance between innovation and day-to-day work, communication problems, problems with signed partnerships
Resources	High costs of innovation and time consumption
IPR	Ownership issues of innovative developments, rights of other companies that collaborated in the development process
Quality of Partners	Partners' lack of competence, missing deadlines
Adoption	Inaccurate judgements about customer needs
Demand	Too specific customer needs, innovation does not fit the market
Competences	Lack of knowledge and proficiency of employees, low labor flexibility
Commitment	Lack of dedicated staff, resistance to change
Idea Management	Plentiful ideas but no administrative or management support

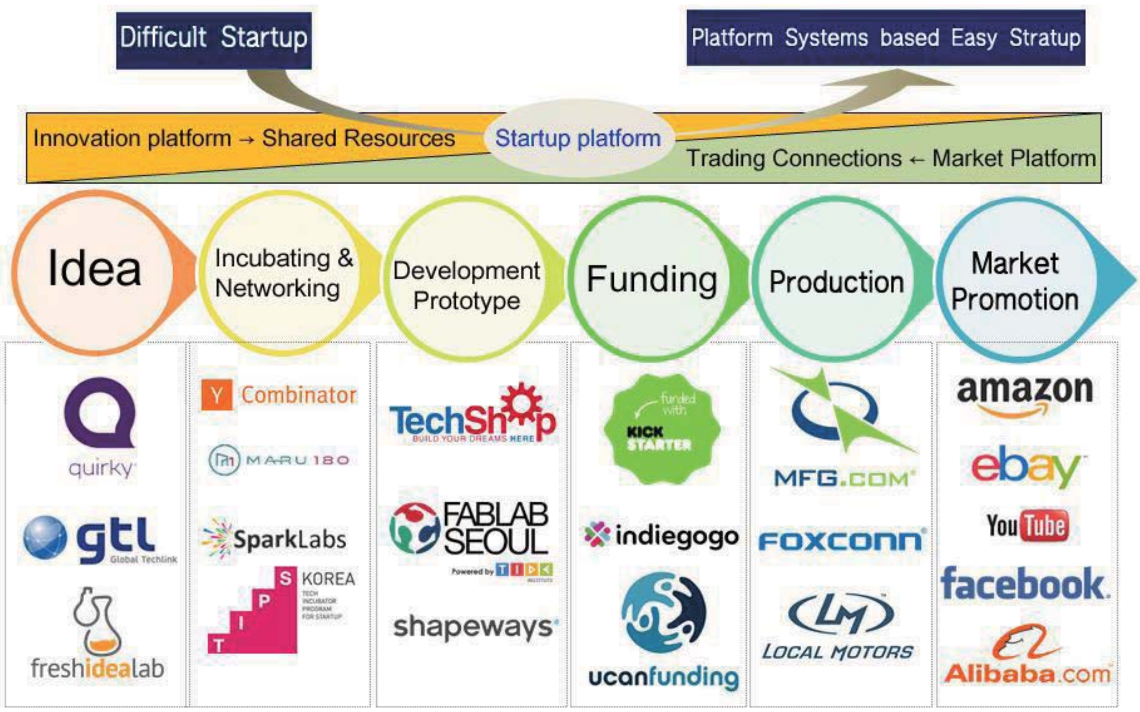
Source: Vrande et al.(2009)

According to previous studies by Kim (2011) and Cho (2012), impediments to domestic adoption of open innovation can be organized into problems of time, costs, technology cooperation, revenue-sharing, and patent and intellectual ownership.

3. Platform based hardware startup cases

3.1 Domestic startup cases

With the development of open source software/ hardware, cloud technology, and startup platforms, entrepreneurs are able to focus solely on core competencies. Consequently, the 5 million dollar average startup cost in Silicon Valley in 2000 reduced to 0.1% at 5000 dollars in 2011, entering the era of ‘light startup’. Among many platforms, this study will focus on startup platforms. A startup platform standardizes the startup process, allowing for faster product development and reducing startup costs and risks. Startup platforms makes ‘light startups’ possible by allowing for entrepreneurs to focus solely on core competencies. At various stages of a startup’s development, platforms provide resources, information, and networks, creating a startup ecosystem and connecting startups to market demand, investors, and relevant industries. A startup platform can be divided into innovation platforms and market platforms (Korea Creative Economy Research Network, 2015).



Source : Korea Creative Economy Research Network, 2015

Figure 3: Entrepreneurial Business Platform

On the left side of <Figure 3> is the innovation platform which can be divided into various types including business idea platform, prototype production platform, open innovation platform, resource support platform, education and network platform, and technology transfer platform.

First, Quirky is an idea platforms, more specifically a social product development platform that helps people realize their ideas into products and services via community and professional cooperation. Quirky prevents copy cats by ensuring a rapid process, and with countless innovative products its main source of revenue is product sales revenue and royalties. In order to increase participation, Quirky quantifies the participants influence and distributes profits accordingly.

Second, Shapeways, Techshop, and Thingiverse are representative prototype production platforms that help realize ideas into real products. Techshop is a US based open manufacturing platform that offers 3D printers and other high tech equipment at affordable prices. In addition, Techshop offers relevant education, consulting, and network among members. Shapeways is another platform that realizes ideas into products using 3D printing using various materials including plastic, ceramic, and metal. Customers can also exchange 3D printing products and design files at Shapeways. 3D Mon is a similar platform located in Korea.

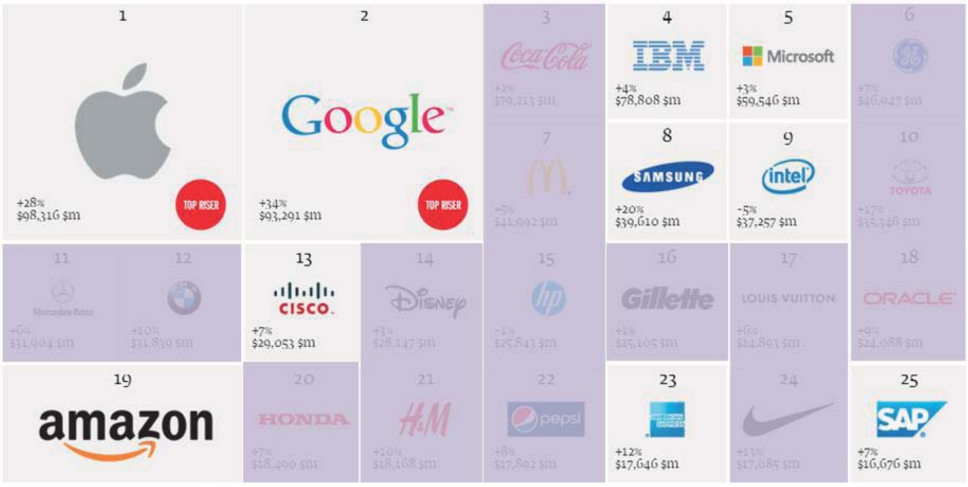
Third, INNOCENTIVE is an open innovation platform that matches companies with professionals from various fields to solve technical problems companies are facing. For instance, Exxon Mobil could not restore for 17 years environmental damages caused by the sinking of an oil tanker. INNOCENTIVE was able to solve this problem in merely 3 months, and John Davison, the person who proposed the solution, was awarded 20 thousand dollars. DARPA, NASA, and DOE also holds state sponsored competitions, and the government cooperates with NineSigma to provide open innovation service for domestic SMEs.

Fourth, Kick Starter is a representative crowdfunding platform. Kick Starter gathers funds from the public for innovative ideas and has met or exceeded fundraising for 44% of the projects. The public sector is also taking advantage of this increasing trend.

Fifth, education and networking platforms are emerging as incubating and accelerating platforms. Y Combinator is one of these platforms that supports startups as their mentor and with financial resources. Y Combinator selects 43 promising startups each year to work with, and often praised as the best accelerator, has raised startups with network based core competencies such as Drop Box and Air Bnb, increasing current value of these companies 1000 fold to 100 million dollars.

Finally, the last is technology transfer platforms such as the NTTC based in the US, IRC based in Europe, and INSTI and Steinbeis Transfer Center based in Germany. Domestically, there exists patented technology marketplace within the Korean Intellectual Property Office, NTB within Korea Technology Transfer Center, and independent government funded platforms. Yet2.com is the largest intellectual property market place and intermediary type platform that sells proprietary technology owned by companies. Boeing, 3M, Toyota, and NEC are among Yet2.com's 500 member companies. Currently, the platform is strengthening support for technology consumers.

On the right side of <Figure 3> is a market platform that secures a wide membership to provide and maximize the network effect. Sellers use the platform to raise profits by selling game and other apps at low prices. In the Value chain, an idea becomes distributed and promoted. Since the distribution accounts for the vast majority of profits, market platforms are that much more important. In the past, market development costs greatly exceeded product development costs, but with app stores, Amazon, Alibaba, YouTube, Facebook, and other distribution platforms, the global market entrance costs have exponentially reduced. These market platforms lower transactions costs between the supplier and the consumer, bringing greater distribution efficiency. Market platforms typically consist of both the supplier and the consumer market, and as participants increase, the value of networks increase exponentially. After securing the threshold number of participants, it is important that the exchange between the two groups remain active by means of open sharing and M&A to keep the market healthy. The value created through the network effect must be redistributed fairly between platform participants in order for the platform to enter a virtuous cycle. <Figure 4> shows representative global platform companies.



Source : Marshall Van Alstyne(2013)

Figure 4: Giant Market platform cases

3.2 Implications and Conclusions

As platform based hardware startups become more personalized and necessitate new technology with little asset, open innovation is becoming indispensable.

According to Vrande et al.(2009), motivating factors of open innovation include efficient control measures for complex systems, defined and focused core competence, market innovation and fusion of new technology, expansion of knowledge, increase in profitability and efficiency, managing insufficient capacity, developing new markets, identifying and satisfying customer needs, using the best of employees' talents, eliminating reluctance toward adopting open innovation as company's business philosophy, and having a positive mindset towards employee involvement in the innovative process. Foreign platform based hardware startups include all the aforementioned prerequisites and are the bases for strategic and innovative business models

According to Jun (2013), motivating factors for domestic open innovation include reduction in development seed and costs, discovery of new products and service, exploration of new business opportunities and markets. Domestic platform based hardware startups that include the aforementioned prerequisites are the bases for strategic and innovative business models.

On the other hand, domestic platform based startups have overcome various impediments that are organized by Kim(2011), Cho(2012), and Jun(2013). These cases provide empirical insight into problems relating to time and costs, technology cooperation, profit distribution, and patent ownership.

Platform based hardware startups fuse mobile and web technology on top of service for users. In addition, hardware, network, platform, and service require the assistance of past but relevant industries that tend to be completely different. The promotion of open innovation is an opportunity for businesses to expand. For reasons stated above, stimulation of platform based hardware startups is important, for open innovation is most extensive in this particular business among many others.

Ⅳ. Limits and Challenges of Research

There is insufficient empirical research into platform based hardware startups. In particular, it is difficult to determine the effects and influences of open innovation, inhibiting factors, and content when researching technology innovation.

A study conducted abroad, Vrande et al. (2009) researched the trend and the extent by which companies preferred open innovation. It also distinguished according to type and size of industry in finding factors that motivated open innovation, and suggested to companies possible directions for open innovation. However, there are only limited case studies and empirical research for technology innovation compared to more traditional manufacturing and service industries.

Future research need to analyze empirical cases of domestic open innovation trends and motivating factors for technology innovation. These studies will stimulate platform based hardware startups and become the bases for relevant policy suggestions.

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Fintech, the Open Innovation to Unbundling Financial Industry and the Next

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Summary

This thesis researches the background for and significance of Fintech's emergence while exploring Fintech's future development directions. Fintech uses IT technology to improve the financial system, effectively merging finance and technology. However, Fintech's uniqueness is defined by its introduction of P2P (Peer to Peer) finance, or the democratization of finance rather than its application of IT technology to finance – a feat that has been made previously. A revolution in smart networks solved past financial problems arising from browsing and transaction costs. Be it providing mobile payment and transfer services that bypass existing financial institutions and P2P lending or crowdfunding intermediates collected investment funds from microfinance, Fintech is dominating existing and newly created markets. By focusing on mobile services amidst smart revolution and network innovation, Fintech is dismantling and restructuring existing financial industries.

This study will analyze in the context of P2P financial network open innovation and in the perspective of technology and business models Fintech's cases by types such as payments, transfers, lending, and investments. Finally, this study will focus the significance of the innovation and convenience that Fintech is bringing and suggest policies that further assist the restructuring of the financial system.

Keywords: fintech, network innovation, open innovation, finance industry, finance technology, smart revolution, mobile revolution

1. Introduction

The recently emerging term Fintech is a combination of two words, finance and technology, and it refers to an economic industry composed of companies that use technology to make financial systems more efficient. More specifically, Fintech can be defined as a new industry based on mobile devices and smart technology that increases the efficiency of financial systems and accelerates the merging of general and financial industries.

Smart revolution that was triggered by smart (mobile) technology goes beyond commerce, SNS, and social commerce and is now even affecting the financial sector. The most important feature of Fintech is P2P (Peer to Peer) financial, or the democratization of finance. Insolvable financial problems arising from search and transaction costs have been resolved through a revolution of smart networks. Fintech is competing against companies that provide traditional financial services and creating new markets with services such as mobile money transfer, P2P payment services, and crowdfunding. In the perspective of mobiles devices, smart revolution, and open innovation network, Fintech is dismantling and reorganizing the previous financial systems.

This study will analyze how Fintech's services – open innovation of financial P2P network - such as retailpayments, transfers, loans, and investments in terms of technology and business models are dismantling existing financial systems. Furthermore, after highlighting the revolution and convenience brought about by Fintech, this study will propose policy measures to assist the reorganization of existing financial systems.

2. The definition of finance and the emergence of Fintech

2.1 Definition of Finance and Fintech

Finance is an intermediary that connects consumers to suppliers with the exchange of money. Financial institutions emerged to resolve the mismatch of time and scale that arises in brokerage. Mismatch in time refers to the discrepancy in time and duration of required money between the borrower and lender. Mismatch in scale refers to the discrepancy in the amount of money demanded and supplied. Based on a trust system, financial institutions resolve this mismatch by creating a pool of funds.

Alongside industrialization, financial institutions came to play a central role in lending funds to companies and industries. In recent years, the financial investment side of these institutions have grown so immense that they now dominate the other industries. Unlike other industries that could practice small-scale co-existence, financial institutions must be industry-scale so that they are effective buffers (of capital reserves) that could reduce or withstand the risks of default. Analyzing this financial network in terms of financial theory, financial institutions link supplier/ sender (node) to consumer/ recipient (node). Further, financial institutions asses the risks and value associated with the transaction between suppliers and consumers and set appropriate exchange fees and interest rates. However, with the recent smart revolution and the advancement of mobile devices and SNS, new technology and business models could replace the financial mediation functions such as secure payments and value analysis of traditional financial institutions.

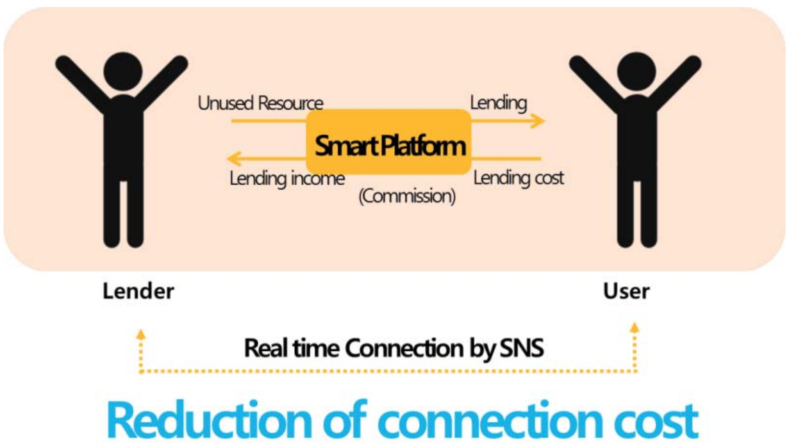


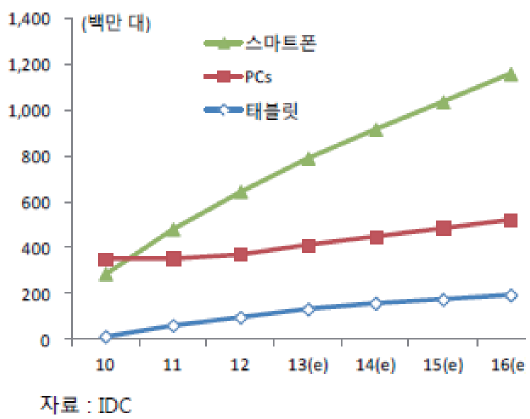
Figure 1. Smart Finance

Fintech creates utility and value in secure financial connection via platform and mobile authentication technology and in value analysis via online (mobile) based big data analysis. With the development of smart platform, financial suppliers (node) and consumers (node) could connect without financial institutions. As such, platforms connect suppliers and consumers directly by means of crowdfunding and P2P lending. Meanwhile, a new mobile market that evaluates the risks of individual transaction and future value based on big data is emerging.

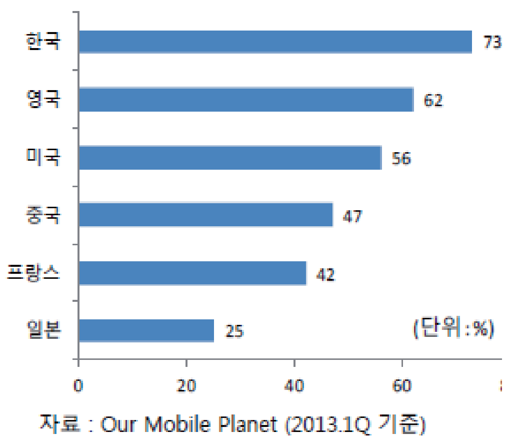
2.2 The emergence of Fintech: Proliferation of mobile devices

The development of PCs, internet, and mobile devices that have computerized business (expansion of financial technology) are now changing the financial systems to adhere to mobile systems (evolution of financial technology). For instance, in South Korea, the development of financial technology paralleled that of communication and IT. The 1980s computerized the financial systems, the 1991 developed PC banking as PCs become widespread, and the 2000s started the internet banking system. Although the proliferation of smartphones began late due to the Wifi policy that prevented the iPhones entrance, smartphones spread rapidly during the 2010s and invigorated mobile banking and transactions.

World's leading IT equipment sales trend



Smartphone penetration in the major countries

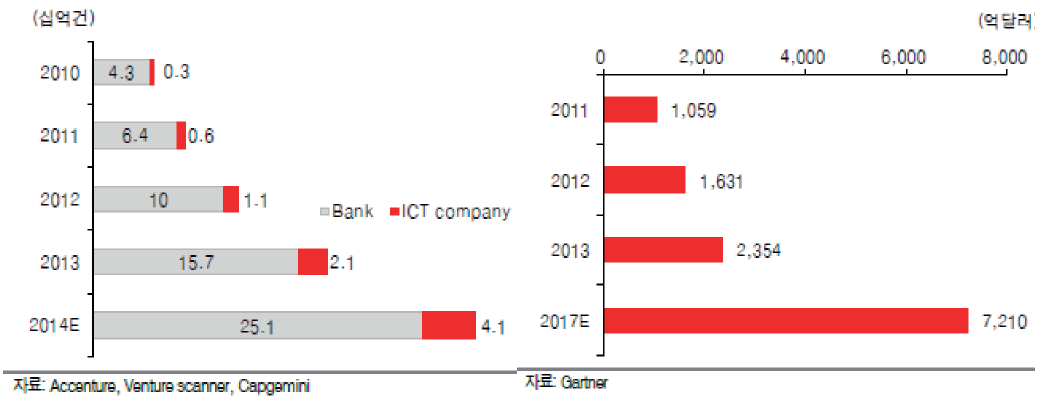


Source: IDC, Our Mobile Planet

Figure 2. Prevalence of smartphones and other mobile devices

In particular, the growth of the mobile payment markets is heading the growth of Fintech. The global mobile payment is expected to grow from 105.9 billion dollars in 2011 to 721 billion dollars in 2017, approximately by a multitude of 7 in 6 years (Gartner). Domestic banks also reported that mobile and online transactions that were 0%, 29% in 2008 increased by 17%, 37% in 2015, exceeding 54% of total transactions. In contrast, telebanking, ATM, and branch banking are continuously decreasing.

Number of mobile payments globally　　Global mobile payment market



Source: Eugene Investment & Securities (2015)

Figure 3. The increase in mobile payments

As mobile markets expanded rapidly, the proportion of smartphone mobile transfer payments increased dramatically, and consequently related technology developments have also gained momentum. Eventually, developments such as the expansion of the mobile devices and business models and services that utilize the internet have set the background for Fintech’s emergence.

2.3 Reduction of financial intermediation

As IT technology advance, mobile and online channels are replacing the role of traditional financial institutions. In Korea, by 2013 internet banking usage reached 65%, and 27% of internet baking was done via mobile devices. Globally, the mobile payment market is growing by 30% each year. This rapid growth of the mobile and IT market shows how financial instructions are facing disintermediation. Intermediary institutions that connect producers and suppliers are losing their role as they are no longer needed in individual transactions that take place without their presence. Furthermore, as consumers make more informed decisions, even financial institutions are undergoing disintermediation. Disintermediation indicates the growth of direct transaction that demands low transaction costs. For financial institutions that profit from transaction fees, growth of direct transaction signals loss in revenue.

As financial institutions lose businesses as intermediaries, they are newly offering various other financial services for IT platforms. IT companies apply recent technology such as mobile, SNS, and Big Data to financial services. According to Accenture, in the case of the US, it is expected that non-banking industries such as Fintech will dominate 30% of the financial market by 2020. Furthermore, Fintech is replacing traditional financial institutions not only in developed states but also underdeveloped ones in which financial infrastructure is weak. In Kenya, Safaricom provides M-Pesa (electronic currency) and dominates 80% of the mobile banking market with more than 73% of Kenyans registered.

Currently, non-financial institutions enter Fintech in three types of business types. Platform based companies such as Google and Apple enter with the purpose of platform extension. Other industries enter with the purpose of providing services linked to existing business area for synergy effect or starting ventures based on SNS and big data.

Table 1. Fintech's business model for non-financial corporations

Business Type	Company name	Service information
Platform extension	Google	Provide new service by expanding on existing business areas Case: electronic wallet, transfer, payment services
	Apple	

Linking existing businesses	Tesco	Provide linked services that synergize with retailers' existing business areas Case: Payment service distributors
	Starbucks	
Startup	Lending Club	Startups that seize market opportunities, focusing on Fintech Case: P2P loans
	OnDeck	

Non-financial institutions that enter the Fintech industry combines two separate stages, selling and buying, that occur in the distribution, service platform into one payment service. In other words, non-financial institutions provide two new services: secure connection and big data value analysis from platforms. Consequently, as non-financial industries enter Fintech, new technology and business models that replace secure connection and value analysis will originate.

3. Analysis of Fintech's business model: payment services

3.1 The growth and investment status of Fintech

Investors expect Fintech to continue growing, so in the global market, investment in industries related to Fintech are increasing as well. Global investment in Fintech industries increase from 4.05 billion dollars in 2013 to 12.21 billion in 2014. In one year, investment increased by more than three folds. In particular, in 2014, global venture investments increased by 64% whereas investments in Fintech industries increase by 201%.

Table 2. Classification of Fintech's business areas

Business area	Content	Details
Retail Payment	Easing to barriers to entry in the payment market by providing easy access and affordable fees	Infrastructure/Online Payments/Foreign Exchange

Financial data analysis	Adding value by collecting data relevant to private individuals and corporate customers	Credit Reference/ Capital Markets/ Insurance
Financial Software	Providing a more efficient and innovative banking services SW based on smart technology	Risk Management/ Payments/Banking/ Asset Management/ Insurance/Accounting
Platform	Offering exchange platforms in which businesses and customers around the world can perform transactions without any intervention of financial institutions	P2P Lending/Trading Platforms/Personal Wealth/Aggregators

Source: UK Trade & Investment

In general, Fintech industries can be organized into 4 different categories: payments, financial data analysis, financial software, and platform. In 2008, 70% of investments in Fintech went to retail payments. After 5 years in 2015, investment in financial data analysis, financial software, and retail payment were fairly spread at around 28%~29%. This shows that investments in Fintech is expanding from retail payments based on mobile services, SNS, Big Data to services such as transfer, loans, investment brokerage, and insurance.

3.2 Financial security of Fintech: payment an remittance services

The area Fintech is replacing the function of financial intermediation is secure payment, more specifically retail payment and remittance. Fintech's beginnings originate from the internet revolution in the 2000s when various online payment services emerged. Among these services, PayPal was the most successful. PayPal was established in 1998 as an electronic payment company. Users would register their credit cards on PayPal, and after certification, users would be able to make online purchases by typing their password (PayPal was available for both sellers and buyers). PayPal was able to provide easy payment transactions because at the Back end, a Fraud Detection System (FDS) operated 24/7, directly managing trade disputes. Unlike the US, China's credit card system was underdeveloped and usage was not widespread. Hence, Alibaba succeeded in China by appropriately creating an Alipay service that allowed users to buy and use virtual currency and ensuring secure connection.

Payment systems such as PayPal and Alipay follow the Pay Gate method. Credit card, communications, and platform companies joined the Fintech market and brought with them various other payment methods that are competing with Pay Gate based companies. In particular, the use of smartphones became widespread, and consequently, online computer based payment systems are reshaping and moving towards mobile based payment systems.

Mobile payment methods include mobile credit cards, mobile micropayments, electronic wallet, and mobile easy payment. In particular, mobile easy payment service providers such as Stripe, Venmo, and Square are competing with new and safe service models. Stripe facilitates mobile payment by simply scanning a code. Venmo is an SNS based mobile transaction service. Square facilitates mobile card payment in stores without POS. Alongside the development of SNS, mobile, and wearable technology are various convergence payment systems that use wearable devices such as location-based rich media (text, pictures, videos), gesture payment using google glasses, and palm payments. TransferWise is a P2P based international money transfer service that matches people who need to exchange foreign currency, allowing people to exchange currency without exchange fees.

Table 3. Mobile payment methods and functions by type

Method	Implementation and Functions
Mobile Credit Card	USIM card equipped with contactless IC chip, built-in payment via the NFC reader, financial information linked to payment via PG certificate vendors, complementary measures such as identity authentication suggested for security reasons
Mobile phone payment	Payment and micro transactions with phone number and social security number, costs added to phone bill, transfer services not provided
Mobile wallet	Insert card information on smart phone app for online payment services, discount coupons, and mileages
Mobile easy	Smartphone, OS, payment using a payment app. Billing information stored on site.

payment	Type in password for registered username for easy payment.

Source: IBK Investment Securities

3.3 Evolution of Mobile based payment services

Current mobile-based payment services are divided into two main axes, electronic wallet and messenger based payment service. Mobile electronic wallet services such as Google wallet, Apple Pay, and smart wallet expand their market by taking advantage of mobile banking, mobile identification, and mobile commerce functions on smartphones

It is worth nothing that mobile messenger companies such as Facebook and Kakao talk plan to enter the mobile payment market. With more than 1.2 billion users, Facebook will reshape the mobile payment market as they enter.

Facebook plans to connect its messenger app with a debit card. Its mobile payment service would allow users to pay or transfer money via their messenger app by entering in a personal pin number. Users would not need to go through the hassle of adding people, and should users use debit cards for their transactions, they would not need to pay any transaction fees. Services such as Facebook that levy zero transaction fee for debit cards are expected to replace debit cards for credit cards or adopt a charging system. Until now, venders were burdened with a 3% fee payment when using online payment systems.

Services that fuse SNS and messenger with payment systems are expected to become smart revolution's representative smart services. These services combine distribution (product) and finance (currency) and bypass intermediary financial institutions, allowing for users to purchase in one step. It is expected that services such as these will permanently alter the way people conduct business online and offline.

4. Analysis of Fintech's business model: service based on big data

4.1 Smart revolution and value analysis of big data

As stated previously, financial network in terms of financial theory, financial institutions link supplier/ sender (node) to consumer/ recipient (node). Further, financial institutions asses the risks and value associated with the transaction between suppliers and consumers and set appropriate exchange fees and interest rates. Services that emerged during the smart revolution such as smart platforms and online (mobile) data based big data analysis are replacing the secure connection that banks offered. At the same time, it becomes possible for these services to create value without going through the existing financial institutions to connect providers and consumers. Platforms such as crowdfunding and P2P lending directly connects providers and consumers of finance and evaluates risks and future value using big data. These platforms are expected to open new Fintech markets.

IT companies with big data technology are replacing large financial institutions in terms of credit assessment and value analysis. The financial use of big data can be divided into two parts, customer management and financial activities. The consumer management area analyzes SNS activities and recommends relevant products. It also provides algorithm based private asset management services

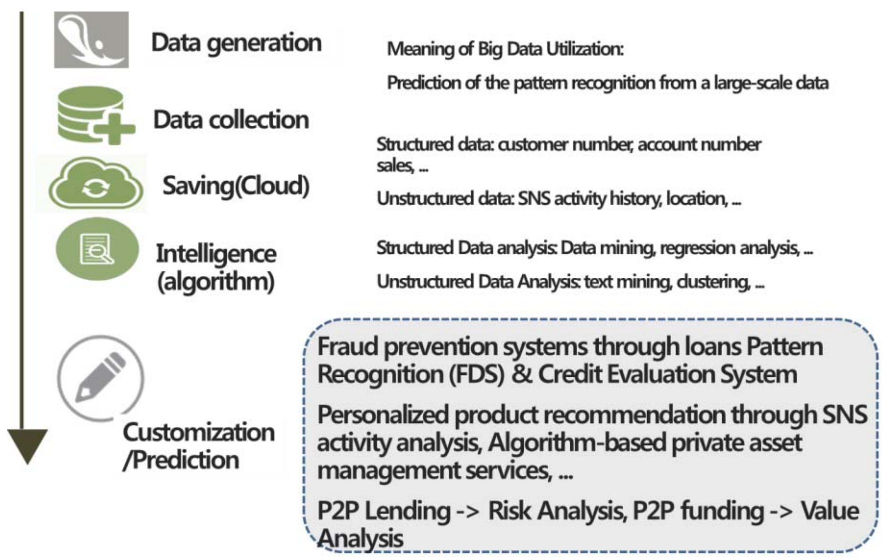


Figure 4. big data in the financial industry

4.2 Big data analysis of the existing financial institutions

Foreign banks use big data for portfolio analysis, trading risk management, marketing, and security. And the areas these banks utilize big data continues to expand. Bank of America (BoA) analyses the SNS unstructured customer data and predicts the customers' preference and mood. BoA uses these data for marketing. Wells Fargo, a US based company, uses big data to provide individualized services, and ATM machines layouts rearrange for each customers according to their preference. JP Morgan uses big data to analyze consumer trends, real estate private banking (PB), and internal inspection. Citigroup uses IBM's Watson, a super computer, to conduct big data analysis on consumer transactions and filter customers with low credit rating. With this data, Citigroup increases its accuracy in determining whether to issue loans or credit cards. For Citigroup, big data is used to simplify banking services. Some Japanese banks also analyze customers deposit and withdrawal transactions and screen navigation route to stimulate internet banking and investment trust agreements.

Domestic banks use big data for elementary purposes such as excavating customers, marketing, customer relationship management (CRM), and security. Credit card companies use big data for marketing, managing customers, and fraud prevention systems, using mainly customer requirements, VOC, purchase history and lifestyle for product development and marketing

Banks and credit card companies' use of big data extends beyond financial uses such as marketing, product development, and credit analysis.

4.3 Value based big data analysis of Fintech's services

Big data is mainly used for credit rating and analysis, and other fast growing uses also focus on customer credit rating and analysis for determining whether to issue loans. Existing financial institutions use big data for aforementioned purposes and collateral and margin management evaluation to develop better credit rating models. Svyaznoy Bank lowers a bad credit rating by using a 'Visual DNA Test', which finds out the psychological characteristics of an individual in a short period of time. Zest Finance evaluates a credit rating via the thousands of variables such as, call habits and SNA messages of loan applicants and their literary style of loan applications. KD Nuggets utilizes a number of Face Book friends, on-time payments of mobile phone bills for evaluating a credit rating. Affirm allows loans to its customers when purchasing a product online and later they pay in installments. In this process, Affirm evaluates their credit ratings using credit history, public and private DB, SNS profiles and the status of mobile phone accounts.

Yodlee Financial Cloud, a SaaS platform operator who provides financial application for banks, companies, and individuals, offers security data analysis, market research service, market insight through FinApps by analyzing data from over 12,500 sources worldwide. In addition, big data value analysis has been used in analyzing claims, price policy and marketing in the insurance industries.

4.4 P2P lending services based on big data

P2P lending service is a major business model based on big data value analysis and credit evaluation. In December 2014, OnDeck, a small business loan company, and Lending Club, a P2P(individual) loan company has been successfully listed on the New York Stock Exchange. Thus the Fintech Market has been doubled or more every year. P2P lending is a P2P (peer-to-peer) concept grafted finances by sharing files directly between individuals via Internet. IT companies with big data technology has led this type of platform business that bridges the direct financial transactions between individuals that bypasses traditional financial institutions.

Ali Finance of Alibaba Group has been utilizing big data when lending business loans to its partners of B2C online shopping site Tmall and B2B e-commerce site Alibaba. Ali Finance evaluates loan process through three different ways using ; 1) structured data such as transaction volume accumulated through Alibaba and Tmall, repurchasing rate, and satisfaction level 2) unstructured data such as seller-buyer conversation history, and review 3) external data such as SNS. It has shown more effective than the commercial banks to reduce bad loan ration of 2% to 0.9%.

In conclusion, P2P lending Fintech companies are lowering transaction costs and bad loan rates at the same time. Investors may be subject to receive higher interest rates than traditional banks. Borrowers can borrow money at lower interest rates than traditional banks. These businesses are rapidly growing while benefiting both borrowers and investors and threatening the current banking industries.

4.5 P2P lending services based on big data

Cloud Funding is one of the platforms that connects directly between consumers and the suppliers in the financing industries and has been rapidly growing since the mid 2000s centered in North America and Europe. It can be called social finding that has a relationship-oriented element and collective intellectual property. Investors and borrowers interactively communicate their funding deals online via social media. Cloud funding platform is composed of fund consumers (individuals or companies), capital providers, and mediators.

In Cloud Funding, borrowers publicize their business contents and plans through the Internet and SNS. People or any organizations who agree with these provide funding or become sponsors. In accordance with the purpose of funding (trade off), there are four different types such as, Donation, Reward, Lending, and Equity. Depending on the purpose of the pursuit of profit, it can be divided by investment type or non-investment type. Non-investment type can be divided into donation type and compensation (reward) type. Investment type can be divided into loan type between individuals and equity type mediated by securities. Loan type cloud funding is also known as P2P lending.

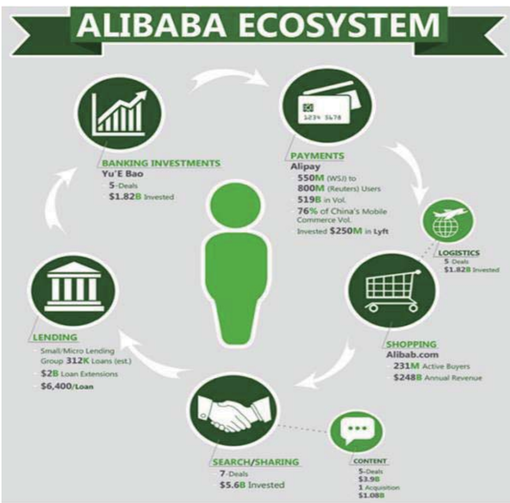
The equity investment type is a funding method using securities as a medium. Investors secure their stake through equity securities, debt securities, and securities investment agreement for the purpose of revenue increase via cloud funding. It has emerged as a passage of new funding for start-up companies.

Equity investment type allows financing for a new start-up company who needs fund desperately. In order for them to grow a small but strong companies crossed the river and valley of death, each nation has been promoting the equity investment type of cloud funding legislation to increase its competitiveness.

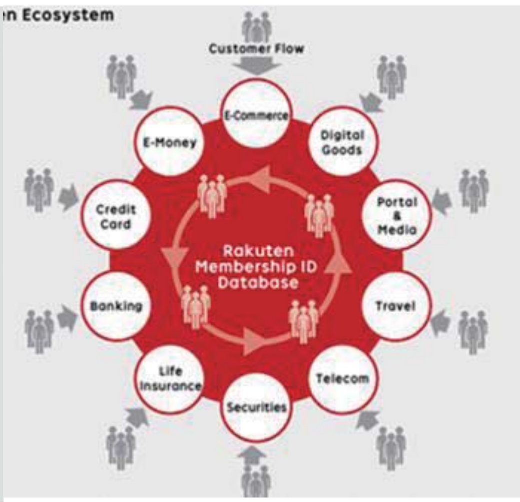
4.6 The development of an integrated platform Fintech

Fintech companies such as Alibaba and Rakuten are evolving into integrated financial platforms and are providing services that go beyond simple payment remittance. Starting from payment remittance services, Alibaba developed into an integrated financial platform that now provides a searching-shopping-payment-loan-investment-payment-insurance-bank service. Alibaba started in 2004 as an electronic currency company with Alipay and expanded their service to Alibaba Financial (loan) in 2007, Yu'ebao (investment) and China online insurance (insurance) in 2013, and internet banking (bank) in 2014. Rakuten, the largest Japanese open market, also is a business-finance platform. With a Rakuten membership ID, users could access electronic trading, electronic currency, credit cards, portals and media, digital products, vacations, communications, securities, insurance, and banking.

Alibaba Ecosystem



Rakuten Ecosystem



Source: Alibaba, Rakuten

Figure 5. Business-Finance Platform Ecosystem

5. Conclusion

The role of finance is a intermediary role that is to connect between consumers and providers of money(funding), a mediator of exchange. Financial institutions can be appeared to resolve the mismatch in duration and scale in this intermediary process. Financial institutions is a basic business model which create a pool of funds, resolve a financial needs and receive a commission (search and transaction costs) between the two (consumers and suppliers of money) based on their credibility.

Fintech emerged as the smart revolution of super networks has resolved the problems of the past that were not possible due to search and transaction costs. The biggest feature is P2P, the direct financing between individuals that can be called democratization of finance. Fintech is to create a market that has been ignored by the existing financial institutions or to compete with them in the current financial market.

Fintech can be described as an open innovation based on smart revolution and network innovation. Fintech based on open innovation has dismantled the closed existing financial industry. Armed with innovation and convenience, Fintech companies are to compete with the existing financial institutions in the area of payment, remittance, loan and investment based on network open innovation and P2P financing.

In order to promote innovation and convenience of these Fintech companies, a drastic change of the existing financial regulatory measures should be necessary. The paradigm of a negative regulation must be promoted. Instead of pre-regulating, it can allow new services first and make appropriate systems later. This will accelerate the disruptive innovations of Fintech and ultimately lead to the development of the financial industry benefiting financial consumers.

In the meantime, the emergence of a huge Fintech company that has financial information and industry information at the same time can be a problem in term of protecting personal information and privacy. At all times, big data owner can a ‘Big Brother.’ When allowing a big data platform company entry into the banking industry, big data should be open wisely. If sharing of big data occurs, the third Fintech company with big data will be able to provide outstanding services based on a new algorithm.

This thesis studies the meaning of the emergence of Fintech and its future prospects while exploring the nature of banking. It also tries to find out the necessary implications in order to establish the policies for Fintech Industry while viewing the whole industrial characteristics. Its purpose is not to prove empirical data. Therefore, based on empirical data, a further research is needed to reveal the characteristics of the each field and to analyze the structure and meaning of the whole Fintech industry.

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A Study on the Direction of Korea’s Open Innovation Technology Market

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Abstract

In the 20th century, industries based on science and technology flourished, and consequently, people highlighted the importance of technological innovation. In no time, people came to regard the capacity of a firm’s R&D department as a determining factor of the firm’s competence. However, technological revolutions arising from isolated R&D efforts reached their limit towards the second half of the 20th century and such businesses faced stagnant growth. In contrast, leading multinational companies such as Google, Facebook, Cisco, Intel, MS, and Pfizer switched to an open innovation system whereby multinational companies merge via M&A with ventures that develop innovative and revolutionary technology. Open innovation helped these industries survive various crises.
Post 2009, domestic M&A trends have expanded, however, a vast majority of M&A are for purposes of restructuring rather than transferring technology. As such, the market for technology transfer is dormant. According to a mobile survey conducted on employees (CEOs, executive officers, startup members, and venture capitalists), 59.1% said ‘establishing a corporate value assessment system’, 43.0% said ‘expanding government M&A support policy’, 27.4% said ‘educating M&A professionals and intermediaries’ is necessary in order to foster a better environment for M&A of ventures.
Therefore, this paper suggests the following to cater Korea’s corporate ecosystem towards open innovation: establishing a specialized exchange organization to assist the merging of conglomerate dominated markets and revolutionary technologies developed by ventures; making policies to assist the elimination of transaction costs and the reaching of critical point at which technology trade is at its maximum. This special exchange as part of the market must grow and develop to become a part of the global market. This proposal will assist domestic corporations to adopt open innovation.

Keywords: open innovation, technology market, market-technology combinated M&A

O2O Convergence trend and Gamification that stimulates open innovation: Focused on crowdsourcing

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Abstract ...

After internet is invented, the convergence of Offline and Online sphere generates O2O environment that creates values. This environment fuels collective intelligence through game or elements of gaming which increase the cases using collective intelligence as the drive to innovate.

In the past, it was almost impossible to acquire innovation from the worldwide public before internet is appeared. However, the internet made countless brains connected and this inspires the environment that collective intelligence can be created. As some of organizations start to realize that the revelation of collective intelligence can be stimulated and applied intentionally through game or elements of gaming, the age of crowdsourcing is now open.

In fact, there is a case listed in ‘Nature Structural & Molecular Biology 2011’ which sixty thousands of gamers solve the problems in 10 days that wasn’t solved for 10 years by several

scientists. We can see that several factors of gaming are applied in most of open innovation platforms based on online sphere.

In this study, we predict how the future of crowdsourcing enhanced as the merge of O2O becomes highly enhanced and plans for gamification that fits in expected crowdsourcing by analyzing IoE(Internet of Everything), augmented reality, virtual reality, new recent technologies that expedites the convergence of O2O, existing crowd souring platforms and the successful cases from the perspectives of gamification.

1. Introduction

After computers and the internet became widespread post 2000, countess brains were connected via the web. The internet formed connections between people and knowledge, reducing connection/ communication costs dramatically. This allowed companies to involve the masses when developing their products and services.

In 2006, Jeff Howe introduced the concept of crowd funding. Although various cases and research confirm crowd funding, there is a lack of research in methods to motivate the masses to participate in the funding.

This study analyzes the motivation behind why people participate in crowd funding and suggest gamification as a means to stimulate the public in participating in crowd funding.

Furthermore, the study will predict how O2O will affect crowdsourcing and suggest appropriate applications of gamification.

2. The concept of crowdsourcing and motivation behind participation

2.1 The concept and definition of crowdsourcing

The term crowdsourcing was first coined by a British journalist Jeff Howe in a 2006 Wired magazine. Crowdsourcing is a combination word that combines the words ‘crowd’ and ‘outsourcing.’ In short, crowdsourcing allows anyone to participate in the production of products and services.

Howe (2006) introduced crowdsourcing as outsourcing what employees would normally do to an indistinct network of people in a competitive manner. In other words, crowdsourcing outsources to the masses for the purpose of extracting innovative ideas.

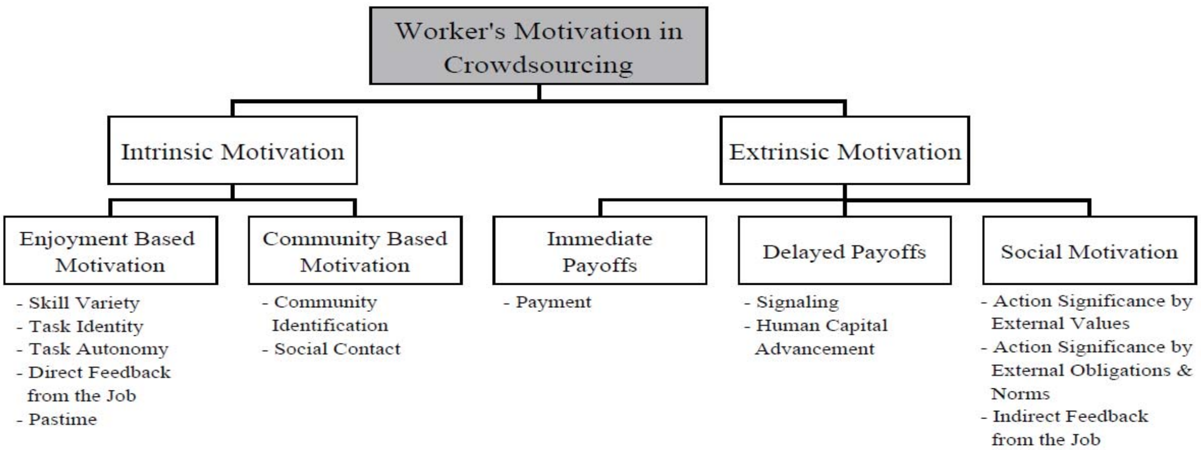
2.2 Motivation behind participating in crowdsourcing

Kaufmann et al.(2011) distinguished the participants' motivation in participating in crowdsourcing as either intrinsic or extrinsic.

According to this distinction, intrinsic motivation consists of enjoyment base motivation, which consists of skill variety, task identity, task autonomy, direct feedback, and pastime and community based motivation, which consists of community identification and social contract.

As for extrinsic motivation, immediate payoffs consists of payment, delayed payoffs consists of signaling and human capital advancement, social motivation consists of action significance by external values, action significance by external obligations & norms, and indirect feedback from job workers.

<Figure 2> A Model for Worker's Motivation in Crowdsourcing



Source: Kaufmann, N., Schulze, T. and Veir, D. (2011),

Leimester et al.(2009) also divided the motivation behind participating as either intrinsic or extrinsic. Moreover, he derived from the MIAB (Motive Incentive-Activation-Behavior Model) 4 motivational reasons: learning, direct compensation, self-marketing, and social motivation. Here, learning, direct compensation, and self-marketing is based on finding new opportunities or self-advertisement for reasons to participate in crowdsourcing. Social motivation is based on one's urge to receive recognition from others.

2.3 The limitations of previous research in finding motivations behind participation

Past research focus on finding the different types of motivation and categorizing them. They do not analyze how to stimulate each type of motivation to attract more participants.

3. Gamification and Motivation

3.1 Definition of Gamification

The term gamification was coined by Nick Pelling in 2002 when he started his consulting firm. In 2011 at the Gamification Summit, Gabe Zichermann (2011) defined gamification as 'the process of utilizing game thinking techniques to help users focus and solve problems.'

According to the perspective above, gamification can be applied to anywhere that can be improved by altering motivation and inducing behavior change. KCERN (2015) thus defined gamification as 'improving reality using game thinking and techniques by continually stimulating motivation.'

3.2 Human desires and motivation seen in the perspective of gamification

The author of Homo Ludens, Huizinga (1938) explained that an important characteristic of game is willingness and concentration. There is reason to analyze factors that stimulate willingness and concentration. According to Nicole Lazzaro (2004), while there are many reasons why people willingly participate and concentrate, the most important reason is that it is ‘fun’.

In 2004, Lazzaro presented a presentation ‘Why We Play Games’. In this presentation, Lazzaro analyzed 4 different emotions associated with fun that people feel when they are concentrating in gaming. The 4 types of emotional fun are ‘Hard fun’, ‘Easy fun’, ‘Serious fun,’ and ‘People fun’.

‘Hard fun’ is when people are challenged with a difficult tank that requires strategic thinking to solve the problem. People feel a sense of accomplishment when they successfully solve the problem. ‘Easy fun’ is when people confront something that deviates from standard patterns and makes people feel uncertainty, curiosity, surprise, and fascination.

‘Serious fun’ is when the game replicates real word values. People see how they change through gaming and feel satisfaction. ‘People fun’ is when people communicate, compete, or cooperate with others and bond with them.

The four types of fun corresponds with intrinsic motivation behind crowdsourcing that Kaufmann et al. (2011) identified. ‘Hard fun’, ‘easy fun’ and ‘serious fun’ correspond with Enjoyment Base Motivation, and ‘people fun’ corresponds with Community Based Motivation. Basically, crowdsourcing, like gaming, needs elements of game, particularly fun, for the masses to willingly participate and concentrate.

<Figure 4> Types and elements of fun

범주	설명	관련 요소	관련 감정	재미의 근원
hard fun	Proficient in opportunities for success	· challenge · goal · obstacles · strategy	· frustration · fiero · relief	Game inside
easy fun	connection to imagination	· novelty · exploration · fantasy · creativity	· curiosity · surprise · wonder	
serious fun	Provide meaning and value	· meaning · learning · rhythm	· relax · desire · excite	Game outside

		· collection		
people fun	Build a social bond	· relation · communicate · cooperate · compete	· schadenfreude · amusement · naches	

Source: Nicole Lazzaro(2013), park(2014) rearrangement

Jon Radoff (2011) derived 42 fun factors while playing games. Here, one could see that each fun factor corresponds with a basic human desire.

<Figure 5> 42 Fun Things and Motication

No.	42 Fun Things	동기요인
1	패턴인식하기	호기심, 질서
2	수집하기	질서, 권력, 저축, 신분
3	무작위 보물찾기	권력, 저축, 신분
4	완수의 느낌 달성하기	질서, 권력, 독립, 평온
5	성취에 대해 인정받기	수용, 사회적 접촉, 신분
6	혼돈으로부터 질서 창조하기	질서, 평온
7	가상세계 개인화 하기	사회적 접촉, 독립, 신분
8	지식 모으기	호기심, 사회적 접촉, 신분
9	사람들의 그룹 조직하기	사회적 접촉, 질서, 가족, 신분, 로맨스
10	내부자 참조 알아채기	사회적 접촉, 수용

11	관심의 중심되기	권력, 신분, 로맨스
12	아름다움과 문화 경험하기	질서, 로맨스, 평온
13	로맨스	명예, 가족, 로맨스
14	선물 교환하기	수용, 명예, 가족, 로맨스
15	영웅되기	권력, 사회적 접촉, 독립, 명예, 이상주의, 신분, 복수, 로맨스
16	악당되기	권력, 독립, 복수
17	현명한 노인되기	권력, 독립, 수용, 명예, 가족, 신분
18	반역자 되기	권력, 독립, 사회적 접촉, 신분, 복수, 로맨스
19	통치자 되기	질서, 권력, 명예, 가족, 신분, 로맨스
20	마법 궁전에 사는 척 하기	호기심, 이상주의, 로맨스, 평온
21	이야기 듣기	호기심, 사회적 접촉
22	이야기 들려주기	권력, 수용, 신분
23	미래 예측하기	질서
24	경쟁	권력, 신분, 복수, 신체적 활동
25	정신 분석	호기심, 질서
26	미스터리	호기심, 로맨스
27	기술 마스터 하기	권력, 독립, 신체적 활동
28	정의와 복수 행하기	권력, 복수, 로맨스

29	양육하기	독립, 명예, 가족, 신분, 로맨스
30	흥분	신체적 활동
31	투쟁에서 승리하기	권력, 복수
32	이완 하기	평온
33	기이하거나 요상한 경험하기	호기심
34	우스꽝스럽게 되기	수용, 평온
35	웃기	신체적 활동, 평온
36	무서워하기	신체적 활동
37	가족관계 돈독히 하기	사회적 접촉, 명예, 가족
38	건강 증진하기	신체적 활동
39	과거와의 연관성 상상하기	호기심, 질서
40	세계 탐색하기	호기심, 독립
41	사회 개선하기	명예, 이상주의, 신분
42	깨달음	호기심, 독립, 평온

Source: Jon Radoff(2011), Game on, Energize your business with social media games

All in all, fun is what people feel when they satisfy their desires. In reality, the corresponding motivation factors to all the fun factors can be categorized into Maslow's (1943) Hierarchy of needs, and most fund related motivating factors are including in the basic desire part.

4. Game design theory and crowdsourcing

4.1. The significance of game design theory in the perspective of crowdsourcing

Currently, humanity invests 3 billion hours in online gaming (McGonigal 2013). In other words, the aggregate time and effort people spent gaming and designing gaming is beyond imagination.

On the other hand, people do not spend nearly the same amount of time participating in crowdsourcing let alone the insignificant number of people who do participate. This indicates that crowdsourcing lacks a complete design theory.

Most game mechanics revolve around satisfying people's basic desires to make them concentrate. Hence, crowdsourcing should be based online and use game mechanics as a tool to stimulate people's motivation to participate.

4.2 MDA Framework

MDA framework is a framework developed by Robin Hunicke, Marc LeBlanc, and Robert Zubek (2001-2004) to explain the relationship between the game system and players. MDA stands for Mechanics, Dynamics, and Aesthetics.

Mechanics refers to factors such as gaming components and rules that add to the component of fun.

Dynamics refers to the interaction between players and the game along time. It is the visual feedback the game provides in response to the players behavior.

Aesthetics refers to the kinds of emotional responses such as aesthetic sensation that players feel as they interact with the game.

4.2.1 Game Mechanics

Game mechanics is what adds fun to the game. Game Mechanics, according to various rules, algorithms, and data structures induce specific behaviors and emotions.

Included in game mechanics are level up systems, quests, and points that make up the basic framework of the game.

4.2.1.1 Point

Point is a system that puts a numeric value to how much the player is committed to the game. Points are closely tied to compensation systems and can be a status symbol in the game. Players could also use the points to access content or buy/ gift virtual products. Hence players are motivated to earn more points.

4.2.1.2 Leader Boards

Leader Boards is a system that allows players to publicize their reputation by listing players with the highest level, points, and achievement.

Players are motivated to compete against other players for higher positions on the leader board or to sustain their current position.

4.2.1.3 Quest

Quests offer players missions and reward them once they complete the mission. Quests are simply Challenge & Reward systems that must be accompanied by custom guidance for each players. Rewards such as trophies and badges make players feel satisfaction, and challenge stimulates players' sense of accomplishment. Hence quests make players work endlessly for a particular goal.

4.2.2 Game Dynamics

Game dynamics is the interaction between the player and the game that allow the player to understand how and why things work the way they do as time passes.

Various factors of game dynamics corresponds with human desire and could be all categorized into Maslow's hierarchy of needs.

4.2.2.1 The desire to survive and be safe

Players want to avoid negative results such as losing or virtually dying. Should players suffer near loss or lose points for not playing by the rules, players buy cash items or concentrate intensely not to lose.

4.2.2.2 The desire for ownership

Regardless of reality or virtual reality, people's desire to make what they want theirs can be effectively used to induce behaviors.

Inside games, people invest great time and effort in attaining items, higher levels, and badges. In particular, players repeat meaningless and redundant behavior to complete quests and be rewarded.

4.2.2.3 The desire for self-expression

Self-expression is a fundamental desire to publicize their personality and characteristic. Players do this in games by decorating avatars and attaining special titles.

4.2.2.4 The desire for relationship

The desire for relationships are founded on social relationships. Desires such as belonging, authority, and altruism are all part of relationship desires. Players in games work to be a part of certain prominent groups (clans, guilds, etc.).

4.2.2.5 The desire for achievement

Satisfaction from sense of accomplishment comes from completing difficult tasks. It matches with the highest desire, specifically self-realization. This desire is heightened by rewards such as points, experience, and badges.

4.2.3 Game Aesthetics

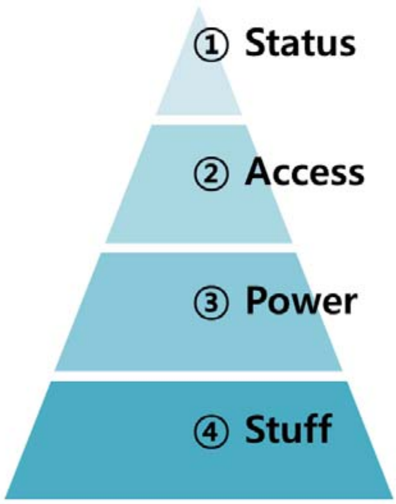
Game aesthetics is the aesthetic response players feel as they interact with the game. Aesthetics affects people emotions, so different people respond differently even when exposed to same components and environments.

Game aesthetics includes all emotions including satisfaction, surprise, happiness, envy, horror, and suspense.

4.3 SAPS Framework

Most reward systems that exist in games can be separated by Gabe Zichermann's SAPS Framework. SAPS stands for status, access, power, and stuff.

<Figure 7> Gabe Zichermann's SAPS Framework



Source: Gabe Zichermann

First, status is a relative position that forms when people interact. Players who have high status receive special treatment from other plays. Symbols of status include rankings, levels, badges, and unique items.

Second, access grants permission for players to approach special content. Similar to VIP system in department stores, in online games, players are provided special permission to access exclusive virtual content.

Third, authority allows players to exert power over other players in the game. Players who have authority often unconsciously work for game administrators. Representative examples include the authority to manage groups, events, and forums.

Fourth, stuff stimulates people’s desire to want free items. Although seemingly less important than status, access, and power, since its effect is immediate, it should not be neglected.

5. Case Study

5.1 Google Image Labeler

Google addressed the problem of Image Tagging and increased the accuracy for automatic image searching by applying gamification to crowdsourcing.

When people participate in the Google Image Labeler game, people are matched randomly with other players. Then the same series of pictures are shown to both players at the same time. For two minutes, each player labels the shown pictures appropriately.

When the labels coincide with each other, players receive new images. The more specific the label is, the more points the player receives. Then the person with the higher point is shown on the Leaderboard.

This game utilizes the countdown mechanism, point system, and a leaderboard to stimulate players to concentrate.

<Figure 8> Google Image Labeler game Play 장면

Source: www.thulme.com

In 2006, during a short period of time, the game received much attention and was able to better image searching. However, when the lack of physical reward became an issue, the service came to an end in 2011.

5.2 NAVER's Knowledge IN

English based search engines such as Google only needed to focus on developing the best search engine. However, Naver realized that contents that were in Korean lacked significantly.

After much thought, Naver provided a service platform named Knowledge IN in October 2002. In the first decade since it first provided its service, there has been now more than one hundred million questions answered on Knowledge IN. Simply put, Naver was able to solve the general problem of the market, namely the lack of Korean content, in its early states. Knowledge IN applies some components of gaming that harnessed the public's participation and commitment.

5.2.1 Point System

In the case of Knowledge IN, when users login and answer questions, they are provided points, which can be used to give points to users who answer their questions. Naver created a leaderboard and rating system according to the points.

5.2.2 Rating System

As of 2015, there are 19 different ranks in Knowledge IN. As a person goes up on the ranks, people are provided with various rewards such as badges and even monetary compensation.

5.2.3 Leaderboard System

There are three different types of leaderboards in Knowledge IN: Knowledge IN ranking, power knowledge IN, and honorary knowledge. According to the number of points users received, the top 1000 are listed on the Knowledge IN ranking.

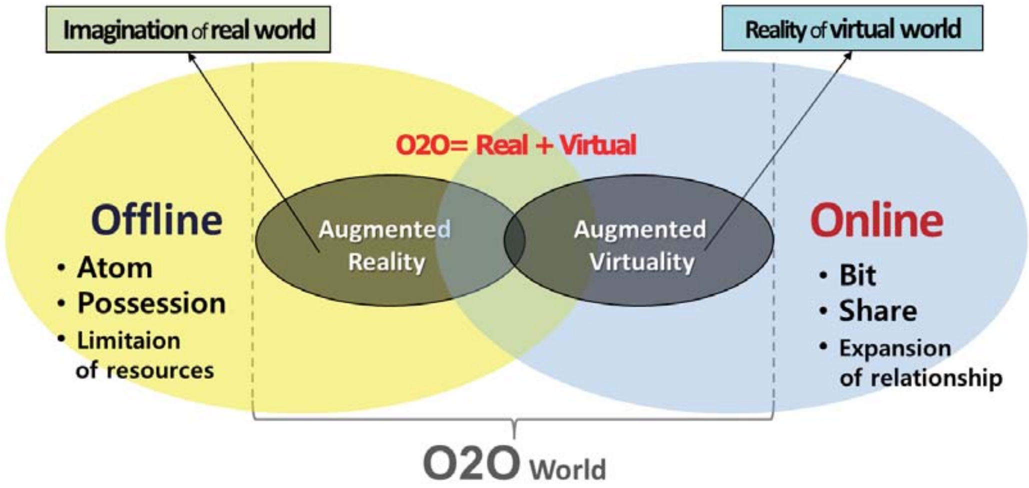
As for power IN, it is rewarded to members with high performances in each subject once every year. The recipients are awarded with emblems, trophies and other presents. They also become listed on the Hall of Fame and are even invited to various VIP events.

6. O2O trend and the expansion of crowdsourcing

6.1 Definition of O2O

O2O(Online to Offline) is the phenomenon that occurs when the offline and online combines around users (KCERN 2015).

<Figure 9> O2O Amalgamation



Source: KCERN 2014

So far, the online and offline could not be organically amalgamated. However, recent innovative technology is changing how the online and offline could possibly organically interact.

<Figure 10> O2O Mirroring

Source: KCERN 2014

6.2 The expansion of crowdsourcing according to the O2O amalgamation trend

Crowdsourcing is expected to change in a number of ways according to how the online and offline merge in a parallel manner and begin the O2O era. First, technology such as big data, virtual reality, and augmented reality hasten the development of O2O and allow for crowdsourcing designs that were previously not possible. This also indicates that crowdsourcing could be applied to specialty areas such as education, shopping, and vacations which O2O is already starting to influence.

6.2.1 Virtual environment optimized for crowdsourcing

The IoE (Internet of Everything) connects everything to everything, people and things alike. Hence people could participate in crowdsourcing not only in front of a computer in their home but outside as well.

Not only is the place where people could crowdsource expanding, technology such as wearables that project virtual or augmented reality enhances the environment in which people could participate in crowdsourcing.

6.2.2 Participants custom design crowdsourcing

In order to increase participants' concentration, crowdsourcing has to evaluate the participants skills and provide various custom resources and goals by stage. However, most crowdsourcing that has been designed so far were not able to evaluate the participants' individual contribution because of technical and monetary limitations.

This problem could be solved with big data technology. Big data can analyze participants and the masses' data to evaluate each player and quantify their ability. The participants would then be provided with quests and resources that are appropriate for their level. Measures such as these will expand the number of participates who join in on crowdsourcing.

6.2.3 Application of crowdsourcing to establish global O2O

Companies such as Google and Naver were successfully able to integrate game mechanisms into crowdsourcing.

The author expects crowdsourcing to also affect how O2O influences the way people interact with the world.

Past crowdsourcing means that utilize the internet are only a small part of the entirety of crowdsourcing. With the development of O2O, crowdsourcing will be used in education, shopping, vacations, etc. that are currently being influenced by O2O.

6.4 Future gamification of crowdsourcing

Gamification 3.0 is the term used to describe the process by which reality and games merge with the development of technology that is accelerating O2O (KCERN 2015). In the future, gamification 3.0 will also be applied to crowdsourcing. In other words, future crowdsourcing that will have been influenced by O2O will advance as game mechanics merge with technology that is accelerating the merging of O2O.

6.4.1 Gamification 1.0, 2.0, 3.0

Gamification 1.0 is the state at which game thinking and mechanics are simply applied to the real world. While successful cases led to meaning results, most cases failed to generate mass participation.

Gamification 2.0 takes advantage of mobile convergence to link reality to game. Mobile allows for data to be shared real time, however, since the collected data could not be analyzed by recent technology such as big data, they were largely not meaningful.

Gamification 3.0 is the merging to reality and game via O2O technology and AI technology. Not only is mobile data shared real time, AI technology analyzes this data to create more meaning. Gamification has to follow the 3.0 structure for it to be successful to the masses.

7. Conclusion

7.1 Results and implications of the study

This study analyzes the theory behind the motivation behind participating in crowdsourcing and gamification in order find better means to generate more participation for crowdsourcing. The study also proposes means to develop O2O era crowdsourcing by applying elements of gamification.

First, the study analyzes how gamification has been applied to crowdsourcing by companies such as Google and Naver to create value. Google was able to enhance image searching in a short amount of time and Naver was able to create massive content in Korean. Both used gamification of crowdsourcing to solve their problems.

Crowdsourcing is not Free Lunch. In order to derive the wanted results, crowdsourcing has to be designed in a meticulous manner that stimulates people's willingness to participate and concentration.

The motivations behind people participating in crowdsourcing matches with intrinsic satisfaction people receive when they satisfy their basic desires. In other words, people participate because it is fun to participate. Hence gamification stimulates humans' basic desires to motivate and use them as tools for crowdsourcing and could be used for more effective crowdsourcing designs.

Second, the author expects that crowdsourcing will change in fundamental ways as it enters the O2O ear and the offline and online merges. These developments could significantly expand the scope of crowdsourcing.

Not only will the scope expand, crowdsourcing will continue to advance as people apply game mechanics and other recent technology that accelerate the development of O2O.

7.2 Limits and challenges of research

This study proposes gamification as a means to motivate the masses to participate in crowdsourcing. This study proposes the development of crowdsourcing according to O2O convergence trends, however, there are limited empirical cases that support whether this theory works.

The author plans to explore the structure and purpose of O2O generation crowdsourcing via empirical analysis and methods to implement gamification 3.0.

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June 15 (Monday)

R# : 201 Conference Room

General Session 2

■ **Session Chair: SangChul Park**(Korea Polytechnic University)

- Paper 1: "The Future of Innovation: Challenges, Complexity & Crossovers" by **Philip Cooke (Bergen University College, Norway)**
- Paper 2: "Growth Strategy for Finnish Science Parks under External Economic Crises" by **SangChul Park (Korea Polytechnic University)**
- Paper 3: "Promotion of university students' skills and behaviours topical for open innovators" by **Karine Oganisjana(Riga Technical University, Latvia)**
- Paper 4: "The scope of coaching in the context of organizational change" by **Angelina Rosha(Riga Technical University, Latvia), Natalja Lace(Riga Technical University, Latvia)**
- Paper 5: "Research Ethics Education for Overcoming Differences in Culture and Value System" by **Hwan-jin NHO(DGIST)**

The Future of Innovation: Challenges, Complexity & Crossovers

Philip Cooke

Draft Presentation:

14 – 18 June, 2015

Venue: DGIST (Daegu Gyeongbuk Institute of Science & Technology), Daegu, Korea

1st Society of Open Innovation: Technology, Market, and Complexity (SOItmC)
& (8th Knowledge Cities World Summit) 2015

Abstract

The Future of Innovation: Challenges, Complexity & Crossovers

Prof Phil Cooke, Center for Innovation, UC Bergen, Norway

Progress has been made of late on understanding that the core process of innovation is 'knowledge recombination'. This implies not a “closed” but an “open” perspective on how innovation occurs. From an economic geography perspective, which is taken in this presentation, this raises interesting issues for the economics of knowledge. First it makes the need to pay serious attention to questions of 'proximity' imperative, suggesting not that knowledge is easily appropriable for ('open') innovation but that it may be excessively difficult to identify because it lies hidden in possibly neighbouring - but different - industries and firms. Thus, second, it makes the notion of 'knowledge spillovers' problematic because the spillovers may come in unrecognisable forms. Hence, third, this means that firms likely need more than usually expected intermediation (including knowledge transfer services) to avoid market failures of innovation. The complexity theory notion of 'transversality' has been advanced to capture the 'emergence' of novelty out of contexts of difference, unifying a solution to the three conceptual problem-issues raised in the paper.

Growth Strategy for Finnish Science Parks under External Economic Crises

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1. Introduction

A new economic order based on globalization and localization processes has changed the fundamental economic systems that caused in the global financial crisis in 2008 and the EU's sovereignty debt crisis in 2011. Particularly, the Finnish national economy was affected by the reformation of the two global and regional economic crises in the beginning of the 2010s. This resulted in a severe economic recession in the beginning of the 2010s. In fact, the suffering from the economic recession started with the collapse of the former Soviet Union in the early 1990s, which was one of the largest trade partners for Finland. However, Finnish economy recovered rapidly in the end of 1990s since it found East Asian markets as substitutes. However, two external economic crises in 2008 and 2011 influenced negatively that made the national economy worse.

Finland has not recovered fully yet from the two external economic crises and led to the loss of a significant part of nation's economic base. Particularly, the structural crisis in the manufacturing is widely reflected its economy and prospects It is extremely important to understand that the present crisis is completely different from the recession in the 1990s. In fact, the present crisis is even more difficult, because productivity growth has halted in an unprecedented way. It is even worse that there is a lack of ideas to improve the situation because achieving new economic growth requires exceptional efforts. (Holström et. Al. 2014)

In the Finnish economy, the electronics industry had played significant roles in generating economic growth, new employment, value added etc. since the economic crisis in the 1990s. In fact, the success of Nokia-led ICT cluster known as Technopolis Plc maintained favorable economic growth for a long time. As a result, the budget surpluses were large and new employment was created continuously. These conditions were able to generate an economic structure in which wages rose rapidly and public spending grew faster than was desirable in term of sustainable development.

In 2012, the electronics industry started to be collapsed along with Micro Soft's merging Nokia Mobile Phone. Since then, exports and output have declined sharply. At the same time, the contraction of paper industry has continued and metal processing has suffered from low prices in global markets. These factors caused a deterioration of profitability in manufacturing sectors. Due to the structural problems and global economic conditions, there is no single and fast way to recover from the crises and return to rapid economic growth so that a long term and goal oriented approach is required. (Bouwman et. al, 2014)

In order to overcome such an economic recession as soon as possible, all economic actors tried to reshape their organizations and adapted the processes of de-regulation and free competition on the markets. Under this circumstance, a consensus on the new growth strategy emerged, and the government and industry began to emphasize technology and innovation as the basis of economic growth in the future As a result, the technology- and innovation-oriented growth strategy was complemented by an emphasis on the new efficiency- and competitiveness-oriented role of the government. With the severe economic crisis in the mid 1990s, the technology- and innovation-oriented growth strategy was regarded as necessary for Finland to implement because the Finnish economy was increasingly exposed to foreign competition. This means that Finland could not compete with other advanced nations without having world-class innovatory capacity, efficiency, and value-adding capacity. In the recent two crises in 2008 and 2011, the solution measures are not so different compared to the previous measures. Particularly, the government can contribute to generating economic growth by improving general operating conditions for business, promoting labor mobility, and supporting innovation activities based on R & D. Moreover, it is important to improve the productivity of public services and to increase the labor participation rate (MTI 1996; Schienstock and Hämäläinen 2001; Holström et. Al. 2014).

This paper focuses on growth strategies of Finnish economy as a whole and of Technopolis Plc in particular which is the largest science park group in Finland. It also explores how Technoplis Plc as an entity of private corporate could achieve high growth during the economic crises and even expand rapidly on the global market although many private and public sectors experienced weak economic performances in terms of output, new employment, and growth rate in the same period. Additionally, it will also be analyzed whether such a high growth and expansion could be sustainable in the future or not. It is also significant to be analyzed how its' corporate governance is composed of and what are its strategies to grow and expand rapidly.

2. Theoretical debates

The internationalization process and its geographical expansion of economic activities of a firm can be analyzed from two different perspectives (Benito, Petersen, & Welch, 2007): the economic–strategic view, and behavioural, or process-oriented view. The economic approach indicates that companies aim to achieve a balance between economic benefits and appropriate degree of control that enables the company to control risk exposure and have strategic flexibility when it comes to location and entry mode choices (Anderson & Gatignon, 1986). This stream of literature consists of different approaches (Benito et al., 2007), but for the purpose of this case, we will focus only on two of them. First, the resources-based view, suggesting that the choice of foreign entry mode is driven by the specific resources a particular firm attains; second, the eclectic paradigm by Dunning (1980; 1993).

The resources-based view (RBV) is built upon that firm's competitive advantage is due to firm-specific resources, which create unique value and reside in an effective organization. Resources are defined by Barney (1991) as simultaneously valuable, rare, imperfectly imitable and imperfectly substitutable. When firms go international, we might conclude that firms need to utilize those resources and develop new resources to overcome inherent disadvantages in the new environment. In other words, a firm's successful international development experience presents firm-specific tacit knowledge that is hard to copy (Barney, Wright, & Ketchen, 2001). The RBV encourages also the involvement of resources in foreign markets as argued by Peng (2001), and therefore expands firms' views toward internationalization and growth strategies. Hoskisson et al. (2000) emphasize the importance of using the RBV framework in the context of explaining FDI streams between Western and emerging economies. The traditional approach notes that multinational enterprises from Western economies build their overseas investments with administrative heritage (Bartlett & Ghoshal, 1991), seek competitive advantages through global learning (Bartlett & Ghoshal, 1989), and then reap the benefits as first movers in markets (Hoskisson et al., 2000). The reverse stream argues that multinational enterprises from emerging economies seek market technologies in Western economies and build subsidiaries there in order to access technologies and to compete in the global market (Yeung, 1999).

In contrast to the economic approach, which puts strong emphasis on rational decision making, the behavioural, or process-oriented approach explains firms' international expansion activities from the decision making process of the entrepreneur, initially suggested by Johanson & Vahlne (1977), and labelled the Uppsala model of internationalization. This internationalization process is not solely based on economic criteria and might include other arguments, like personal preferences or experiences of the decision makers in the firm as well, and was initially developed as a stage model, or process theory of internationalization (Autio, 2005). Johanson and Vahlne have later revised their model by strengthening the importance of networks in the internationalization process of firms and by considering trust-building and knowledge creation as important factors (Johanson & Vahlne, 2009).

They emphasize now that firms are embedded in a business networks that include different actors involved in interdependent relationships, both externally and internally. Internationalization might therefore be analyzed as an activity to strengthen or improve a firm's position in its network. Existing business relationships of a firm influence the selection of foreign markets a firm would like to enter, as well as the selection of the entry mode. The importance of the existing business relationships is led by their ability to provide access to recognize and exploit new opportunities. They point out that learning and commitment building, that take place in the development of business networks, have positive relationships with the identification of opportunities. Because some types of knowledge are difficult to access or restrained to network insiders, a strong commitment to partners provides opportunities to firms to access these knowledge. Like in the 1977 framework, the revised model consists of two sets of variables: state variables and change variables, which impact each other. The framework describes processes that are dynamic and cumulative – processes of learning, trust, and commitment building. Thus, an increased level of knowledge impacts both, trust building and commitment.

They also added the recognition of opportunities to their conceptualization of knowledge. The identification of opportunities is the most significant element of the body of knowledge that drives the internationalization process. In addition, there are other components, such as needs, capabilities, strategies, and networks that are directly or indirectly related to the firms' institutional contexts. The learning, creating, and trust-building emphasize the importance of experiential learning. Therefore this factor focuses on the subjective, direct experience in the learning process. In this sense knowledge results from the combination of grasping and transforming individual experience (Kolb, 1984). The relationship commitment decisions-variable implies the decisions of the firm to increase or decrease the level of commitment to one or several relationships in its network. These decisions would be presented by changes in entry modes, the size of investments, organizational changes, and definitely in the level of dependence. However, a change in commitment would lead to the possibility of both strengthening and weakening the relationship. Generally, there are two types of decisions in terms of commitment to the relationship. The first is to create new relationships, and the second is to build a bridge to new networks and fill structural holes.

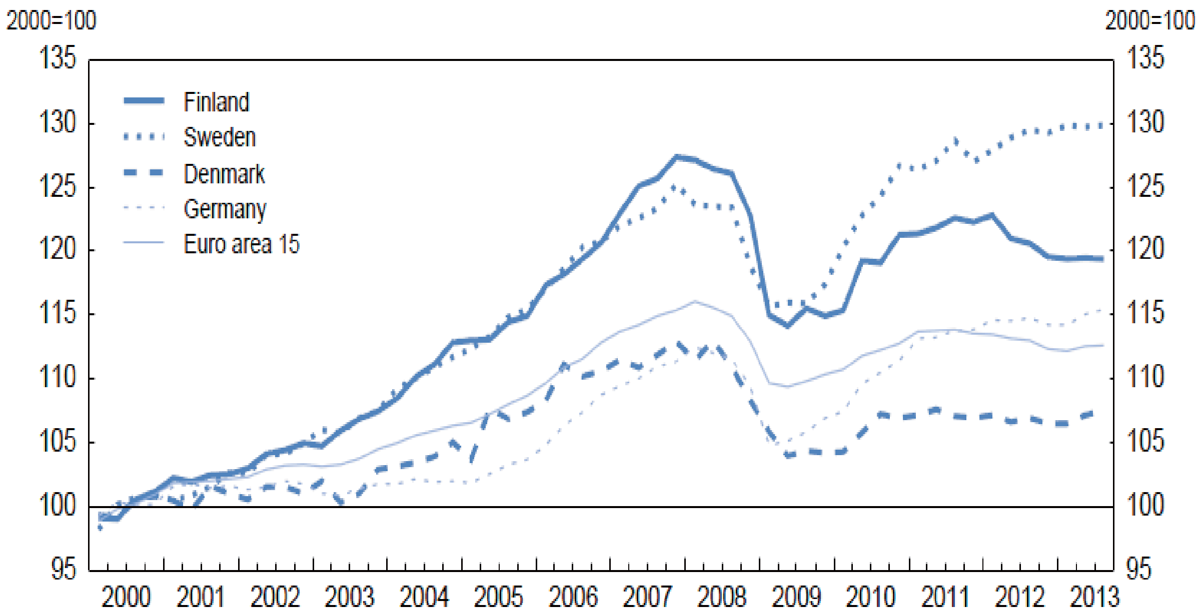
These two theoretical backgrounds are useful to explain how Technopolis Plc has been able to implement its growth strategies not only in the domestic market, but also in the global market particularly in the recent period although domestic and global economic environment has not been positive due to the two global and regional economic crises that have affected to the Finnish economy severely.

3. Finnish Economy and Innovative Condition with Two External Crises

3.1. Macroeconomic situation in Finland

Finnish economy had outperformed most comparable countries on GDP growth since the 2000s. However, the global financial crisis and the EU sovereignty debt crisis hit the economy severely since 2008. As a result, it experienced a double dip, and the output is still about 6 percent below its peak level in 2007. The Finnish GDP declined nearly 9 percent in 2009 that reflects the vulnerability of the country's economy to global trend. Its output declined in 2012 once again. Foreign demand still remains weak, and Finnish economy is undergoing deep restructuring. Furthermore, household income growth is weak so that private consumption and business investment are low. Since 2014, the global economy is expected to be improved gradually. However, strong growth will require innovation and gains in competitiveness to revive exports and investment. (Honkapohja, 2013; OECD, 2014) (See fig. 1)

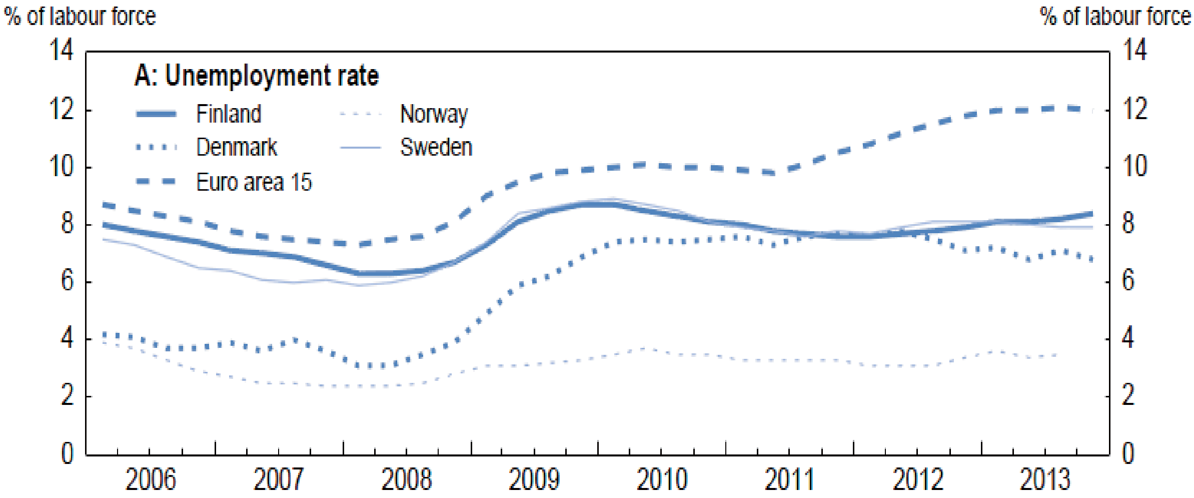
Figure 1: Trend of Real GDP in Nordic Countries (As of 2000 ~ 2013)



Source: OECD Economic Outlook database between 2000 and 2014

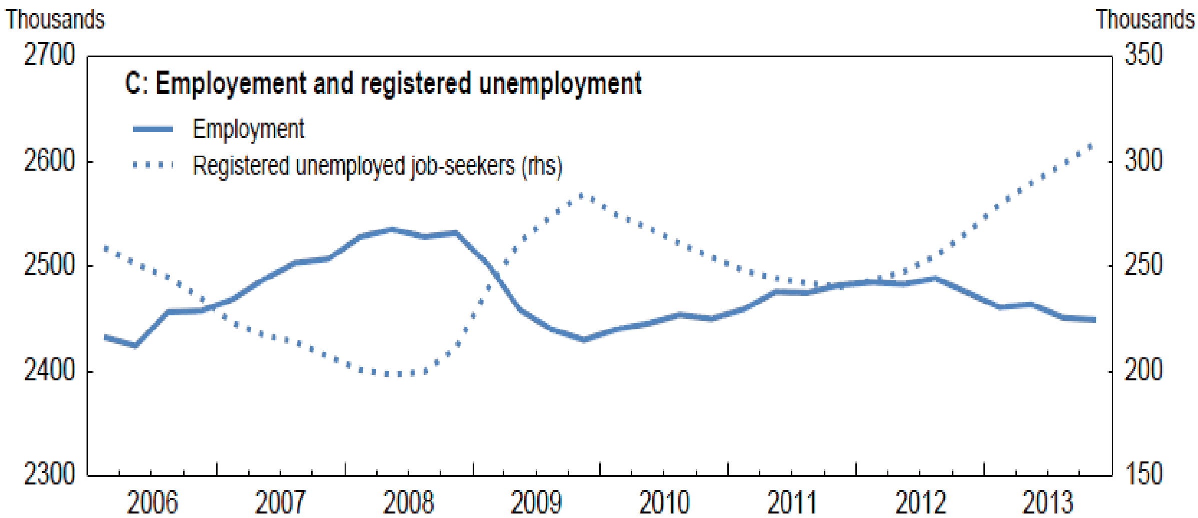
Finnish economic downturn caused a high unemployment rate since 2008 that has remained still high with over 8 percent. The long term unemployment has been contained. However, employment has declined and registered unemployment has increased after 2008 and 2011. In the Finnish economy, there is clear shift of the production structure from high productivity manufacturing to lower productivity services that has made losses in output in relative to employment. Shrinking labour supply and the shift to lower productivity service sectors caused slower growth due to low investment. The Finnish economy as a small open economy is extremely vulnerable not only to the global demand, but also to a slowdown in neighbouring countries such as Russia and other Nordic countries. In order to get out from the recession, a highly competitive workforce and a favourable business environment could revive knowledge and innovation-led economic growth. Additionally, the economic recovery could be strengthened if the economic restructuring process is completed and cost competitiveness improves. (Fig. 2, 3)

Figure 2: Trend of Unemployment Rate in Nordic Countries (As of 2006 ~ 2013, %)



Source: OECD Employment and Labour Market Statistics database, Statistics Finland, Ministry of Employment and the Economy, and Eurostat

Figure 3: Trend of Employment and Registered Unemployment in Finland (As of 2006 ~ 2013, %)



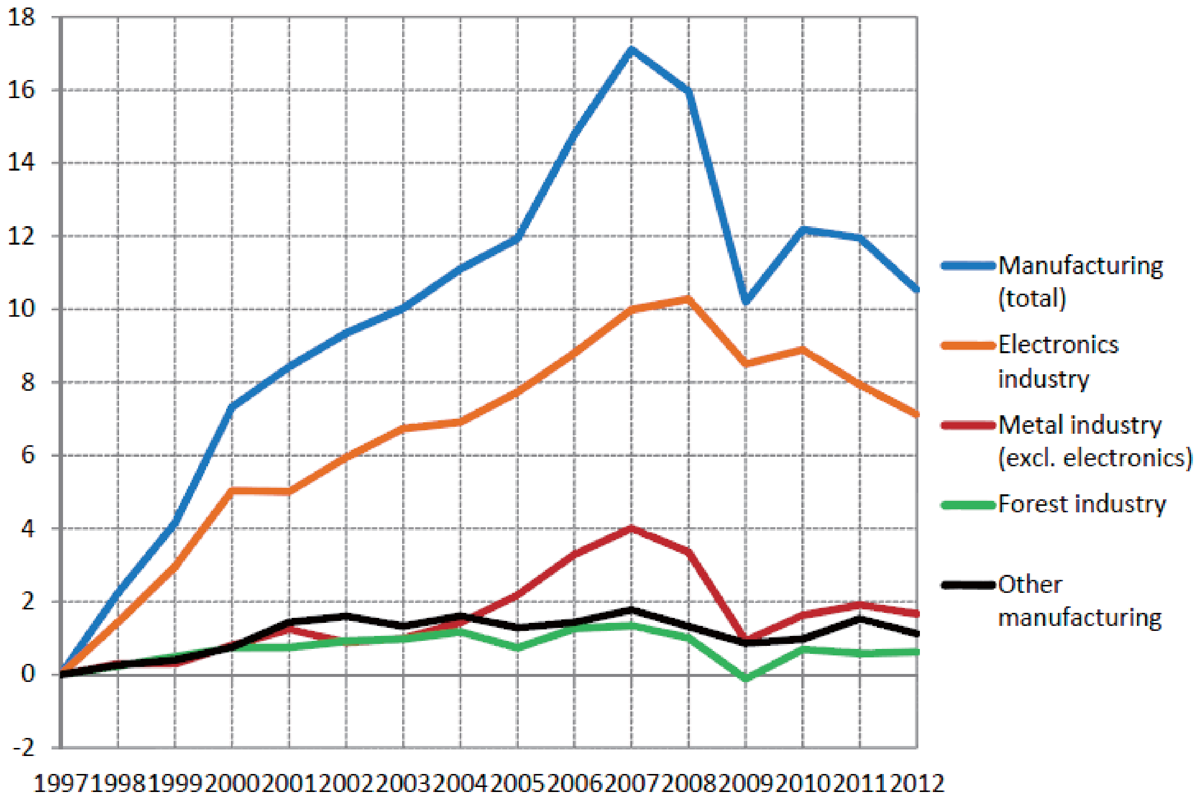
Source: OECD Employment and Labour Market Statistics database, Statistics Finland

3.2. Trend of industrial sectors in Finland

Finnish manufacturing sectors have suffered from a sharp decline since 2008 particularly in electronics and metal industries. 50 percent of the Finnish economic growth between 1998 and 2007 was created by the manufacturing sector. Among this, 60 percent of contribution came from the electronics industry, and 20 percent from other metal industry. However, the situation of manufacturing sectors has changed dramatically since the global financial crisis; the manufacturing sectors declined sharply, while private service sectors have maintained its growth.

The decline of the electronics industry is the largest, and basic metals as well as production of machinery, metal products and transport equipment have followed. The electronics industry has declined from 6 percent of total value added in 2007 to 1 percent in the recent year that was led by Nokia's tumble in the mobile phone market. Along with the electronics industry, the metal industry declined sharply. Although private service sectors have increased under the external economic crises, it has not been able to compensate for losses in output and exports in manufacturing. (Holström et. Al. 2014; OECD, 2014) (Fig. 4)

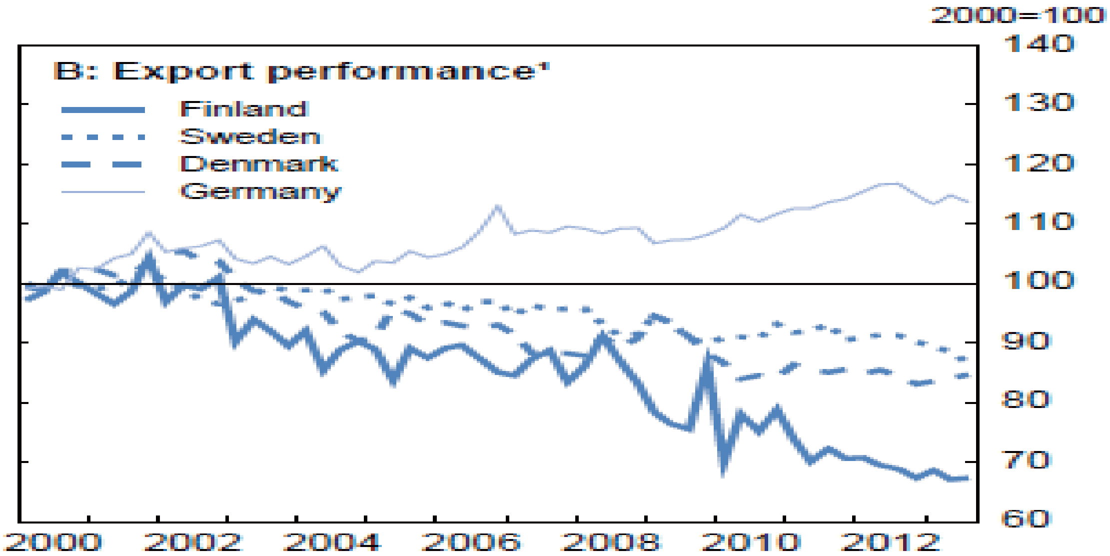
Figure 4: Cumulative Contributions to Growth of Total Output of Economy (%)



Source: Statistics Finland, 1997 - 2014

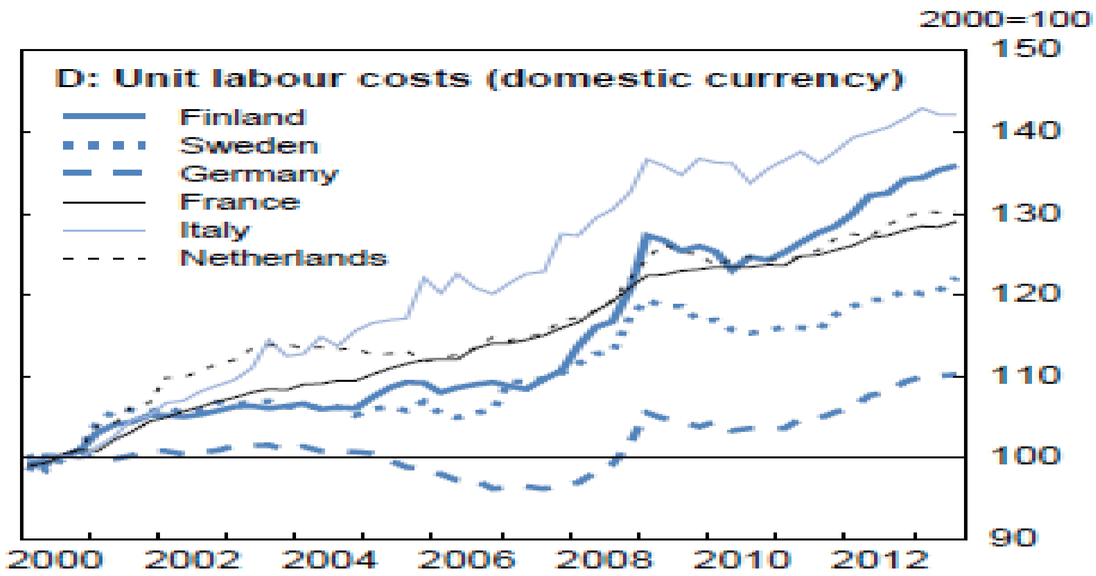
Owing to the negative trend of Finnish industries, the current account has fallen into the deficit after nearly two decades, and exports have declined sharply. The declining exports have been based on losses in non-cost competitiveness particularly in electronics. Moreover, price competitiveness has been weakened because unit labour costs have increased faster than many other European countries since 2000. These factors have resulted in low economic growth and high unemployment rate in the recent years. In order to overcome the present recession, social partners settled the modest wage increase over the next two years that will impact positively on cost competitiveness and export recovery. (OECD, 2014) (Fig. 5, 6)

Figure 5: Export Performance in Nordic Countries (2000 ~ 2013)



Source: OECD Economic Outlook database

Figure 6: Unit Labour costs in Major EU Countries (2000 ~ 2013)



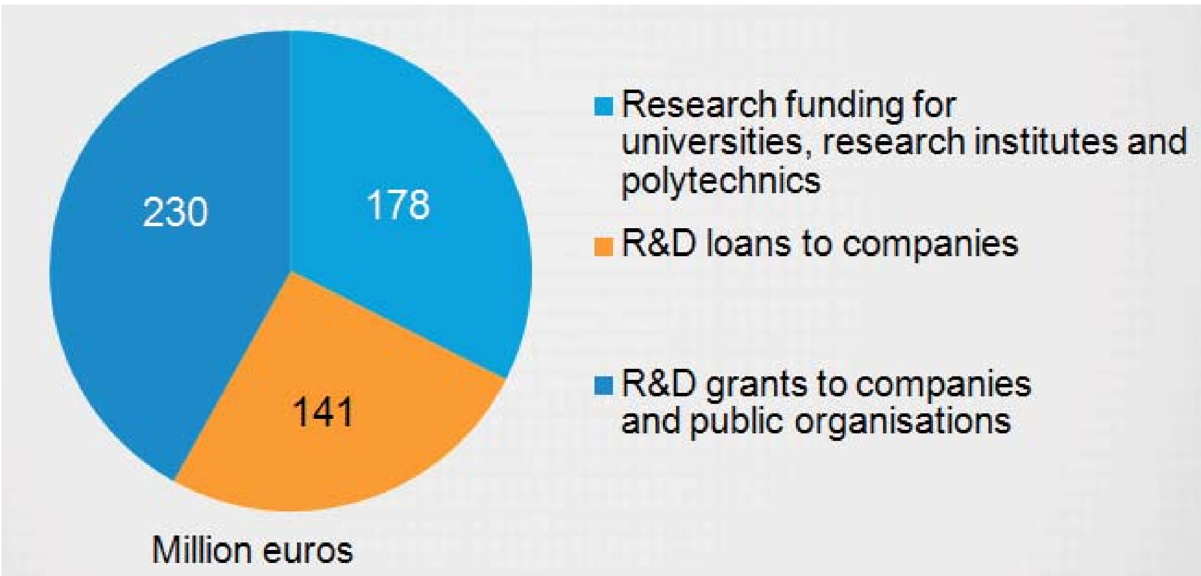
Source: OECD Economic Outlook database

3.3. Innovative condition

One of the major actors for supporting national innovation system is TEKES. In 2014, TEKES funded 550 million euro for companies and research organization. 3,670 projects were applied, and 2,750 projects were decided to be funded. For private companies' projects, 371 million euro was funded. Among this, 134 million euro was funded for young growth companies. Additionally, 63 percent of company funding was for SMEs. As an outcome, TEKES has partly funded 65 percent of well known Finnish innovations. Over 80 percent of TEKES customers stated that TEKES funding played a significant role in their successes. Moreover, projects that were completed in 2014 generated 1,500 products, services or processes. (TEKES, 2014)

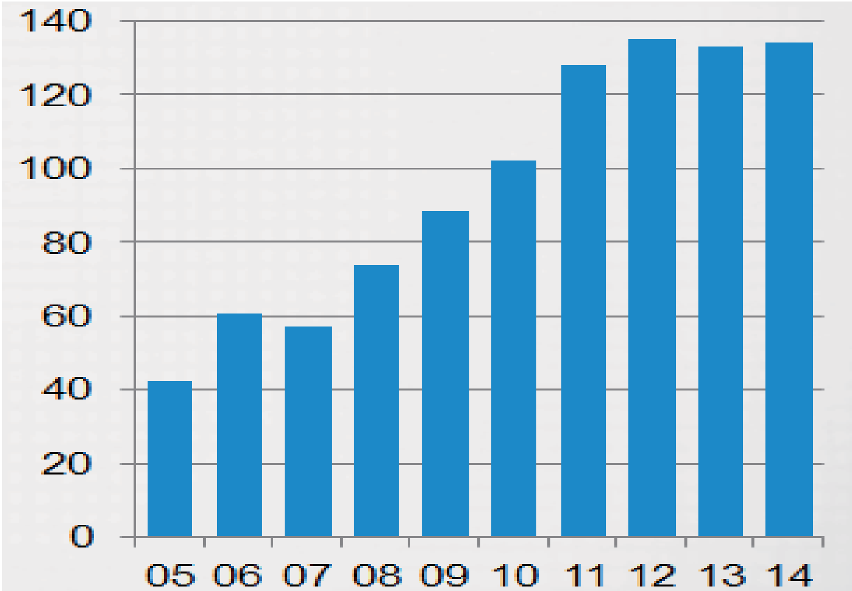
TEKES provides its financial measures for R & D fund, loan, and grant. Among these, R & D fund accounted for 230 million euro in 2014. R & D loan and grant were provided 141 million euro and 178 million euro respectively in the same year. At the same time, TEKES emphasises young growth companies in its funding in order to generate new emerging companies. Particularly, it has focused on funding to small and less than six years old companies. In 2014, 134 million euro was funded for young growth companies, of which 28 million euro was funded for young innovative companies. The funding for young growth companies has increased since the global financial crisis. It means that TEKES focuses on funding not only for state of arts technology in large sized companies or research institutes, but also for high technology in SMEs and start ups in order for them to get in the global markets. R & D loans and grants are also very useful financial measures for SMEs and start ups to strengthen their technological levels for the global markets. (Fig. 7, 8)

Figure 7: TEKES R & D funding in 2014



Source: TEKES, Key Figures in 2014

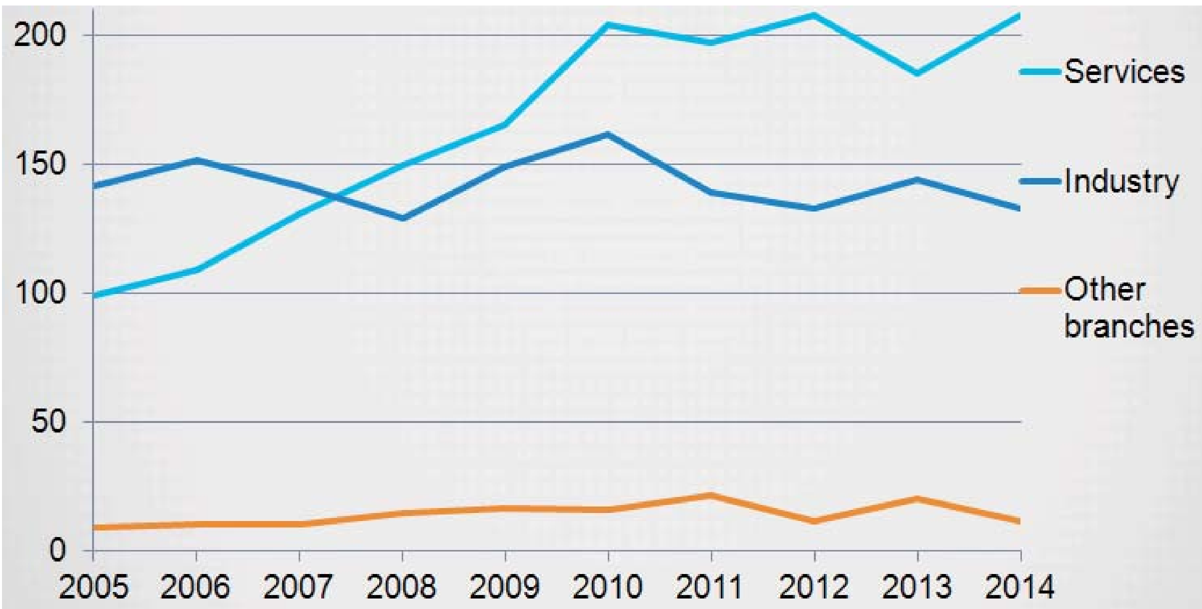
Figure 8: TEKES Funding for Small and Young Companies (2005 ~ 2014, million euro)



Source: TEKES, Key Figures in 2014

The funding direction of TEKES is identical to the industrial trend which emphasizes service industries instead of manufacturing industries since the global financial crisis. R & D funding in industrial sectors are also the same trend to the industrial structure. In the manufacturing industries, electronics, machines, and metal industries were funded mostly, while chemical, forest, and foods industries were funded less. In the service industries, software and data processing have been funded mostly. (Figure 9)

Figure 9: R & D Funding for Industry and Services (2005 ~ 2014, million euro)



Source: TEKES, Key Figures in 2014

4. Technopolis Group as Innovative Cluster

4.1. Background

Technopolis is a growth company focused on renting offices for innovative companies. It started in 1982 with 4,000 square meters of office space for small growth companies in Oulu, Finland. During the 1980s and 1990s, Technopolis made 2,300 percent growth that was an extraordinary expansion in a remote area. In 2001, Technopolis was succeeded in enrolling in the Helsinki Stock Exchange that was the first time ever to be registered as a science park in the world for gaining capital in the financial market.

Moreover, Technololis merged and acquisited other domestic science parks in 2003 and became the largest science park group in Finland. It started to be globalized since 2010 after establishing its first science park abroad. In 2014, it operated in Finland, Estonia, Lithuania, Russia, and Norway and became a global science park group creating its own name brand as Technopolis Plc representing the hub of state of art technology particularly in electronics technologies. The global giant, Nokia has been the largest single company operating in the Technopolis Plc although its portion has declined since its mobile phone business was sold to Micro Soft in 2012.

4.2. Corporate governance

Technopolis Group consists of the parent company, Technopolis Plc, whose subsidiaries have operations in five nations in Europe such as Finland, Estonia, Lithuania, Russia, and Norway. Technopolis Plc has several subsidiaries and associates home and abroad. Early in the year, Technopolis Plc incorporated most of its Finnish properties into five regional real estate companies. During the fiscal years, the parent company acquired investment properties in Peltola, Oulu, and the Falcon Business Park in Espoo.

Since 2010, Technopolis Plc carried out global strategy to expand its business model abroad. In line with the strategy, it established a subsidiary in Lithuania with 100% ownership, which is Technopolis Lietuva UAB. It owns three the three real estate companies associated with the Vilinus campus. Technopolis Group has 51% holding in Technopolis AS, which owns the Fornebu campus via its Norwegian subsidiaries, Technopolis Holding AS and Technopolis Hoding 2 AS. In Russia, Technopolis Plc manages its Pulkovo properties via Technopolis St. Petersburg LLC with 100% ownership. In Estonia, the parent company owns Technopolis Baltic Holding OU, which manages the holding in Technopolis Ulemiste AS with 51% ownership. (Technopolis Plc, 2014)

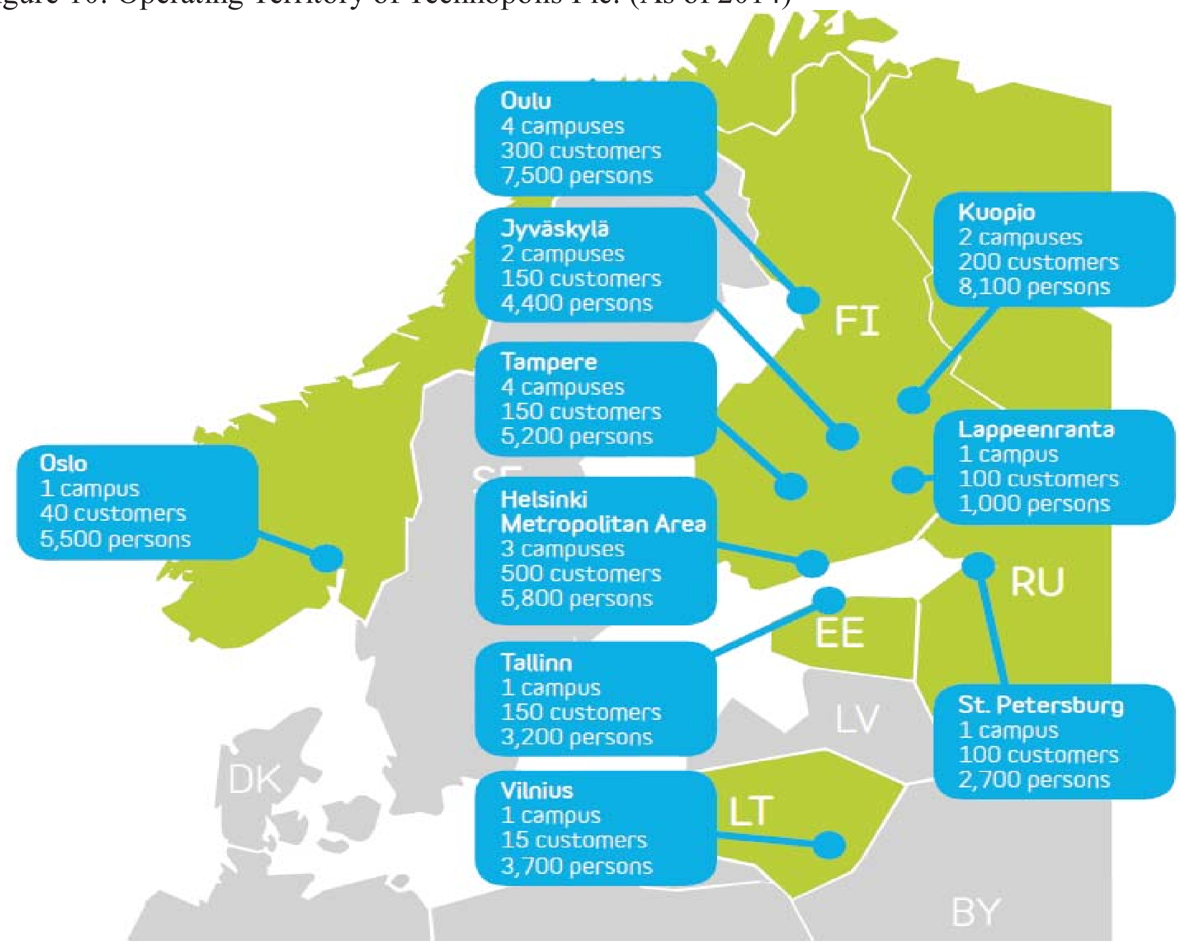
Governance and decision making in Technopolis Plc is based on Finnish regulation, and with regard its subsidiaries on the legislation of the domicile of each subsidiaries. In addition, Technopolis Code of Ethics as well as internal policies and guidelines are also important measures guiding company’s operation. The company’s administrative structure is based on the Limited Liability Companies Act, which requires the general meeting of shareholders, the Board of Directors, and the CEO. Shareholder’s Nomination Board is established by the Annual General Meeting. The board of Directors is supported by the Board Committee, and the CEO is assisted by the Management Team while managing the company’s operation. These three organizations are the major decision making bodies. Among these, the General Meeting of shareholders is the highest decision making body in Technopolis Plc. ((Technopolis Plc, 2015a)

Technopolis Plc had 220 employees in 2014. Among them, 80 employees worked in real estate services, 84 in business services, and 56 in the group functions. The goal of the Technopolis governance is to support and facilitate the 12 regional independent science parks. Skilled, capable, and motivated employees are the major source of success of Technopolis and the key factor to create a good governance.

4.3. Growth strategies

Technopolis Plcs is a company that specializes in providing operating environments for high tech companies and high tech ventures. It also utilizes a service concept that combines premises, business services and development services. Therefore,, it is not a simple real estate company offering only rental services for its premises, but providing a comprehensive service for high tech companies focusing on growing on domestic and global markets. It operates in six regions such as Oulu, Helsinki Metropolitan Area (HMA), Jyvaskyla, Kuopio, Lappeenlanta, and Tampare as well as four foreign countires such as Russia, Eastland, Lithuania, and Norway. (Fig. 10)

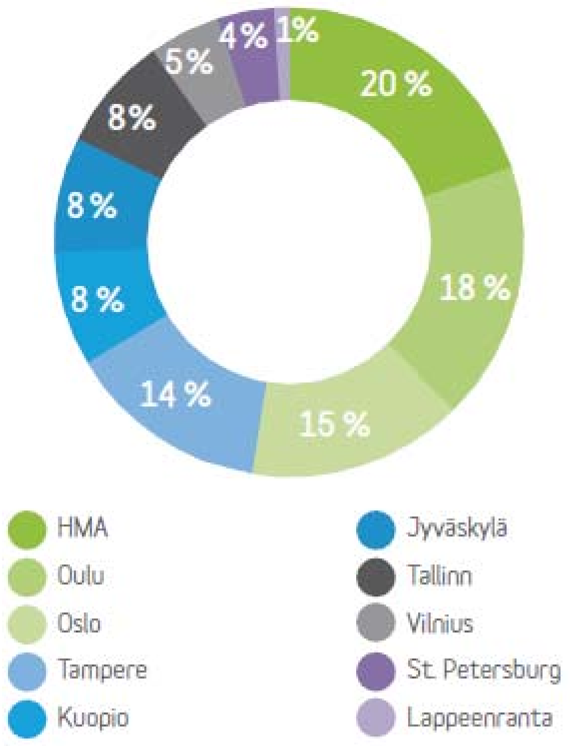
Figure 10: Operating Territory of Technopolis Plc. (As of 2014)



Source: Technopolis Plc, 2015

Technopolis plays very significant roles in vitalize not only its campuses, but also its regions located. In 10 Technopolises, 1705 high tech companies operated and 47,000 employees worked in 2014. The net sales in the same year accounted for 161.7 million euro, which grew 28% compared with the net sales in 2013. A growing independent community is formed by the one or two anchor customers on each campus which play as leading companies in the site. Particularly, Nokia's role has been very dominated in Oulu and Helsinki Metropolitan Area. In each Technopolis, high tech companies can easily find customers and partners that create new technological innovation and business models. Following the expansion of the Technopolis chain, new opportunities to find customers and partners have continuously grown from the campus to new cities and countries. For this reason, 110 Technopolis customers operate at more than one location within campuses. Among the ten Technopolises, Technopolis in Helsinki Metropolitan Area and Technopolis in Oulu generate high outputs while Technoplis Oslo generates the largest output among foreign campuses. (Technopolis Plc, 2015b) (Fig. 11)

Figure 11: Portion of Output in Technopolises (As of 2014)



Source: Technopolis Plc, 2015

The company's strategy to grow is to become a major global office chain that offers high tech companies standardized space and comfortable Technolopis management, knowhow and services. Technoplis focuses on growth opportunities in Baltic and Nordic region in next few years. Particularly, growth will be pursued by building expansions of present offices and by seeking new office properties to acquire. Moreover, company's growth is created from service sales, which have been increased in three measures. The one is to focus on service sales with regard to certain products. The second is to increase all campus service sale levels to the level of the best campuses. The third is to develop and sell new service products.

Last five years (2010 ~ 2014), Technopolis has grown rapidly with average 18.9% in terms of net sales although the national economy could generate a low economic growth due to the global financial crisis and the EU sovereignty debt crisis. The tenants of high tech companies located in the Technoplises also are well balanced. Information and communication as well as professional services accounted for 40% which are dominated compared with other industrial sectors such as manufacturing, education, financial services etc. Customers carry out their businesses in ten different areas. (Table 1)

Table 1: Business Performance of Technopolis Plc (2010 ~ 2014)

	2014	2013	2012	2011	2010
Net sales, EUR million	161.7	126.3	107.3	92.8	81.2
Growth, %	28.0	17.7	15.6	14.4	
EBITDA, EUR million	87.2	64.1	55.8	47.5	41.4
Growth, %	35.9	15.0	17.3	14.8	
Return on capital employed, % *)	6.6	4.4	5.5	5.2	4.5
Equity ratio, %	38.5	40.2	36.2	35.8	37.4

Source: Technopolis Plc, 2015

In order to create a further growth, Technopolis created four values as growth strategies providing guidelines for the business.

Firstly, customer orientation

The company works with passion and aims to exceed customers' expectation. As a service provider, customers' satisfaction is regarded as the uppermost important goal for the company. Additionally, Technopolis intends strongly to upgrade customer's expectation.

Secondly, innovation focused

The company seeks creative solutions to fulfil customer's needs. Most of tenants are high tech companies so that it is not easy tasks for Technopolis to fulfil their expectations. Accordingly, the company needs to develop innovation based approaches to support the high tech companies.

Thirdly, profitable growth targeted

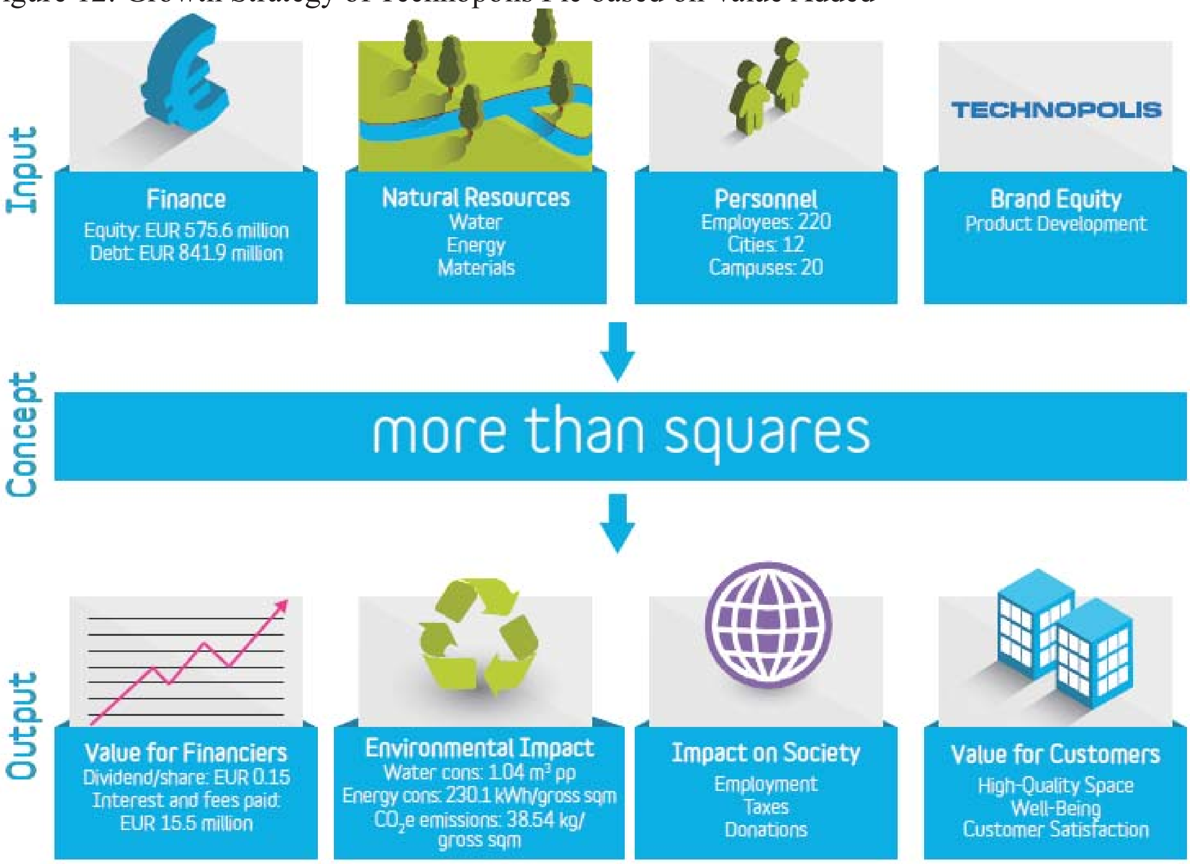
The company works cost effectively, and aims to improve its operations continuously. As a company enrolled in the Helsinki Stock Exchange, a key factor to grow continuously is to make proper profits that can create a sustainable growth.

Fourth, community responsibility based

The company works to maintain and enhance its community spirit at each campus consistently. All technopolises in Technopolis Plc is a community based within and beyond. All companies located in technoploses are connected one another by services provided by Technopolis. Therefore, they have easy access to contact to other high tech companies needed.

The reason why the Technopolis focuses on customers' satisfaction is that they are the company's key shareholder group. Additionally, all of company's operations target to continuity and improving customer's satisfactions. Technopolis Plc is keen to create value added as a growth strategy. It is a real estate based service provider based on its knowledge and knowhow how to manage science parks. Therefore, it can create more value added by providing customers business services that can generate value added based on customer satisfactions As a result, it creates its output for financial value, environmental impact, positive impacts on society, and value for customers. (Technopolis Plc, 2015b) (Fig. 12)

Figure 12: Growth Strategy of Technopolis Plc based on Value Added



Source: Technopolis Plc, 2015

5. Analysis on Technopolis Plc

Despite high growths last five years, Technopolis faces several risks which can hinder from its further growth. The company identifies strategic risks in three areas such as investment portfolio market risks, counterparty credit risks, and operative risks. The investment portfolio market risks consist of interest rate risk, portfolio's geographical concentration risk, currency risk, and portfolio liquidity risk. The counterparty credit risks are customer risk, derivative counterparty, reinsurance counterparty, contract counterparty, and partners. Finally, the operative risks consist of processes, personnel, systems, external events, and compliance risks.

In order to manage various risks, Technopolis carries out its own risk management system. Risk management is a dynamic and continuous process. Therefore, it plays a core role in Technopolis' strategic and annual planning process. For carrying out the risk management properly, the Board of Directors monitors regularly and evaluates risk related to the company's business operations and business environments. It also reports on them in accordance with the legislation and other regulations applicable to the company.

Technopolis has a risk management system consisted of four steps. In the planning process, the company identifies risks such as threats, uncertainties, and opportunities. At the second step, it assesses risks what are impacts, probability, and prioritization. At the third step, risk treatment is implemented such as risk treatment actions, contingency actions, and responsibility and deadline. As a final step, risk reporting and follow up of treatment actions are carried out. (Technopolis Plc, 2014) (Fig. 13)

Figure 13: Risk Management System in Technopolis

Source: Technopolis Plc, 2014

Although the company carries out its risk management system, several risks are detected, and the management team is aware of it and deal with mitigating minimum. At the same time, the company tries to find out its solution measures to deal with these risks. The company has found five major risks for their business operations. These are interest rate risk, geographical concentration risk, currency risk, customer risk, personnel risk which belongs to the three major risk areas. In each risk area, the company create a respond measure which could minimize the risk. Technopolis regards risks as uncertainties that are a normal part of business operations. Therefore, risks are assessed from the point of view of utilizing opportunities and eliminating the risks. (Table 2)

Table 2: Five Major Risks and Responds in Technopolis Plc (As of 2014)

Risks	**Situation**	**Respond Measure**
Interest rate	High interest rate bearing of 841.9 million euro	Hedging of 57.6% of liabilities
Geographical concentration	69.1% of output in Finland and 19.7% of output in the capital region	Distribution and growth of business in new areas
Currency	79.3% of net sales with euro and 20.7% of net sales with other currency	Distribution and hedging of exchange rate risks
Customer	The 20 largest customers accounted for 29.7% of the company's rented space	Distribution of individual customers, industries, and geographical concentration
Personnel	Monitoring 220 employees, developing job satisfaction, and ensuring competitive remuneration	Appealing, attracting, and retaining skilled employees

Source: Adapted by the author based on Technopolis Plc

Technopolis Plc. made loss of nearly 3 million euro in 2014, which is the second time since 2009. The company's loss made in 2009 was based on the result of the global financial crisis. However, the company made net profit during the EU sovereignty debt crisis although it affected the national economy severely. The main reason for making loss in 2014 is because the income tax was high, which was based on distribution of earning for the year to the parent company shareholders. However, the major concerns for the company are that operating profit and profit before taxes had declined since 2011 although the net sales had increased. It may be because of rapid business expansion abroad. Therefore, the management team must be aware of it to improve not only net sales but also operating profits in order to create a sustainable growth. (Table 3)

Table 3: Trend of Output and Profit in Technopolis Plc (2011 ~ 2014, 1,000 euro)

Summary of Income Statement	2014	2013	2012	2011
Net sales	161,678	126,335	107.330	92,835
Operating profit	42,865	43,854	48.031	71,990
Profit before taxes	630	22,649	34,476	60,015
Net result	-2,981	31,558	26,950	46,700

Source: Technopolis Plc, 2013, 2014, 2015

6. Conclusion remarks

Since the global financial crisis in 2008, the global economy has been turmoil and still performed weak growth several years. In order to overcome the economic crisis, US Central Bank, FED has implemented unconventional monetary policy which is called as quantity easing (QE). FED provided nearly 2 trillion US dollars in the financial market since 2009 and plans to raise its interest rate in order to pull back liquidity. Along with the US monetary policy, Japanese Central Bank and European Central Bank carry out their QEs in order to get out from the economic recessions.

In Europe, the EU sovereignty debt crisis hit the economy in 2011 after the global financial crisis so that the regional economy suffered from it very much. Finland as a small country was very much vulnerable from the two external economic shocks and generated a low economic growth several years. Although the global and national economic condition was not positive, some industrial sectors grew more than others. During the economic downturn, a clear pattern of industrial structure illustrates that manufacturing industry declined while service industry increased.

Technopolis Plc as business service provider for high tech companies could utilize such a new trend of industrial restructure. The company could grow nearly 20% per annum since 2010 although other companies suffered from the EU sovereignty debt crisis in 2011. It has overcome two external economic crises wisely with the company growth strategies and its risk management system. The company's internationalization strategy has worked out properly to expand its business activities abroad that are based on strong entrepreneurship and accumulated experiences and knowhow how to manage science parks

Despite strong growth and business expansion in terms of output and various operating sites, the company faces five major risks such as interest rate risk, geographical concentration risk, currency risk, customer risk, and personnel risk. The management leading group and team are aware of it and carry out their risk management system in order to mitigate risks. However, declining net profit in the recent year alerts the company's future as well. It is still a challenging situation for the company to create a sustainable growth not only in the domestic, but also in the global markets. For it, the company needs to upgrade its innovative solution measures to fulfil customers' satisfaction.

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Promotion of university students' skills and behaviours topical for open innovators

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Abstract

It is argued that the participation in open innovation processes requires a specific set of thinking, skills and behaviours founded on the willingness and readiness to exchange, accept, encourage, cooperate and co-create based on trust and collaboration. The paper presents the results of a study conducted in Riga Technical University with 85 bachelor students within the course "Economics of Entrepreneurship" in the autumn semester of 2014. The course was organised in an open environment, in which students worked in teams for solving real life problems in order to create new products and services. They had the opportunity to act not only within the University framework realising intra-team and inter-team collaboration facilitated by teachers and invited entrepreneurs, but as well they were encouraged to collaborate with people they needed for their projects from outside the University. The qualitative content analysis of the students' reflection texts revealed how highly students evaluated the potential intergenerational collaboration outside the formal University frames for co-creation. However their judgements on the advantages of such openness remained mainly at the level of theoretical thoughts but were not followed by corresponding behaviour.

Key words: open innovation, openness to experience, university education, learning for entrepreneurship

Introduction

The concept of "open innovation" is defined as use of purposive inflows and outflows of knowledge to accelerate internal innovation, and expand the markets for external use of innovation (Chesbrough, 2003). Open innovators have specific mind-set and disposition to co-evolve ideas, co-innovate and co-create new products and services elaborating innovation ecosystems (Chesbrough et al., 2014). They have the skills to relearn, create new ways to identify, assimilate, and utilize external knowledge, making it "digestable" (Salter, et al., 2014), scouting for external ideas, shepherding external ideas through internal processes, and facilitating their exploitation in the firm (Chesbrough, 2003). Open innovation requires supportive environment. Although an organisation may encourage its staff to be more open, individuals shy away from these efforts (Salter, et al., 2014). The question which is faced in this regard is how to promote individuals' openness.

Psychologists argue that openness to experience is one of the Five Factor Model of personality and describes the extent to which an individual is broad minded, imaginative, curious, and original (Barrick & Mount, 1991). The research, conducted by Comings and colleagues showed that openness to experience may be conditioned by DRD4 gene (Comings, et al., 1999). A decade later Scott Shane and colleagues showed that there is genetic correlation between openness and opportunity recognition which indicates that the same genetic factors influence both (Shane, et al., 2010). Shane and colleagues concluded that "62 percent of the covariance between openness to experience and opportunity recognition is accounted for by genetic factors, leaving 38 percent of the variance in opportunity recognition free to be influenced by efforts to change a person's openness to experience. This observation, of course, is consistent with the belief that personality traits, like openness to experience, are difficult to change." (Shane, et al., 2010:299). Despite the law probability of success, it is not excluded that openness to experience could be evolved in students if appropriate study and work environment is created.

This paper aims to analyse the situation related to the promotion of university students' skills and behaviours topical for open innovators while solving real life problems and creating new products and services within the study course "Economics of Entrepreneurship" in Riga Technical University.

The research question:

- How should open innovation promoting studies be organised?
- What do students consider to be of value in the open study environment?

The research methods:

- students' reflections on open study environment;
- qualitative content analysis of the students' reflection texts.

1. Organisation of the study process in the University for promoting students' skills and behaviours topical for open innovators

The methodology of the promotion of students' skills and behaviours topical for open innovators used by the author in Riga Technical University is based on three main principles:
- studies should be organised close to what takes place in a real enterprise;
- study ethos and interactions between all the participants of the study process should be entrepreneurial;
- students should have a number of collaboration channels both in and out of the university.

1.1. The character of studies organised close to what takes place in a real enterprise

Theoretical stance

It is argued that traditional teaching methods such as lectures, literature reviews and examinations do not activate students' entrepreneurship (Gibb, 2002; Sogunro, 2004; Heinonen & Poikkijoki, 2006; Hannon et al., 2005). Researchers and specialists in the field of entrepreneurship education consider that the most effective way to promote students' entrepreneurship is to "push" students into entrepreneurship through the structuring of learning as an entrepreneurial process (Hynes, 1996; McMullan & Long, 1987; Tan & Frank, 2006; Hjorth & Johannisson, 2007; Hannon, 2006).

Entrepreneurship education comprises two principal aspects: the first one encompasses a broader view of education which is oriented to the development of students' entrepreneurial attitudes and skills but is not directly oriented to the creation of a new enterprise (Bikse, 2009; Gibb, 2002; Kearney, 1999); the second one concerns the development of entrepreneurship competence in educational process accompanied with the creation and management of a new enterprise (Bikse, 2009) by playing entrepreneurial games (Caird, 1993), attending student business clubs and regular campuses (Tan & Frank, 2006) or by industrial visits and participation in a real enterprise (Erkkila, 1996; Wilson, 2008; Antones & Van Vuuren, 2005).

Realisation in practice

The approach analysed in this paper concerns the first aspect of entrepreneurship education. Since opportunity recognition (Baron, 2006; Drucker, 1998; Shane, 2000), opportunity creation (Sarasvathy, et al., 2003) and opportunity development (Sanz-Velasco, 2006) make the heart of entrepreneurial process, the study strategy here was based on the consideration of real life problems as new opportunities. The studies ensured all the stages of problem-based learning (Ramsay & Sorrell, 2007) providing activities which take place in a real enterprise (Davies, 2004; Hynes, 1996). They were realised according to the "Opportunity-oriented problem-based learning model for enhancing students' entrepreneurship" (Fig. 1).

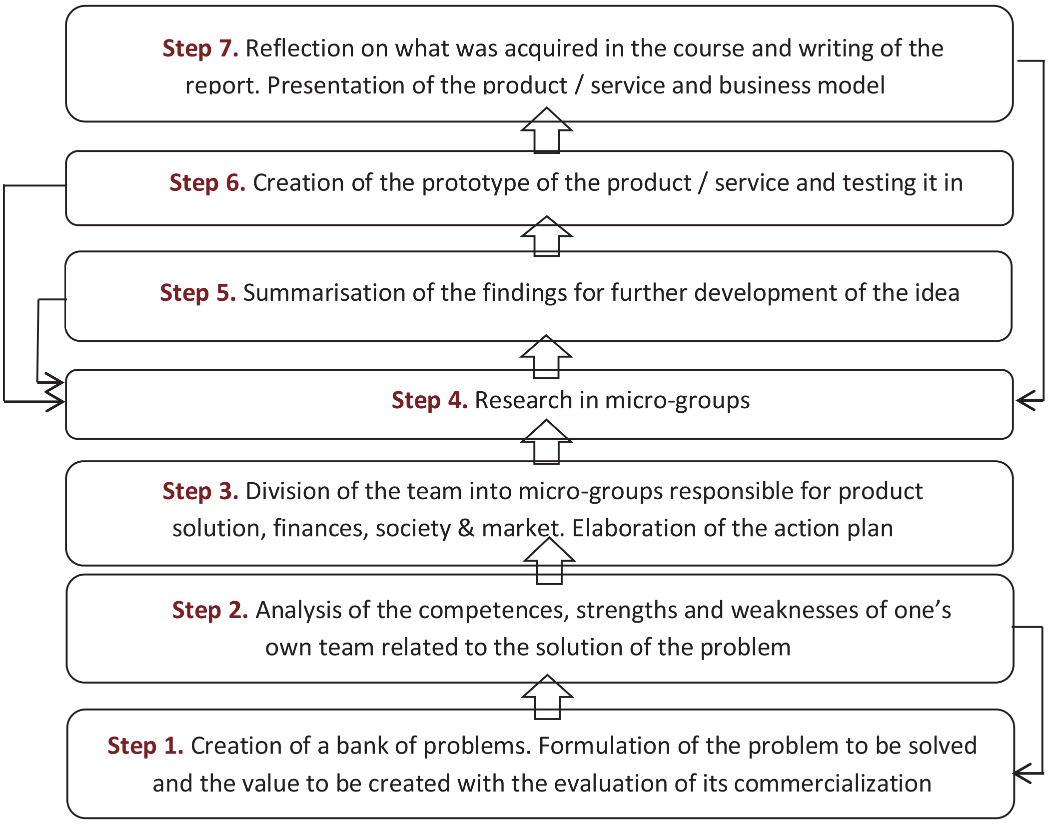

Fig. 1 Opportunity-oriented problem-based learning model for enhancing students' entrepreneurship, elaborated by Karine Oganisjana (Oganisjana, 2015:33)

This model was elaborated by the author and tried out within the European Social Fond project "Support to education research" in five schools of Latvia in 2012-2013; some elements of it were tested as well in three secondary schools of Malaysia within ASEM Asia-Europe Lifelong Learning Research HUB cooperation (Oganisjana, et al., 2014; Rahman & Lindenskov, 2014). Then it was adapted for university students, and as a strategy tried out with second year bachelor students (N=85) in Riga Technical University (Oganisjana & Laizans, 2015).

The students made teams of 3-6 people and started with the creation of a bank of problems of personal, social, cultural, environmental, economic and political character. Then each group discussed and came to the agreement which of the problems they would like to solve in order to create a new product or a service for commercialization. The groups realised each step depicted in the model till they created prototypes of the new value for the final presentation and discussion as shown in Figure 1. Step 4 was connected to research and was of great importance as each time the groups had to come back to it after steps 5, 6 and 7 to conduct additional research in order to find some new opportunities for the perfection of the product/service-to-be and for enhancing its potential of commercialization.

1.2. The entrepreneurial study ethos and interactions between its participants

Theoretical stance

The study ethos and atmosphere in entrepreneurship promoting education should be social, democratic, flexible and inspiring; students should be encouraged and motivated to cooperate (Taylor & Thorpe, 2004; Löbler, 2006; Hjorth & Johannisson, 2007; Kearney, 1999; Fiet, 2000; Heinonen & Poikkijoki, 2006). Such a study atmosphere motivates students to be active, generative and inquisitive able to help themselves and others (Heinonen, 2007; Politis, 2005). The best way of learning for entrepreneurship is to learn as entrepreneurs do - learn by doing (Chesbrough, 2003), reflecting (Heinonen, 2007; Antonites & Van Vuuren, 2005) from their mistakes based on their own experience (Hjort & Johannisson, 2007; Rae & Carswell, 2000; Wing Yan Man, 2006). The role of the teacher differs from what traditional university lecturers do. The teacher should be in dialogue with students ready to learn together with them and from them acting as a coordinator, colleague and facilitator (Hannon, 2006; Heinonen, 2007; Hynes, 1996).

In entrepreneurship education theoretical knowledge should be combined with its practical application (Heinonen, 2007; Hannon, 2006) and experience should be combined with formal educational activities (Timmons & Stevenson, 1985). The teacher should encourage students to create theory-based activities (Fiet, 2000) and promote derivation of theory from practice (Shacklock et al., 2000). Students should be able to transfer what has been learnt into current practices (Jones, 2006; Wing Yan Man, 2006; Hjorth & Johannisson, 2007; Heinonen & Poikkijoki, 2006; Tan & Frank Ng, 2006; Rae, 2007; Antonites & Van Vuuren, 2005). This transfer can most likely be related to previous experiences of their own or of others, in success or failure, and of direct or indirect relevance (Wing Yan Man, 2006). As for teaching interventions, they may appear in a separate and sporadic mode, but in the longer term they form more holistic and sequential learning circles in which new knowledge and activity continuously produce new experiences through individual reflection in a social context (Heinonen & Poikkijoki, 2006).

Realisation in practice

The course “Economics of entrepreneurship” was realised by an interdisciplinary team of teachers – the author who was responsible for the delivering of the part of the course related to creative solutions of real life problems and elaboration of new products / services, and her colleague – responsible for economic and financial aspects of entrepreneurship. The activities were organised in a democratic interactive manner. Students worked in small groups planning, managing, researching, analysing and discussing the results, reflecting, improving the ideas of the products/services elaborated and presenting them to the teachers, the other teams and invited entrepreneurs. They could always get their teachers and other specialists' consultation.

1.3. Collaboration channels

Theoretical stance

As open innovators learn by doing (Chesbrough et al., 2014), in order to promote university students' skills and behaviours topical for open innovators, there should be several collaboration channels for making students learn by real doing and using the opportunities to exchange knowledge and experience. It is in line with the standpoint that in the learning for entrepreneurship there should be frequent and planned work with entrepreneurs and other specialists from different fields (Jones, 2006; Wing Yan Man, 2006; Hjort & Johannisson, 2007; Hannon, 2006).

Realisation in practice

The study course was realized in collaboration with three invited entrepreneurs who represent different fields of business. They shared their experience being ready to consult students on any question. In the end of the course they participated in the evaluation of the final presentations of the students and the prototypes of the products/services elaborated by them. If a group, having analysed their competences, strengths and weaknesses related to the solution of the problem (see step 2 in Fig. 1) came to the conclusion that they needed the assistance of a specialist from certain fields, they were allowed to take into their team one specialist from outside the University. Thus, each student had the chance to participate in five channels of collaboration shown in Table 1.

However, the students didn't exploit all the channels of collaboration very actively or at all. The arrows depicted in the table show the intensity and direction of the collaboration. The most active were “Intra-group” and “Students-teachers” channels of collaboration. As for the “Inter-group” collaboration, it didn't work very effectively. When each group was presenting their work in different stages of the course, the other groups were to listen to them and be critical friends and potential partners for identifying some principal gaps, giving some valuable advice or recognizing some opportunities for becoming a “partner-company”. Our practice showed that groups were concentrated mainly on their own problems and didn't wish to listen to other groups' presentations very attentively and weren't so eager to find a joint platform for inter-group collaboration. In cases when a group offered some ideas, the presenters' group didn't always demonstrate a very great interest in utilizing the ideas proposed.

Table 1

The channels of collaboration for each student in the course “Economics of entrepreneurship”

Collaboration channel	Character of collaboration
Intra-group collaboration	Within each group students divided responsibilities for product solution, finances, society or market research exchanging findings and discussing further activities with their group-mates.
Students – teachers collaboration	Teachers were open to discuss, consult and facilitate both individual students and groups’ learning.
Inter-group collaboration	In the end of each intermediate phase groups presented their work done and discussed the challenges faced with the other groups of students and the teachers who had to be their critical friends and potential partners.
Students-entrepreneurs collaboration inside the University	Entrepreneurs were invited to share their experience and to answer students’ questions helping them to understand practical aspects of entrepreneurship.
Intergenerational collaboration with specialists outside the University	Each group could recruit one member from outside the University.

In the beginning the collaboration channel “Students-entrepreneurs” had mainly one direction of operation, that is from the entrepreneurs to the students who used to listen to them with great interest and asked some questions concerning basically entrepreneurs’ experience but not related to their own projects or co-creation of at least ideas of some joint products or services. Only by the end of the study course an idea of collaboration with Aivars Zhimants, one of the guest entrepreneurs who is the co-owner of “Pure Chocolate”, one of the most prospering chocolate production companies of Latvia, occurred to one of the groups. The group consisting of five female students had elaborated a gift set “Say “Yes!’ to the dress!” for little girls supposing to teach them to sew dresses, using different models and decoration elements. The set was supposed to provide families and kindergartens with the opportunity to organise the child’s socialization and development in a capturing manner while co-creating new dresses for dolls with mums, grannies and friends. The students decided to provide their gift set with certain type of “Pure” chocolate, thus making their product a perfect gift to little girls.

Though the students were encouraged to cooperate as well with people of their parents and grandparents’ generations filling up the gap of specific knowledge which they lacked, they didn’t use this opportunity though in their reflections they highly appreciated such collaboration.

2. The findings of the research

The questions for the students’ reflections on what they consider to be of value in open study environment were sent to them in Google Drive electronic questionnaire forms having passed 20 % of the study course. The qualitative content analysis of the reflection texts was conducted assigning the categories special labels:

- "in" when the students were speaking about getting some useful ideas or help concerning that category from the collaboration partners;
- "out" when the students were judging about being useful themselves to their collaboration partners;
- "in-out-in" when the students meant exchange of useful ideas or assistance with collaboration partners (see Table 2).

Table 2

A fragment of the qualitative content analysis of the students' reflection texts

	Qualitative content analysis of the students' reflection texts	Categories spoken about	The direction of interaction		
			Frequencies of categories		
			In	**Out**	**In-out-in**
Student 1	Of course I can get new knowledge (***knowledge – in***), a bit of their experience (***experience – in***), support (***support – in***). From me they could get understanding about young peoples' way of thinking and problems which are topical for us (***intergenerational awareness - out***)	Knowledge	1		
		Experience	1		
		Support	1		
		Intergenerational awareness		1	
Student 2	Perhaps we could try to solve the problem together (***problem solving – in-out-in***). It could be very useful as people of different generations see things in some different ways (***other view of life – in-out-in***). We could exchange experience (***experience – in-out-in***). I could provide fresh ideas! (***new ideas – out***).	Problem solving			1
		Other view of life			1
		Experience			1
		New ideas		1	
Student 3	They have experience (***experience – in***) and I – great enthusiasm and motivation to do something valuable (***inspiration & motivation – out***)	Experience	1		
		Inspiration & motivation		1	

Table 2 illustrates in what way the texts of students' reflections on the question: "What to your mind can you acquire from representatives of other generations and give to them in the process of the co-creation of new values for commercialization?" were analysed and coded. Having summed up all the frequencies of each category under each of the three labels "In", "Out" and "In-out-in", got in the result of the qualitative content analysis of all the students' reflection texts, Table 3 was built.

It shows that to students' mind their collaboration via the intergenerational channel could be even richer than the "exchange of knowledge across boundaries" broadly discussed in scientific literature on open innovation (Wikhamn, 2013; Faludi, 2014; Chesbrough et al., 2014; Salter, et al., 2014). The students considered that they could exchange not only knowledge and experience with people of other generations and professions but as well advice, problem solving, new ideas, other view of life, advice, intergenerational awareness, support, inspiration and motivation, etc.

Table 3

The frequencies of categories mentioned in the students' reflection texts on the question "What to your mind can you acquire from representatives of other generations and give to them in the process of the co-creation of new values for commercialization?"

	In	Out	In-out-in
Experience	38	15	10
Knowledge	22	10	4
Advice	7	5	2
Problem solving	7	3	0
New ideas	8	17	4
Other view of life	9	8	1
Creativity	2	4	0
Inspiration & motivation	3	7	2
Critical thinking	4	1	1
Creation	4	6	4
Support	4	0	0
Intergenerational awareness	2	6	1
New opportunities	6	2	1
The sum of frequencies	110	84	30

The proportion of what students considered they could acquire and give in intergenerational collaboration can be seen in Figure 1. For its construction the frequencies under the label "In-out-in" (see the last column of Table 3) for each category were added to the frequencies of both "In" and "Out", as exchange ("In-out-in") means both getting ("In") and giving ("Out").

The diagram shows that the students think that in the course of co-creation of new values for commercialisation they can more give than get: new ideas, creativity, inspiration & motivation as well as awareness of specific elements about their generation to the representatives of other generations. Meanwhile the students consider that they will more get than give experience, knowledge, advice, problem solving, critical thinking, support and new opportunities from representatives of other generations. There are two categories: other view of life and creation which were considered to be exchanged in equal proportions in the intergenerational collaboration. None of the students spoke about supporting representatives of other generations.

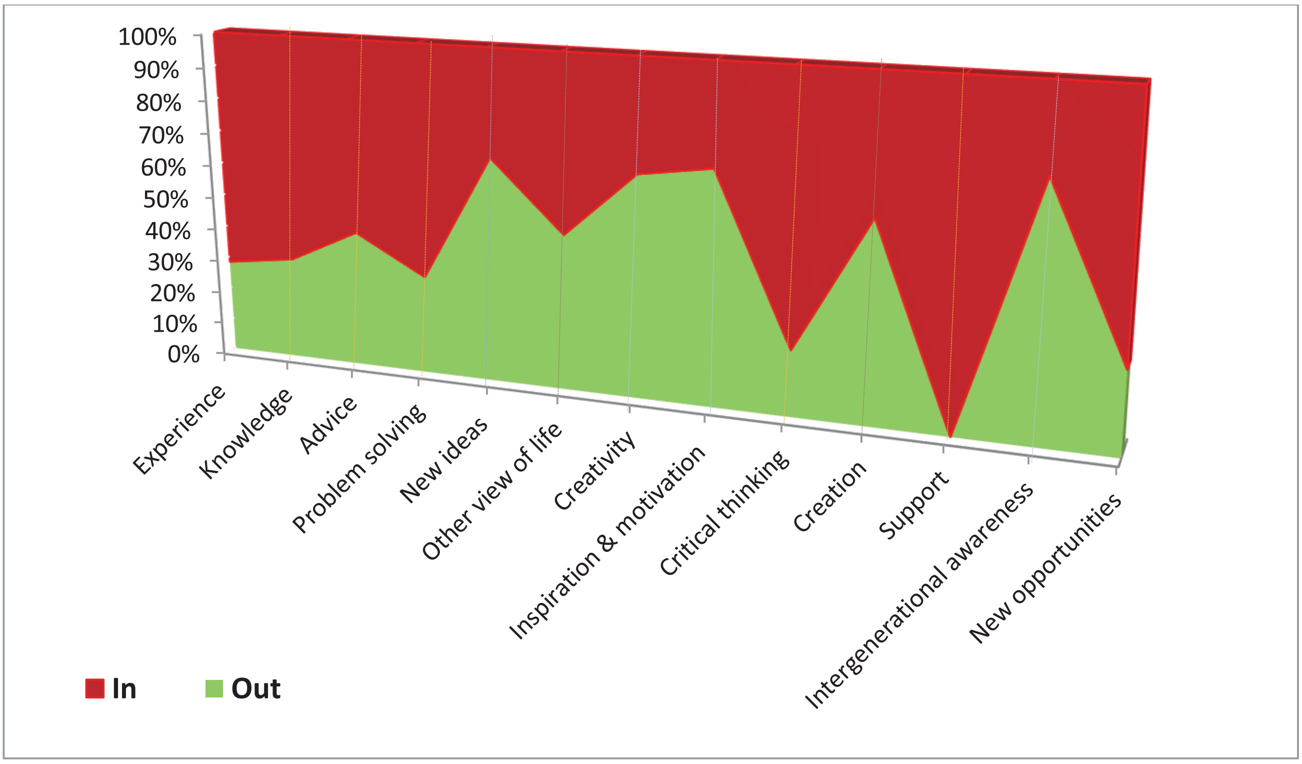

Fig. 1 The students' views of possible intergenerational collaboration while co-creating new products and services for commercialisation

Having judged very positively concerning the advantages of the intergenerational channel of collaboration with specialists outside the formal University activities, the students, however, didn't exploit it. The final defence of their projects showed that they were aware that they really lacked certain experience and knowledge needed but they had avoided collaboration with appropriate people.

Conclusions

- The students showed disposition to act mainly within small circles of participants – with their groups and teachers.
- The groups were not very open to the intergroup collaboration.
- The students appreciated guest entrepreneurs' visits as sources for entrepreneurial inspiration but they didn't exploit this channel of collaboration very effectively.
- The students lacked openness to the collaboration with people from outside the formal University frames. Their positive judgements about the advantages of intergenerational collaboration for co-creation at the level of theoretical thoughts were not followed by corresponding behaviour in practice.
- The promotion of students' skills and behaviours typical for open innovators and topical for open innovation still remains a challenge for the University. Though the students were encouraged to act in an open environment with the opportunity to exchange experience and knowledge crossing the formal University study borders for cooperating, co-evolving and co-creating, they didn't utilize this opportunity.

Discussion

An interdisciplinary team of researchers from four universities of Latvia: Riga Technical University, Latvia University of Agriculture, University of Latvia and Riga Stradiņš University is realising the project "Involvement of the society in social innovation for providing sustainable development of Latvia" within the National Research Program 5.2. EKOSOC-LV. One of the objectives of the project is "to elaborate teaching and learning methodology and materials aimed at the development of social innovation, openness to novelty, interdisciplinary creative thinking and active involvement in the solution of social problems in Latvia". Therefore the exploration of the elements and mechanisms of the study process in the University which could trigger open mind-sets and behaviours of students toward other members of society for getting organised and networked for solving social problems in effective innovative manners is the focus of our research team's activities.

We are open to collaboration with other institutions and individuals!

Acknowledgement

The paper was supported by the National Research Program 5.2. "Economic Transformation, Smart Growth, Governance and Legal Framework for the State and Society for Sustainable Development – a New Approach to the Creation of a Sustainable Learning Community (EKOSOC-LV)".

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The scope of coaching in the context of organizational change

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Abstract.

Purpose
The aim of this paper is to explore the scope of coaching in the context of organizational change considering peculiar issues associated with the use of coaching in Latvia and Lithuania.

Design/methodology/approach
A two-stage study seeks to answer the following research questions. How is coaching defined? What is the aim of coaching? Who are involved in coaching? What coaching outcomes are expected? During the first stage, the definitions of coaching are extracted from the literature and analyzed to identify the distinctive features of coaching. During the second stage, the experts are interviewed to explore the views of practitioners in coaching about a place of coaching in organizations. Literature review, content analysis and comparative analysis are used for the purposes of this study. Triangulation of research results is obtained through cross verification from two sources.

Findings
41 general definitions as well as definitions of executive and business coaching were extracted from the literature and taken for analysis. Based on the established criteria for selection, 7 experts from Latvia and Lithuania took part in the interview. The list of participants was extended with 2 experts from Germany and Poland with the aim to trace the tendency of the development of coaching in the countries that might have influence on the development of the subject matter in the Baltic countries.
Based on commonly used characteristics, coaching is defined as a regular, synergic, learning and development, goal-oriented process. Content analysis and comparative analysis of definitions reveal that facilitation is a primary aim of coaching. Coaching is more beneficial for people who provide decisions. In organizations coaching should be started from the top management and then gone down to lower levels. Achieved results and personal growth is considered as the key expected coaching outcomes. In respect to organizations, coaching provides greater goal clarity, better alignment with the role in organization that facilitates change in the style of management. However, the experts marked the possible threats and challenges such as stereotype and misunderstanding, lack of systematic approach to ensure that coaching engagements are in line in organizational change needs. It is also difficult to explain how effective coaching can be because coaching is not homogeneous and it is difficult to measure the results of coaching.

Originality/value

The findings of the study are expected to use for promotion of coaching in EU New Member States and for the further research on organizational coaching.

Keywords: coaching, organizational change, EU New Member States

Research Ethics Education for Overcoming Differences in Culture and Value System

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ABSTRACT

Although ethical standards and procedures for research in Korea have become closer to the global standards, significant conflicts have been found to take place widely due to cultural differences. In Korea where relationship-centered East Asian values prevail, it is difficult for “internal whistle-blowing” and “management of conflicts of interest” to function well enough. At university, it is difficult to form a relationship of free discussion and equality between professor and student. In addition, the research community has been influenced by such side effects as “respect for quantity and speed,” “excessive competition,” and “mammonism” which have permeated Korean society during its process of modernization. Students have taken such values for granted too.

Under these circumstances, how can we educate students to have them get familiar with the global standards as well as deal wisely with cultural conflicts? It is proposed that the overarching principle of research ethics education should “not be delivery of knowledge but be to change the way of thinking.” Five-stage education is proposed, and discussion of dilemma cases is recommended as a method of education. It is advised to avoid education through the Internet, and to lead the whole teaching work by one educator in case of team teaching. It is also asserted that classroom instruction can change the way of thinking of students only with social education.

Efforts of universities and operational modes of research laboratories are two most important aspects of social education. The government is asked to establish legislation and to expand financial support for the facilitation of change in this direction. It is, in particular, held that national development can be made only if universities play the role of a fountain which pours clear water into society.

INTRODUCTION

In Korea, research ethics educators teach, in most cases, graduate students Western (or American) ethical norms for research as the global standards. Most of the research ethics education programs do not focus on the infusion of ethical knowledge. Instead, they emphasize understanding of ethical precepts and institutional principles for application in the reality. For this purpose, the background of establishing ethical norms as well as the current institutional standards and procedures are explained, ethical dilemma situations are taken as the theme of discussion. In the process of education, however, educators come to face the limitations of the reality in Korean society. There is disparity between the values research ethics education pursues and those the real society respects. For instance, although educators explain students the consequential risks of neglecting "conflicts of interest," which may arise during the conduct of research, the real society, however, jeers at the need of managing such conflicts of interest. Sometimes, some students, who have learned "internal whistle-blowing," really become whistle blowers, but only to repent for being disadvantaged. The cause of disparity seems to lie in the differences of value systems.

Korea has grown a great deal materially thanks to speedy economic development. Korean society, however, is evaluated yet to be short of a mature stage of mental development. The greatest virtues of Korean society, during its modernization process, were speedy achievement of goals and quantitative growth. This seemed to lead to the backsliding of overall ethical level of society. Ethical drawbacks, which are often found in Korean society, are as follows:

- Securing speedy achievements at the expense of procedural ethics
- Securing quantity at the expense of quality
- Valuing outer appearance, camouflaging inner conflicts
- High possibility of ethical flaws in upstarts
- Society often goes as far as to consider norm-followers as "idiots."

This paper will identify problems of research ethics taking place due to the unique situation of Korean society, try to find out their causes, and try to propose how to overcome them as naturally as possible.

WHOLE SCOPE OF RESEARCH ETHICS

There is no universal agreement among scholars on the scope of research ethics. How to classify the scope of research ethics may vary with scholars. For the purpose of this paper, however, it is proposed to set the whole scope of research ethics as shown in the table below. In the table, research ethics is classified into three types according the background of formation of ethics: life ethics, RCR (Responsible Conduct of Research), and academic ethics. They are buttressed by a total of 13 norms.

<Scope and Classification of Research Ethics>

Classfication	Ethical Norm	Major Concepts
General	What is research ethics?	Ethics, Research Purpose, Value Orientation, Dilemma
Life Ethics	Research ethics on humans	Research on Humans, Protection of Human Subjects, Written Consent, IRB
	Research ethics on embryos and human-derived biological materials	Human Genes, Human Embryos, Protection of Personal Information, IRB
	Research ethics on animal experiments	Animal Care(Standards), 3Rs, IACUC, Assurance
RCR	Norm on research misconduct	Forgery, Alteration, Plagiarism, Investigation Procedure, Retaliation, Interference
	Management norms on research notes, and research data	Institutional Ownership Principle, Disclosure Principle, Researcher Responsibility
	Publication ethics	Paper Writing, Authoring, Copyright, Paper Review Ethics
	Norm on joint research (Research contract)	Pre-Meeting, Allocation of Assignments. Distribution of Results
	Technology management norm	Report of Technology, Patent Right, Technology Transfer, Material Transfer
	Management of conflicts of interest	Report of Interest, Management, Avoidance, Professorial Business Startup
Academic Ethics	Professorial ethics	Peer Review, Self-Proving Validity, Tenure
	Student ethics	Learning Ethics, School Ethics, Honor Declaration, Student Trial
	Norm on mentoring	Student Guidance, Paper Writing Guidance, Capacity Guidance
	Academic freedom and social responsibility	Self-Governing Management, Self-Evaluation, Social Activities of Professors

“Life ethics” is an ethical system the concept of which has been most recently established. The concept of the protection of human subjects has been embodied through the Nuremberg Code (1947), the Declaration of Helsinki (1964), and the Belmont Report (1979). Later, the rapidly developing life science gave birth to an ethical concept on the use of human embryos after the 2000s. The concept of laboratory animal welfare began to form thanks to the efforts of animal protection organizations during the middle of the 1900s. Now, strict ethical norms on laboratory animal welfare are set in place.

"Responsible Conduct of Research (RCR)" became an institutional concept in 2000 after certain large-scale research misconduct cases, mostly in the USA, during the 1980s. In Korea norm-setting for RCR began with the establishment of the "Guidelines on Ensuring Research Ethics" in 2007. Many aspects of RCR, however, have not yet been dealt with officially. It seems that this has not taken root in Korean society.

"Academic Ethics" is a norm which has the longest history. With the beginning of European higher education during the Middle Ages, the powers and responsibilities of professors had gradually taken form. The institution of higher education traveled to the USA, combined with liberalism, and began to establish academic freedom, professorial ethics, and social responsibility of professors during the mid-1900s.

RESEARCH ETHICS PROBLEMS TAKING PLACE UNIQUELY IN KOREAN SOCIETY

☐ Disparity Caused by East Asian Thinking

"East Asian thinking" refers to a system of thinking which uniquely exists in China, Korea, and Japan all of which have been influenced by Taoism, Confucianism, and Buddhism. Its characteristics include collectivism, interdependence, and comprehensive thinking. On the contrary, Western people tend to think individualistically, independently, and analytically [1]. The Western culture has valued the autonomy of individuals while the East Asian culture has respected harmonious human relationship. Unlike Western society, East Asian society tends to value the honor of individuals rather than the honor of groups. In East Asian society, all members of a group feel ashamed when a member of the group commits a misconduct. It seems that these differences between East Asian and Western thinking systems are also reflected on research ethics. As such, it is difficult for East Asian society to accept at least part of research ethics which have been systemized by the Western culture. Disparities in thinking are frequently found in the areas below:

- Conflicts of interest
- Internal whistle-blowing
- Joint research activities
- Report of misconduct to the government

☐ Disparity due to “Top-Down Democracy”

It seems that democracy, which began as a form of government during the period of ancient Greece, went through social democracy and has finally settled deep in Western society as a way of life. In Western society, ideals of democracy such as respect for humans, freedom, and equality are applied to private contracts between individuals as well as to the modes of operation of entities or groups, and reflected well on the ethical system. Principles of democracy are found, for example, in the written agreement of the human subject, employment contracts of researchers, principles of peer review, mentoring manuals, and arrangements for the investigation of research misconduct.

After the liberation of Korea, politicians and intellectuals took the lead in introducing democracy. Korean democracy is, therefore, short in history and may be said to be top-down. At that time, the general public elected the President of the nation without correctly knowing the concept of democracy. In addition, East Asian way of thinking remained dominant in society. It may be said that the principles of democracy, even at present, are not fully established in society.

Even researchers of science and technology are not, in most cases, familiar with the principles of democracy, which often leaves “A’s” (Those who have an advantageous position with regard to contracts are stereotypically called an “A.” They include government officials, heads of institutions, guiding professors, superiors, and seniors) to misuse their power. As the result, the following problems of research ethics often take place:

- Non-democratic operation of universities and research institutes (leader-centric decision making, making light of trade unions, etc.)
- Non-democratic decision making within the research room (professor- and senior-centric hierarchy)
- The rights of students remain undocumented. (dominant discretion of the guiding professor)
- The right of researchers remain undocumented. (only appointment letters without employment contracts)
- Passive participation of researchers in the process of important decision making
- Exertion of inappropriate influence by forming factions (unreasonable protection of factional minorities)
- Research contracts which are forcefully too general (so that “A” can interpret the terms and conditions of the contract arbitrarily)

☐ Disparity due to Rapid Economic Development

Korea achieved unparalleled economic growth very rapidly. The Korean war tore the country down to ruins and put the people in extreme poverty. After the armistice of the fratricidal war in 1953, Korea also suffered from widespread political turmoils. It was not until the establishment of the military regime in 1961 to carry out elaborate plans for political stabilization and economic development. At that time, economic development was the overarching value and on top of the priorities based on the national development model which depended heavily on science and technology [2]. It is evaluated that the current growth and achievements of Korea owe very much to the well-organized planning and intensive efforts.

During the process of national development, however, Korea imitated Western-style research institutes, researcher management, and project management in appearance while it failed to take after scientific management principles and ethical principles. This has caused many adverse side effects. “Quantity- and speed-centric evaluation,” “excessive competition,” “mammonism,” and “government-lead decision making” are widespread across the nation including the research community. At least, partly for this reason, society does not think highly of the reliability of the science community. Frequently seen problems of the science community are as follows:

- Researchers often make more efforts to secure “research funding” than to conduct “research.” (The title of the research plan is exaggerated, not being true to the content of the research.)
- Researchers are indifferent to the level of quality as their products are evaluated quantitatively. They stick to the number of papers. (Research does not contribute to the development of scholarship. Rather, it changes itself just for papers.)
- As speed is a virtue, ethical review is considered to be burdensome. (IRB and IACUC are thought to be annoying.)
- Business startups are encouraged in spite of deficient technology management system (report and evaluation of technology). This often leads to the conflicts of interest. (Policy failures often take place.)
- Self-evolving arrangements, based on autonomy, do not exist. (The government always takes the lead.)

☐ Other Important Ethical Problems

Korea does not have experience in making an academic discipline by itself and developing its systematic structure independently. Most Korean scholars have studied in Western society (mostly in the USA or Europe). Regrettably, development of “science” does not seem to contribute substantially to the development of “technology.” Rather, engineering scholars who studied in Western society develop "technology." Technology, however, does not seem to contribute to "resolving the problems" of society. The government directly resolves important social problems through resourceful experts of Western society. Consequently, "science," "technology," and "resolving social problems" are not interconnected but broken off. Under these circumstances, many worrisome problems take place in terms of research ethics as fusion research is emphasized:

- In case of joint research, contractual practice does not clearly define shared provision of resources, role division, and distribution of achievement. In addition, insufficient arrangements for the resolution of conflicts of interest often cause new conflicts of interest.
- To avoid conflicts of interest, researchers think highly of friendship and informal relationship. It is ironical, however, that friendship and informal relationship cause conflicts of interest to the contrary.
- Co-researchers are not very active in opening research data and information or research capabilities. It is frequent that co-researchers are not true to the name (when a researcher lends his/her name).

It is notable that research ethics has been used as a means of personality attack against worthies recently in Korea. Such personality attacks are based on research misconduct found in doctoral dissertations or academic work that were done more than 10 years ago when there was no concept of research ethics in Korea. Government guidelines of 2007 had a five-year verification prescription with regard to academic work. Such provisions, however, were removed from the 2011 guidelines. It is painful for worthies to be attacked because of their research misconduct committed long before. On the other hand, the general public become disappointed and angry with such research misconduct. What is important is that the general public comes to distrust leaders of society. And it is incidental that there arises an atmosphere where educators of research ethics are not welcomed.

PROBLEMS AND SOLUTIONS AT SCHOOL

This paper will now discuss research ethics education at university in Korea. According to the findings of the 2013 survey of research ethics, 108 universities offer research ethics courses. However, only less than 20% offer regular courses while a half provide on-line courses. 44% provide students with research ethics education in the form of a one-time special lecture, and 24% take the form of consecutive special lectures through workshops. It is notable that professors and administrative staff are also given research ethics education albeit it takes the form of one-time special lecture or a series of special lectures under the name of a workshop [3]. This is partly because universities lack human resources specializing in research ethics education and partly because they are not active in providing research ethics education.

□ Embarrassing Problems

It is not an easy task at all to teach students research ethics that society balks at accepting due to disparity between conventions and values coupled with pre-mature conditions. In the course of classroom instruction, professors may receive embarrassing questions from students. Such questions, as shown below, based on conflicts deriving from disparity between, chiefly, traditional conventions and Western ethical standards:

- I understand the importance of internal whistle-blowing. But, is it ethical to accuse my friend?
- In reality, internal whistle blowers are, in most cases, disadvantaged by his/her organization. Do you want your students to be disadvantaged?
- In case guiding professors or seniors make their own decisions, it is the convention of the research room that students or juniors should not oppose their decisions. Ethical principles for joint research, therefore, are merely ideals up in the air for joint researchers.

Students point out that research misconduct cases are not dealt with reasonably chiefly due to the deficient administrative system short of realizing research ethics.

- In Korea, institutional arrangements for conflict resolution of universities are very deficient. When graduate students, therefore, are entangled in conflict with guiding professors, students will end up, in most cases, in serious trouble (they will leave school in the end.).
- As university administrative units are not reliable, it is desirable to report the case to external entities (government, mass media).

☐ Educational Measures for Research Ethics

To set research ethics in place more efficiently in Korea under these circumstances, it will be needed to strategically set educational goals and methods depending on types of students. It will be the responsibility of the government to resolve the lack of research ethics educators. Then, what should be done in detail for this purpose?

First, the level of research ethics education should be set for undergraduate and graduate students. It is advisable for the scope of education to cover all of the afore-mentioned 13 norms because fusion research will become a commonplace in the future. For example, a non-biology major should know life ethics. It is, however, necessary to set the minimal level of knowledge (e.g., principles, procedures, and standards) for each of the 13 norms as they have their own deep expertise respectively. The following five stages of education are proposed:

- Stage 1 : Understanding of general knowledge and importance of research ethics
- Stage 2 : Understanding of the principles of 13 norms, and capability to abide by the standards and procedures
- Stage 3 : Understanding the principles, standards, and procedures of 13 norms, and ability to write lower-level norms as need (equivalent to the process of agreement on norms)
- Stage 4 : Understanding of the principles, standards, and procedures of 13

norms, and ability to resolve conflicts in the vicinity and to provide consulting service (Being able to introduce the norms of advanced countries)

- Stage 5 : Ability to make a plan for the revision and development of the national system of ethical norms by applying new concepts (cases of the court of law) to research ethics

What is needed next is government-led nurturing of expert educators. It will be advisable for the government to provide financial support to universities so that they can open graduate programs to nurture experts with master’s or doctoral degrees. It will be appropriate for the nurtured personnel to work at universities as educators or specialized administrators. Without active strategies like this, research ethics in Korea will not have been established even in decades.

□ Education for Overcoming Differences in Culture and Values

It will take time for education to result in overcoming the differences in culture and values. In addition, classroom education at university seems to have clear limitations. Education will take effect only with social changes that will lead to the establishment of the arrangements to resolve conflicts of interest, prohibition of retaliation against internal whistle-blowing, and reinvigoration of IRB functions.

What should be done first by education is “to change the way of thinking rather than just to deliver knowledge.” For this,

- Educators should teach students to the extent that they can understand the principles of research ethics and comply with the standards and procedures. They should be educated to reach at least the second stage, and be given opportunities to discuss as many dilemma cases as possible. For this purposes, professors are supposed to introduce many cases of conflicts of interest to students to lead discussion with them.
- It is recommended to avoid unilateral delivery of knowledge through the

Internet.

- There are merits with team teaching by experts of respective norms. Although team teaching is a method of teaching to promote expertise, it not a good method to promote understanding of general principles. In the case of team teaching, it will be advisable for one educator to lead the whole classroom instruction.

Classroom instruction should be accompanied by social education. Social education refers to social efforts to realize research ethics. What students see becomes education for them.

- Universities should establish a consulting unit, a report-receiving unit, and an investigation unit. Such units should be manned with experts. Considering the necessity of secretariat functions for IRB and IACUC, a big research ethics unit should be established.
- Researchers are recommended to have ethical discussions as frequently as possible in research rooms. In addition, as many practices as possible should be compiled and published in the form of manuals so that students can read them easily. Guiding professors who try to find solutions to ethical dilemmas will serve as a good model of social education for students.
- The government is requested to establish legislation to proactively facilitate these changes and to provide financial support for universities. This is the most important method for Korea to achieve qualitative growth in research ethics.

CONCLUSION

A big premise is needed for the afore-mentioned method of education. Do we want to introduce Western ethical system discarding traditional system of thinking? The answer is simple. As Korea adopted democracy and Western legal system, it is needed to criticize traditional thinking system rigorously. In other words, positive aspects of collectivism should be promoted while its negative aspects should be suppressed. For example, paternalism may be applied to helping neighbors in need while "conflicts of interest" should be controlled to prohibit collective misconduct. Whistle blowers are now protected by laws. Although there may be understandable aspects of ethical problems taking place due to the differences in culture and values, they have been sometimes called traditional values and, for that reason, become chronic social evils unfortunately.

Research ethics develops with social ethics. If the level of social ethics is not high enough, it will not be easy to ask research ethics similar to the global standards of the research community. In this sense, universities should keep ahead of society by playing the role of a fountain which pours clear water into society. The nation finds hope in universities which look like a fountain.

When students, who were educated at universities looking like a fountain, grow desirably and later contribute to the establishment of political ethics, social ethics, business ethics, military ethics, and ethics of public office, democracy will have become completed. The nation will, then, become a real advanced country.

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June 15 (Monday)

R# : 203 International Conference Hall

Open Innovation & Business Model Contest

- **Presider: Prof. ChangHwan Shin** (Kyungpook National University)

- "Smart phone Photo based Smart Length Measuring System and Method" by **JinHyoung Kim (L-Line)**
- "Parking lot information sending on real time system and their method" by **Jaeho Yoon (Senior Researcher at BOKJU CO., LTD.)**
- "Lumicrew, Smart Group Lamp System" by **SuYeon Cho(KAI Spring Co.,Ltd.)**
- "A business model about an online based real estate brokerage service" by **SeokHyun Moon**
- "Smart Social Library System Business Plan" by **SangHyun Lee (CEO of Sntec, LTD.)**
- "Story Make A City" **by SangGoo Kwon (Institute of Time & Space)**
- "Smart panel system construction and management method for mobile and online survey" by **Kyounghun Kim(Neo Economy Society Institute)**
- "Feedback public-relations server and method of manufacturing homepage using thereof" by **Ki-dong Baek**
- "Adjustable Walker" by **Shalini Kumari Shalu (National Innovation Foundation, India)**

Smart phone Photo based Smart Length Measuring System and Method

JIN-HYOUNG KIM (L-LINE)

Using the smartphone camera and an infrared sensor, and measures the exact distance ,and measuring the exact size. through the ratio of the object to be displayed on the screen of the smartphone. You are SMART! But, your hand has a ruler.

Parking lot information sending on real time system and their method

JAEHO YOON(BOKJU CO.,LTD.)

Lumicrew, Smart Group Lamp System

SuYeon Cho(KAI Spring Co.,Ltd.)

A lamp system which contains communicatable smart lamps.
In this system one lamp represents one person. Once building up a group of several lamps, every change of topology can be treated as member's change in a small group such as riding and climbing.

A business model about an online based real estate brokerage service

SeokHyun Moon

Real estate development Information intermediate method and system
IPC : G06Q 50/30 G06Q 50/16
Applicant: DGIST
Applicant No: 1020120012973
Applicant Date: 2012.02.08
Registration No: 1013891450000
Registration Date: 2014.04.18
Unex. Pub. No: 1020130091581
Unex. Pub. Date: 2013.08.19

Traditionally, the real estate brokerage service was one of the hardest business areas to leverage on IT. Today, there are lots of businesss which become more efficent using IT, however, most of real estate brokers hasitate to use IT for their business. In the presentaiton, we'll review the characteristics of the business that makes it hard to use IT and present service models to make it more efficient.

Smart Social Library System Business Plan

SangHyun Lee(Sntec)

Smart social library service method and system
IPC : G06Q 50/26
Applicant: SangHyun Lee
Applicant No: 1020120010317
Applicant Date: 2012.02.01
Registration No: 1013363800000
Registration Date: 2013.11.27
Unex. Pub. No: 1020130089006
Unex. Pub. Date: 2013.08.09

Different from the existing library that keeps books in a specific space based on the spatial concept, this is a user participation–based library that connects privately owned books in a smart manner.

Story Make a City

Sang Goo Kwon(Institute of Time & Space)

Re-discovery of Daegu, urban renewal project (2001-2015)

Smart panel system construction and management method for mobile and online survey

Kyounghun Kim

TIME AND LOCATION BASED SURVEY MARKETING SERVICE PROVIDING SERVER, AND METHOD THEREOF
IPC : G06Q 30/02 G06Q 50/30
Applicat : DGIST, Kyounghun Kim
Application No: 1020120010027
Application Date: 2012.01.31
Registration No: 1013124210000
Registration Date: 2013.09.23
Unex. Pub. No: 1020130100814
Unex. Pub. Date: 2013.09.12

Feedback public-relations server and method of manufacturing homepage using thereof

Ki-dong Baek

IPC : G06Q 30/02
Applicant : JeongSuk Moon, DGIST
Application No: 1020130069705
Application Date: 2013.06.18
Registration No: 1015093110000
Registration Date: 2015.03.31
Unex. Pub. No: 1020150000004
Unex. Pub. No: 2015.01.02
Unex. Pub. Date: TAEBAEK

June 16 (Tuesday)

R# : 204 Auditorium

Keynote Speech

Francisco Javier Carrillo (Monterrey University of Technology, Mexico)
Presentation Theme: "Knowledge-Based Development as Cultural Disruption"

Tan Yigitcanlar (Queensland University of Technology, Australia)
Presentation Theme: "Incentivising innovation: insights from Australian and Brazilian incentive schemes"

Tommi Inkinen (University of Helsinki, Finland)
Presentation Theme: "Reflections on the innovative city: examining three innovative locations in a knowledge bases framework"

Katri-Liis Lepik (Tallinn University, Estonia)
Presentation Theme: ""Strategic management for public sector innovation in knowledge societies"

Keun Lee (Seoul National University, Korea)
Presentation Theme: "Schumpeterian Analysis of Catch-up and Catch-up cycles "

KNOWLEDGE-BASED DEVELOPMENT AS CULTURAL DISRUPTION[1]

Francisco Javier Carrillo

GIEE Knowledge Society, Tecnológico de Monterrey, México

& The World Capital Institute

Keynote presentation at the Joint Conference *1st Society of Open Innovation: Technology, Market, and Complexity (SOItmC) & 8th Knowledge Cities World Summit 2015*. DGIST, Daegu. South Korea, 14-18 June, 2015[2].

Abstract

Purpose: to make the case for the cultural evolution underlying the transition from industrial to knowledge societies.

Category: conceptual paper.

Approach: Knowledge-based development relies as much in the re-definition of production factors as in the output variables to characterize and measure social worth. The 'knowledge' attribute of knowledge cities relies on the capacity to balance all societal values into an equitable and sustainable dynamic equilibrium.

Scope: an economy and culture where not just financial and material capital, but all worthy value dimensions, are given due attention.

Results: knowledge-based value is characterized through represented experience. The nature of k-based as opposed to material-based economics is discussed. Knowledge-based urban development is then defined.

Conclusions: a new economic culture shall evolve in parallel to the emergence of knowledge cities.

Keywords

Knowledge, value, material-based, industrial culture, knowledge-based, knowledge-based value systems, capital systems, knowledge city, knowledge-based development (KBD), knowledge culture, knowledge society, knowledge economy

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[1] Keynote presentation of this work at SOItmC & 8th Knowledge Cities World Summit 2015 was possible thanks to a sponsorship by Professor Rhee, President of GyeongBuk Techno Park and Senior Professor of YeongNam University; Prof. Junghyun Yoon of Entrepreneurship Center, POSTECH and Prof. JinHyo Joseph Yun of DGIST, President, Society of Open Innovation: Technology, Market and Complexity and conference Co-Chair.

[2] Elements of this work were first included in Chaper 1 of *Knowledge and the City* by F. J. Carrillo, T. Yigitcanlar, B. Garcia and A. Lönnqvist (Routledge, 2014). This version was prepared specially as a keynote for this conference. This paper needs to be further re-worked in order to be published as a distinctive paper.

Incentivizing innovation: insights from Brazilian innovation support programs

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Abstract

Innovation is the transformation of knowledge of any kind into new products or services in the market. Its importance as an important production factor is widespread today. In the age of the knowledge-based economy innovation it became critical for any company or even country to compete globally. Many countries are encouraging innovation through various mechanisms, and one of the most widely used is the provision of special incentives for innovation. This paper investigates incentive systems for the growth of technology companies as a strategy to promote knowledge-based economic development. As for the case investigations the study focuses on an emerging economy, Brazil. The research is based upon the available literature, best practices, government policy and review of incentive systems. The findings provide insights from the case study country context and some lessons learned for other countries using incentive systems to boost the innovation capabilities of their technology companies.

Keywords: Innovation; incentive programs; technology companies; knowledge-based economy; knowledge-based economic development; Brazil.

Reflections on the innovative city: examining three innovative locations in a knowledge-bases framework

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Abstract

This paper combines three location-based cases with literature background focusing on knowledge-bases and cities. The paper considers the regional context of the city of Helsinki and its surrounding area (HMA). Analyzed cases include three specific locations highlighting urban form, connectivity and knowledge-intensive production. Conceptually innovative cities are experiencing extensive change as they transform and change in order to become competitive providers of first class living for highly skilled global work-force. The integration of spatial characteristics into analyses of knowledge intensiveness of cities brings forth new theoretical openings for urban analysis setting platforms for open innovation and economy. The paper focuses on extensive material resources collected in numerous projects. The data gives more reliable picture of the knowledge-intensive locations compared to single interviews or survey studies. The total data includes company surveys, stakeholder interviews and observation field work. Provided reflections are classified according to key issues presented in urban studies and economic geography.

Strategic management for public sector innovation in knowledge societies

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Abstract

Purpose –
The purpose of this article is to analyse the knowledge-based urban development (KBUD) policy approach for the purpose of profiling Tallinn city as a knowledge city in the KBUD context.
Design/methodology/approach –
We propose desk research methods as well as expert interviews. Knowledge-based urban development (KBUD) policy approach has four broad policy domains—i.e., economic, societal, spatial, and institutional development-and KBUD is described as the new urban development policy of the knowledge era that aims to bring economic prosperity, environmental sustainability, a just socio-spatial order and good governance to cities. KBUD is used as a framework for benchmarking knowledge cities. For specific purposes of analysing the capital city of Estonia, Tallinn, as a potential knowledge city, theoretical model of the generic knowledge capitals system is used. Tallinn is analysed according to the knowledge capital system theory.
Originality/value – Knowledge-based development performance analysis of knowledge cities is still an understudied area.
Profiling of a city as a knowledge city and benchmarking it according to the knowledge cities' criteria is still a novel concept in order to assist policy makers in assessing, compiling and implementing strategies that would aim at balancing the city's economic prosperity and citizens' wellbeing.
Practical implications – The outcomes of the analyses assist the city planners, developers, policy makers and strategist in assessing the weaknesses and strengths of the city in its pursuit towards a knowledge city and provide insights of which aspects need to be improved and which strategies require reformulation. The policy makers and practitioners tend not to be fully aware of the possibilities of how the methods and theories of knowledge city could be utilized for the development of the city. It includes awareness raising on the knowledge city concept and its practical implications for citizens.

Keywords : knowledge city, knowledge-based urban development

Schumpeterian Analysis of Catch-up and Catch-up cycles

Keun Lee and Franco Malerba

Many industries have witnessed numerous changes in industrial leadership and successive catch-up by late entrants. The incumbent fails to maintain its superiority in production or market shares, and a latecomer catches up with the incumbent. The latecomer, who gains leadership, then loses to another latecomer. We call these phenomena of successive changes in industrial leadership as 'catch-up cycles', where catch-up means a substantial closing of the gap in market shares between firms in a leading country and those in a latecomer or follower country. This paper attempts to explain these phenomena in six sectors of cell phones, memory chips, camera, steel, mid-sized jets, and wine. These cases were analysed in view of the common theoretical framework on successive changes in the industrial leadership and a catch-up cycle proposed by Lee and Malerba (2015a) which is based on the notions of sectoral systems and the evolution of these systems over time (Malerba, 2002).

Several discontinuities may occur during their evolution, which we call as 'windows of opportunity' which was first used by Perez and Soete (1988) to refer to the role of the rise of new techno-economic paradigms in generating leapfrogging by the latecomers who take advantage of a new paradigm and thereby surpass the old incumbents. We broaden the notion of windows of opportunity by consider more dimensions, and identify three windows, namely, technological, demand and institutional windows (Lee and Malerba, 2015a). With the notion of 'windows of opportunity', this study uses the concept of 'response' by firms and systems. A few firms from emerging countries and the sectoral system that supports them may respond to the opening of windows and rise to global leadership, whereas the falling behind of the current leaders from a certain country may be due to a lack of effectiveness in the response, often due to an 'incumbent trap' (Chandy and Tellis, 2000), by firms and by their sectoral system leading to misalignments to the new window. In sum, the gist of our theory is that diverse combinations of windows of opportunity and the responses of firms and sectoral systems of latecomers and incumbents determine the pattern of successive catch-ups that will most likely emerge in a sector.

While we consider all these 'three windows' of opportunity, the final emerging picture is quite 'Schumpeterian' because we confirm the supremacy of technological innovation as the critical interface connecting the three windows. While the demand-related windows are important, they tend to have an influence on the forging-ahead stage primarily because they lead to demand-driven innovation and new investment or demand-driven adoption and diffusion of new technologies. Similarly, while the role of the institution and government window is 'significant' during the forging-ahead stage in several cases (such as Japanese steel), its actual impact is realized through the adoption or diffusion of new innovations. However, we have also proposed to qualify and specify the subtle nature of technological windows along the different dimensions of exogenous versus endogenous innovation and of competence-enhancing versus destroying innovation. However, the aforementioned distinctions must be complemented with the nature and types of capabilities and strategies of the incumbents and latecomers, as well as their sectoral system adequacies, alignment and responses.

June 16 (Tuesday)

R# : 202 Conference Room

Special Session 4

"Open Innovation and Creative Entrepreneurship from Gyeongbuk TP and University Entrepreneurship Center"

■ **Session Chair: Jaehoon Rhee** (Yeungnam University)

- Paper 1: "Knowledge-Based Development as Cultural Disruption" by **Francisco Javier Carrillo (Monterrey University of Technology, Mexico)**
- Paper 2: "Organizational Slack and Managerial Practices for Open Innovation: Moderating Effect of Social Capital" by **Hoyoung Bae(Woosong University), Jaehoon Rhee(Yeungnam University)**
- Paper 3: "A conceptual framework for coalescent and innovative public services in the context of reducing public sector resources (UK)" by **David Parks(The Skill Mill Limited, UK), Paul Brownlee(The Skill Mill Limited, UK)**
- Paper 4: "Assessment of Knowledge-Based Urban Development Potential of Turkish Provinces" by **Sinem Metin(Istanbul Technical University, Turkey), Ferhan Gezici Korten(Istanbul Technical University, Turkey)**
- Paper 5: "A conceptual approach to the relationships between the social economy, social welfare, and social innovation" by **ChangHwan Shin(Kyungpook National University)**
- Paper 6: "Learning Organization Activities and Innovativeness of Tech-based SMEs in Technopark: The Mediating Role of Learning Transfer" by **Junghyun Yoon(POSTECH), Jaehoon Rhee(Yeungnam University), Sunghoon Hwang(Yeungnam University)**

KNOWLEDGE-BASED DEVELOPMENT AS CULTURAL DISRUPTION[1]

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Paper submitted to the Joint Conference *1st Society of Open Innovation: Technology, Market, and Complexity (SOItmC) & 8th Knowledge Cities World Summit 2015*. DGIST, Daegu. South Korea, 14-18 June, 2015[2].

Abstract
Purpose: to make the case for the cultural evolution underlying the transition from industrial to knowledge societies.
Category: conceptual paper.
Approach: Knowledge-based development relies as much in the re-definition of production factors as in the output variables to characterize and measure social worth. The 'knowledge' attribute of knowledge cities relies on the capacity to balance all societal values into an equitable and sustainable dynamic equilibrium.
Scope: an economy and culture where not just financial and material capital, but all worthy value
dimensions, are given due attention.
Results: knowledge-based value is characterized through represented experience. The nature of k-based as opposed to material-based economics is discussed. Knowledge-based urban development is then defined.
Conclusions: a new economic culture shall evolve in parallel to the emergence of knowledge cities.

Keywords
Knowledge, value, material-based, industrial culture, knowledge-based, knowledge-based value systems, capital systems, knowledge city, knowledge-based development (KBD), knowledge culture, knowledge society, knowledge economy

Organizational Slack and Managerial Practices for Open Innovation: Moderating Effect of Social Capital

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Abstract

This research is designed to analyze the moderating effect of social capital between organizational slack and managerial practices for open innovation. After controlling the firm size, firm age, and environmental uncertainty, we test two hypotheses. First, we test the hypothesis that organizational slack has a positive effect on managerial practices for open innovation. Especially we focus on the managerial innovation and open innovation because recently managerial innovation and open innovation are more and more important. Second, we test the moderating role of social capital between organizational slack and managerial practices for open innovation. Because social capital is a kind of networking activity, we assume that social capital can contribute to managerial practices for open innovation through the networking activity.

For this research, we administered the questionnaire surveys, and got the 250 effective data (companies) in Korea. Then we used the validity, reliability, correlation and multiple regression analysis by means of SPSS 18.0.

As a result, we can find the two meaningful results. First, organizational slack, especially not absorbed slack but unabsorbed slack, has positive effect on managerial practices for open innovation. It is because absorbed slack such as excessive facilities, machines, or employees is not useful in managerial practices for open innovation. On the other hand, unabsorbed slack is useful in managerial practices for open innovation because unabsorbed slack such as excessive money or securities is very flexible and active. Taken together, the relationship between managerial practices for open innovation and unabsorbed slack is proven in terms of flexibility. Second, social capital has moderating effect between organizational slack, especially not absorbed slack but unabsorbed slack, and managerial practices for open innovation. A prior study related to the relationship between managerial practices for open innovation and social capital doesn't exist yet, so this analysis result is very meaningful in academic respect.

But this research has some limitations. First, this research is analyzed by limited region (Korea) and samples (250 companies), so more region and samples are recommended in the future.

Second, we focus on managerial practices for open innovation in this paper, so the studies about technological practices for open innovation are recommended in the future.

Keywords: Organizational Slack, Managerial Practice, Open Innovation, Social Capital, Moderating Effect

A conceptual framework for coalescent and innovative public services in the context of reducing public sector resources (UK)

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Since qualifying as a Social Worker in 1993 Paul Brownlee has worked in a number of Social Work Departments in the North East of England. He has spent the majority of his career delivering, managing and leading services for young people involved in the Criminal Justice System. Paul has worked as an advisor and improvement consultant to the Youth Justice Board of England and Wales developing best practice models at both local and national levels. Recently Paul has focused on implementing innovative partnership responses to juvenile justice issues and has spoken on the subject at international events. Paul is currently responsible for Youth Justice Services, Young People's Substance Misuse Services, Multi-Systemic Therapy, Youth Work Services, Young Carers and Vulnerable Young People in Newcastle upon Tyne. Paul is an Associate Partner of the Centre for Offenders and Offending at Northumbria University and a founding Director of The Skill Mill Limited a Social Enterprise dedicated to the employment and training of young people in environmental work.

Abstract:

This paper will draw from research and the evidence based practice of developing new services for youth at risk in the UK using a knowledge based design approach which delivers multiple benefits to the individual, the local economy, the community and the environment. The authors will explore the model in detail including the success criteria and propose a conceptual

framework for the sharing of practice whilst preserving intellectual property and programme integrity. This case study will be of interest to those involved in the field of open innovation, especially where there is a significant statutory and legal requirement for services and will address the tensions that arise where fidelity to a model is paramount without prohibiting scale-up and replication. Taking the example of social enterprise as an catalyst for change, the evidence from the study will show that a new business model which combines ethical business practice, social innovation and a methodology for measuring social impact provides a compelling argument to policy makers and leaders. The research takes account of shrinking public sector resources and the need for cities to respond to societal challenges in new and creative ways and engage the broadest possible group of stakeholders. The authors will provide qualitative and quantitate evidence of impact over a 5 year period.

ASSESSMENT OF KNOWLEDGE-BASED URBAN DEVELOPMENT POTENTIAL OF TURKISH PROVINCES

The 8th Knowledge Cities World Summit
14-18 June 2015, Daegu, South Korea
(KCWS 2015)

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Cities and regions have begun to re-shape upon Knowledge Economy (KE) and the concept of Knowledge City (KC) arose accordingly. Several cities have already adopted Knowledge-Based Urban Development (KBUD) strategies that draw the path to become KCs. Turkey as one of the developing countries that has developed strategies for increasing competitiveness in KE, is facing a challenge to transform cities into knowledge-based. A comprehensive planning approach towards becoming a KC is the missing link so far. The purpose of this paper is to determine which province(s) are strategically more appropriate to adopt KBUD strategies in Turkey. The study will, first, evaluate existing assessment models; second, will introduce the model used specifically for Turkish provinces. After presenting the results of KBUD potential index of Turkish provinces, the study aims to end with a note on which provinces have higher potential to adopt KBUD strategies for a balanced and sustainable economic development.

Keywords
Knowledge Economy, Knowledge City, Assessment Models, Developing Country, Turkey

1. Introduction

The vast change in information and communication technologies (ICT) allowed us to distribute knowledge in seconds and changed our perception of life. Such developments added knowledge a commercial value, transformed production system towards knowledge-based systems (Castells, 2000; Baum et al., 2006), affected the way society lives daily-life (Gonzalez et al., 2005; Weinstock, 2010) and, relatively, reflected in the economy as Knowledge Economy (KE) rapidly (Drucker 1998; OECD, 1996). The hand-in-hand relationship of economy, society and urban form raised the need of a new planning approach to transform cities into knowledge creation centres. A new urban concept, Knowledge City (KC) was proposed to the literature (Carillo, 2006a). Its applications have already started to be implemented. However, instead of traditional planning approaches, new development strategies were needed to transform cities accordingly. To accomplish the task, Knowledge-Based Urban Development (KBUD) strategies took place in planning literature. Today KBUD is commonly accepted as the pathway for cities to become KCs (Ergezakis vd., 2004, 7; Knight, 2008; Yigitcanlar et. al, 2008a).

In the global economic system, where the city's relationship is largely regarded in terms of 'connectivity' to the Internet (Weinstock, 2010), cities are required to be places of knowledge spillover (Griliches, 1992; Brecshi and Lissoni, 2001a) within its changing form and function in knowledge era (Ellison and Glaeser, 1999; Castells, 2002; Baum et. al, 2007; Yigitcanlar vd., 2008a, 2008b). Additionally, KC is required to attract both knowledge-intensive activities (Audretsch and Feldman 1996; Fujita ve Weber, 2003) and knowledge workers (Van den Berg et. al., 2004; Carvalho, 2006; Yigitcanlar, 2007a). Moreover, institutions are expected to organise, manage and govern all other aspects while bringing all actors and sources together to facilitate knowledge-intensive activities (Yigitcanlar, 2010; Carillo et al., 2014). It is clear today that planning a KC is not only spatial issue; it has economical, societal, spatial and institutional aspects within itself.

Adopting KBUD strategies supports increasing competitiveness in KE (Ergazakis, et.al. 2004; Yigitcanlar, 2011; Carillo et. al, 2014). Therefore, measuring KBUD performance or level of cities is important for competitiveness and for planning cities accordingly. It has been a difficult question to answer since KC has several aspects and requires a new way of systems thinking. Many scholars and organizations have already developed assessment models (WCI, 2006; Ergazakis et. al, 2006; Corey and Wilson, 2006; Van Winden et. al, 2007; Yigitcanlar, 2008a, 2013). However, there isn't a viable integrated KBUD assessment model today (Dang and Umemoto, 2009). All models vary based on their approach and geographical differences (Heywood, 2008). One of the main critiques of KBUD assessment models was about integrating locality into the models especially for developing countries, who has less knowledge stocks, lacking knowledge worker (Veugelers, 2011) and needs to experience technology adaptation stages (Verspagen, 1991). However, it is important to state that some of the models get updated towards eliminating critiques and developing an integrated model (Carillo et. al, 2014).

Turkey has been investing on increasing its competitiveness in KE. The nation-wide policies that are in progress are increasing knowledge worker capacity, providing an efficient platform for innovation and strengthening institutional leadership (Ministry of Development, 2003). Verspagen's (1991, 1992) three phases of technological development process is mainly measured by international trade channels; such as FDI, import, export and etc. Therefore, 151% increase in FDI, 323% in import and 338% in export between 2002-2012 indicates that Turkey is in the process of acquiring new technology and knowledge. The missing link, so far, is the lack of urban development strategies in Turkey. Although there are studies that designate Istanbul as a prospect KC (MAKCi, 2013, Carillo et. al, 2014) and stating that Ankara building a Science Valley (Ankara Development Agency, 2012), there is not any urban planning strategies or KC vision in their existing plans. In addition, Istanbul's role as a Global City and finance centre in the country raises the argument of whether it is the right choice for Turkey. Although, investing on a KC will be beneficial for Turkey to accomplish nation-wide goals, what is more important, is using resources wisely. Therefore, it is crucial to understand the provinces' potential to channel investments in right direction.

This study aims to find out the provinces with higher potential to adopt KBUD strategies in Turkey and to understand the similarities, differences and possible grouping formations. The goal is to measure KBUD potential of Turkish provinces. To accomplish the task, the study evaluated assessment models and determined indicators based on literature and expert opinions. The model for Turkish provinces is consisted of an indexing framework. First, the article will present the evaluation of the analysed assessment models and, second, it will explain the methodology. Following section is consisted of results and final section will present evaluation and discussions.

2. Developing a KBUD Assessment Model for Turkey

2.1 Evaluation of assessment models

Developing a successful model for Turkey requires detailed analysis of the existing assessment models. The investigation on assessment models split in two parts; first is about content along with explanations of indicators and second is about quantifying the model (Table 2). The MAKCi Awards (WCI, 2006), The KnowCis Model (Ergazakis et. al, 2006), The ALERT Model (Corey and Winson, 2006), KBUD Characteristics Model (Van Winden et. al, 2007), KBUD/AM (Yigitcanlar, 2013) were analyzed in the first section (Table 1).

All KBUD assessment models were created to accomplish different goals; and therefore, have different approaches. Relatively, the goal and approach of the models effect the determination of indicators. Most of the models combine quantitative and qualitative methods. This study's goal is to measure KBUD potential of Turkish provinces. The missing link to increase competitiveness in KE is determined as the urban planning strategies. That is why; the study is more concerned about planning perspective. The measurement of four main categories, economic, societal, spatial and institutional, following the footsteps of KBUD/AM (Yigitcanlar, 2013), will be helpful to prioritize planning strategies and actions.

Table.1 Evaluation of KBUD Assessment Models

Model	Number of categories	Approach	Content	Conceptual framework

MAKCi	8 (capitals)	To determine high performance KCs	Qualitative & quantitative	City systems of knowledge City systems of learning City systems of information
The KnowCis	9	To determine KBUD strengths and weaknesses and implementation	Qualitative & quantitative	Concept, Support, Infrastructure, Participation, Business environment, Public sector, Networking, Human skills and International networks
The ALERT Model	5	To support local and regional planning practitioners	Qualitative & quantitative	Awareness, Layers, E-business, Responsiveness and Talk
KBUD Characteristics Model	7	To acquire, to create, to disseminate and to use knowledge	Qualitative & quantitative	Knowledge base, industry structure, quality of life, diversity, accessibility, social equity and scale
KBUD/AM (2013)	4 categories 8 indicator sets	Urban development and planning	Quantitative performance analysis	Macro-economics foundation, knowledge-economy foundation, human and social capitals, diversity and independency, quality of life and place, sustainable urban development, planning and leadership, support and partnership

Second part of the investigation is on the statistical procedures. The goal of the study requires an index study since the method summarizes and ranks multiple indicators. It is clear that there isn't a single formula that can be applied to all index studies. However, all studies that took place in Turkey prefer Principle Component Analysis (PCA) and normalization. PCA is used to eliminate the dependency structure between indicators and to reduce the dimension of the dataset. PCA can, also, be used to analyse the dataset to prepare for other analysis (Saruhan and Ozdemirci, 2005). If preferred, weighting methods are consisted of expert opinions. Expert opinion provides the qualitative part of these models. Based on the evaluation of the statistical procedures of indices-based studies, this study will use PCA and normalization. Expert opinions will be included in determining indicators.

Table 2 Summary of methods used in investigated multiple indicator-based indices used globally and locally.

Model	Number of sub indices	Number of indicators	Statistical procedures	Weighting method
MAKCi (2006)	8	17 (questions)	Regression	Expert opinion
KBUD/AM (2013)	4	32	Normalization	Expert opinion
Network Readiness Index (2014)	4	9 - 90	Depends on final variable set	-
URAK Competitiveness Index (2009)	4	36	PCA – Normalization	Expert opinion
EDAM & Deloitte Competitiveness Index (2009-2010)	6	50	PCA – Normalization	-
Foreign Trade Potential (2011)	4	-	Network analysis	-
SEGE (2013)	7	58	PCA – Normalization	-

2.2 Methodology

The methodology is consisted of five parts; (1) evaluation of existing assessment models and indices-based studies, (2) determining an indexing framework of KBUD potential of Turkish provinces, (3) determining indicators, (4) collecting data and applying statistical procedures, and (5) evaluation of findings. Before PCA, KMO, Barlett's sphericity test and anti-image analysis were applied to all data to test the data compatibility for factor analyses. The results are shown in 5 intervals (0-5, 5-15, 15-25, 25-50 and 50-100) based on frequency distribution of final scores.

2.3 Determining indicators

Indicators of KBUD Potential Index of Turkish provinces are based on literature and expert opinions. Since Turkey is considered as a developing country, it is important to understand developing countries' picture on KE and KBUD development. This section explains indicators' place in literature and data availability for Turkey in each category.

2.3.1. Economic Development

Macro-economic indicators that are commonly used in evaluated studies are included in this study to capture stability and existing structure of economy. One of the critiques states that innovation is built upon existing knowledge stock and developing countries usually lacks knowledge stock and/or knowledge worker. Producing new knowledge and technology is slower. Relatively, this slows down the pace of increasing competitiveness. That is why, R&Ds, as new knowledge producing centres, are stated as crucial ingredients for economic development (Griliches, 1979; Audrectsh and Feldman, 2004; Acs et.al, 1992; Feldman, 1994). Another point is the technology adaptation process that developing countries have to experience to be able to create new knowledge and technology on its own (Verspagen, 1991). Verspagen (1991, 1992) identifies three phases for technological development process; (1) pre-catch-up, where technological progress does not contribute to economic growth, (2) catch-up, where technology absorption increases, and (3) post-catch-up, where the country begins to develop its own R&Ds and finally starts to see outcomes on knowledge-based growth. R&D expenditure data is not available in province level. Therefore, the study included number of R&Ds and number of patents.

Veugelers (2011) points out two crucial ingredients for developing countries to complete technological adaptation process; (1) access to 'foreign' technology via international partnerships, trade flows or investments and (2) absorptive capacity (Cohen and Levinthal, 1990) and social capability (Abromovitz, 1986), which are required to deliver growth and sustain the developed capacity. First ingredient can be measured with foreign trade indicators (FDI, import, export), while the second requires technologically-literate workforce and highly-skilled elite, public-sector institutions, etc. for measurement (Veugelers, 2011).

Table 3 The indicators of Economic Development indicator set of KBUD Potential Index of Turkish Provinces.

Category	Indicator sets	Indicators	Variables	Source	Year
Economic Development	Economic structure	Unemployment	Unemployment rate	TSI	2012
		Employment	Employment rate	TSI	2012
		Founded firms	Number of founded firms	TSI	2012
		Closed firms	Number of closed firms	TSI	2012
		Import	10-year average of import	TSI	2002-12
		Export	10-year average of export	TSI	2002-12
	Knowledge Economy infrastructure	Foreign investments	FDI (TRY)	ME	2002-12
			Number of foreign firms	ME	2012
		High-tech sectors	Employment in high and medium-high tech. industries	SSI	2012
		Knowledge-intensive sectors	Employment in knowledge-intensive industries*	SSI	2012
		R&D	Number or R&D units	SIT	2012
		Patent	Number of patents	TPI	2012
		ICT initiatives	Number of ICT initiatives	TSI	2012
		Technoparks	Number of Technoparks	SIT	2012
		ICT infrastructure	Number of mobile phone users	ICTA	2012
			Number of internet users	ICTA	2012
			Number of broadband users	ICTA	2012

** Eurostat, Knowledge Intensive Activities, Nace Rev.2 at 2 digit.*

2.3.2. Societal Development

Knowledge workers play a critical role for both KE and KBUD development. Attracting and sustaining knowledge workers have become one of the key factors of economic development of a city, region or nation (Gottlieb, 1995; Saxenian, 1994; Yigitcanlar et. al, 2007). On the one hand, firm diversity along with place and life quality effect knowledge workers' location choice (Gottlieb, 1994). On the other hand, firms are following talent and knowledge workers (Glaeser, 2000; Saxenian, 1994). In developing countries, where knowledge worker density is lower, it becomes problematic to attract both firms and knowledge worker. Also, existing knowledge worker concentrates only in certain cities. Powell and Snellman (2004) argues that if the worker classification is not prepared carefully and technologically disadvantaged workers are not educated well, there would be a new social class and a possible social segregation. This is why; the education level of the society is as important as sustaining knowledge workers. Additionally, knowledge worker is described as independent, highly mobile in location and in between firms, seeks for cultural diversity (Van den Berg et al., 2004), social equity (Carvalho, 2006) and social tolerance (Yigitcanlar et. al, 2007). Understanding society's existing dependency ratio, cultural diversity, tolerance and life satisfaction is important to attract knowledge workers.

Table 4 The indicators of Societal Development indicator set of KBUD Potential Index of Turkish Provinces.

Category	Indicator sets	Indicators	Variables	Source	Year
Socio-Cultural Development	Societal Structure	Dependency	Dependency ratio	TSI	2012
			Female population's employment participation rate	TSI	2012
			Total fertility rate	TSI	2009-13
		Cultural diversity and Tolerance	Number of work permits for foreigners	LSS	2012
			Number of foreign visitors	Ministry of Tourism	2012
			Number of disabled employees	LSS	2012
		Life satisfaction	Level of happiness	TSI	2012
			Level of hope	TSI	2012
	Knowledge Worker Infrastructure	Education	Vocational and technical high-school enrolment rate	TSI	2012
		Higher education	Number of university and graduate school students	SSPC	2012
			Number of university and graduate school graduates	SSPC	2012
			Number of university lecturers	SSPC	2012
		Technical staff	Number of engineers and technician staff members	UCCE	2012

2.3.3. Spatial Development

The city needs to provide, not only high quality of life and place (Yigitcanlar et. al, 2007, 2008b, 2010c, 2013); but also, knowledge intensive-activities and knowledge-sharing areas (Karlsson et. al, 2012; Richardson et. al, 2011; Carillo et. al, 2014; Edvinsson, 2000). Universities, R&Ds, research parks and knowledge-intensive industries need to be planned and designed in harmony with open spaces, cultural activity areas and etc. (Edvinsson, 2000). The lack of the knowledge or consciousness of new way of living, effect the planning and design approach negatively. A city's place and life quality is considered to be one of the most important ingredients for economic development (Florida, 2002). Additionally, sustainability plays a significant role in the spatial formation to provide a good quality of life within a healthy and physically attractive environment (Yigitcanlar et. al, 2008d).

Table 5 The indicators of Spatial Development category of KBUD Potential Index of Turkish Provinces.

Category	Indicator sets	Indicators	Variables	Source	Year
Spatial Development	Knowledge-intensive Activities and Sustainability	Urbanization	Urbanization rate	TSI	2012
		Knowledge-intensive activities	Number of knowledge-intensive firms	SSI	2012
			Number of universities	HEI	2012
		Accessibility	Airport passenger capacity	SAA	2012
			The distance to the closest airport	TSI	2012
			The ratio of railways to total area	TSR	2011
		Sustainability	Housing stock	TSI	2012
			Number of green buildings	TSI	2012
			Residential electricity consumption per person	TSI	2011
	Life and place quality	Health	Number of hospital beds per 100.000 people	TSI	2012
			Number of doctors per 100.000 people	TSI	2012
			Number of public libraries	TSI	2012
		Culture	Number of museums	TSI	2012
			Number of movie theatres	TSI	2012
			Number of theatres	TSI	2012

2.3.4. Institutional Development

Institutional development is a crucial component of KBUD development and develops the main part of absorptive capacity (Cohen and Levinthal, 1990). The category organizes, manages and governs all other categories (Yigitcanlar, 2010; Carillo et. al, 2014). Institutions are expected to provide a trustworthy economic platform to be able to attract firms and foreign investments. Additionally, partnership and leadership are crucial components of institutional development (Knight 1995; Van Winden, 2010; Ergazakis vd., 2004b). The category has limited number of indicators than expected because of data availability difficulties of category's context. As a result, the element of knowledge in institutional indicators could not be included in this category.

Table 6 The indicators of Institutional Development category of KBUD Potential Index of Turkish Provinces.

Category	Indicator sets	Indicators	Variables	Source	Year
Institutional Development	Leadership – Partnership – Satisfaction	Management employment	Number of administrative staff	UCCE	2012
		Use of corporate technology	Number of active individual internet banking customers per 1.000 people	TSI	2012
			Number of active corporate internet banking customers per 1.000 people	TSI	2012
		Partnerships	Number of SANTEZ project	SIT	2012
			Number of active association	Dept.Asso.	2012
			Number of NGOs	Dept.Asso.	2013
		Public support	10-year average of public investments	ME	2002-12
			10-year average of incentives	ME	2002-12
			Share of transportation-communication public investment in total	ME	2012
		Satisfaction of public services	Satisfaction rate of judicial services	TSI	2012

Indicators of KBUD Potential Index of Turkish provinces were determined according to the literature with respect to critiques. Available data in province level in Turkey were sent out to experts to determine final indicator sets. Expert opinions were collected from 10 experts (Academicians, government officers, NGO employees, planning practitioners). Each expert stated the importance level of each indicator in likert scale. Afterwards, KMO, Barlett's sphericity test and anti-image analysis were applied to all data to test the data compatibility for factor analyses. The data with less than 0,5 significance in anti-image analysis were deducted.

Four main categories are structured in indicator sets to understand existing structure and knowledge infrastructure and/or potential for KBUD development for each category, except institutional development because of data availability limitations and reliability. Some indicators are represented by more than one variable. In total, Economic Development (ED) has 17, Societal Development (SoD) has 14, Spatial Development (SpD) has 15, Institutional Development (ID) has 10 variables and in total KBUD Potential Index has 56 variables. PCA analysis used to test compatibility of variables between each other and to analyse factor groups' relativity with literature. PCA indicates factor weightings; however, weightings determined by PCA are strictly mathematical and did not included as a weighting in the equation. PCA was applied to each category's variables separately.

3. The KBUD Potential Index of Turkey

The KBUD Potential Index of Turkish Provinces is calculated with arithmetic average of 4 categories, while category's sub-index score represents the potential of that category to determine the strengths and weaknesses of provinces. The results of KBUD Potential Index (Table 8) show a clear picture of Istanbul being the main centre for KBUD development in Turkey with full score in all categories. The categories of Economic Development and Spatial Development have only Istanbul higher than 50. Economic development's scores are distributed mainly in between 5-15, which indicates that KE performance is low throughout the country. The Societal Development scores are distributed within a higher range than other categories. Majority of the scores are higher than 25, whereas other categories scores are mainly in between 5 and 10 (Table 7). Ankara, the capital, comes second in institutional development; while it is interesting that Istanbul's institutional development is higher than the capital.

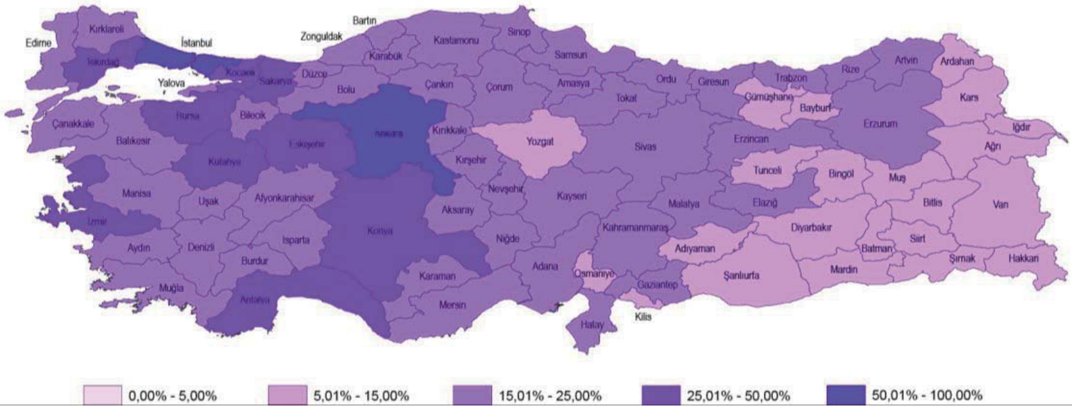

Figure 1 KBUD Potential Index of Turkish Provinces.

Table 7 Frequency of KBUD Potential Index of Turkish Provinces results.

Scores	Economic Development	Societal Development	Spatial Development	Institutional Development	KBUD Potential Index
0-5	5	5	3	9	0
5-15	60	6	40	37	22
15-25	11	12	32	30	48
25-50	4	53	5	2	9
50-100	1	5	1	3	2

Table 8 The KBUD Potential Index of Turkish Provinces.

	Economic Development		**Societal Development**		**Spatial Development**		**Institutional Development**		**KBUD Potential Index**	
1	İstanbul	100,0	İstanbul	100,0	İstanbul	100,0	İstanbul	100,0	İstanbul	100,0
2	Ankara	44,36	Ankara	66,25	Ankara	47,22	Ankara	67,43	Ankara	56,32
3	Kocaeli	42,98	Eskişehir	64,18	İzmir	40,08	İzmir	52,22	İzmir	43,52
4	Bursa	40,64	İzmir	56,62	Konya	29,59	Bursa	37,64	Bursa	37,70
5	İzmir	25,17	Bursa	50,38	Kocaeli	27,62	Sakarya	27,17	Kocaeli	34,78
6	Manisa	24,92	Bolu	49,67	Gaziantep	26,90	Kocaeli	24,58	Eskişehir	31,85
7	Tekirdağ	22,86	Antalya	49,52	Adana	24,69	Antalya	24,55	Antalya	28,76
8	Antalya	19,79	Isparta	47,67	Kayseri	24,28	Kütahya	23,62	Sakarya	26,99
9	Sakarya	19,16	Balıkesir	46,26	Eskişehir	23,57	Bolu	23,40	Konya	26,09
10	Adana	17,73	Sakarya	45,99	Diyarbakır	22,56	Sinop	22,42	Tekirdağ	25,14
11	Konya	17,50	Edirne	45,17	Bursa	22,14	Muğla	22,34	Kütahya	25,10
12	Eskişehir	17,41	Kütahya	44,70	Sivas	21,90	Eskişehir	22,24	Balıkesir	24,97
13	Denizli	15,71	Giresun	44,49	Antalya	21,16	Aksaray	21,11	Manisa	24,48
14	Samsun	15,56	Bilecik	44,06	Elazığ	20,93	Gaziantep	21,01	Isparta	23,49
15	Mersin	15,31	Kocaeli	43,92	Balıkesir	20,53	Balıkesir	20,63	Bolu	22,90
16	Yalova	15,18	Çanakkale	43,03	Mersin	20,01	Konya	20,50	Denizli	22,45
17	Trabzon	14,97	Tekirdağ	42,25	Malatya	19,86	Tekirdağ	19,47	Samsun	22,27
18	Kayseri	14,72	Kırıkkale	41,94	Uşak	19,39	Denizli	18,14	Kayseri	22,26
19	Erzurum	14,49	Kırklareli	41,15	Erzurum	19,22	Kayseri	17,75	Uşak	21,91
20	Muğla	14,41	Rize	41,00	Isparta	18,91	Erzincan	17,18	Afyonkarahisar	21,37
21	Hatay	13,95	Sinop	40,89	Manisa	18,84	Adana	16,71	Sinop	21,32
22	Aydın	13,93	Uşak	40,22	Samsun	18,73	Mersin	16,57	Adana	21,29
23	Kars	13,82	Düzce	40,16	Kütahya	18,66	Rize	16,46	Muğla	21,18
24	Edirne	13,51	Afyonkarahisar	40,06	Nevşehir	18,46	Samsun	16,44	Bilecik	21,13
25	Erzincan	13,51	Çankırı	39,65	Denizli	17,67	Kastamonu	16,02	Edirne	21,01
26	Elazığ	13,49	Bartın	39,54	Batman	17,10	Uşak	15,88	Çanakkale	20,78
27	Kütahya	13,41	Artvin	39,30	Tokat	17,08	Afyonkarahisar	15,83	Kırıkkale	20,47
28	Çanakkale	13,30	Amasya	38,90	Afyonkarahisar	16,73	Çanakkale	15,80	Trabzon	20,11
29	Ordu	13,17	Manisa	38,55	Mardin	16,68	Edirne	15,67	Erzincan	20,10
30	Ardahan	13,01	Samsun	38,36	Erzincan	16,54	Manisa	15,62	Rize	19,98
31	Kastamonu	12,90	Denizli	38,30	Bilecik	16,22	Aydın	15,54	Aydın	19,87
32	Aksaray	12,88	Ordu	37,76	Kırıkkale	16,10	Karabük	15,44	Mersin	19,69
33	Afyonkarahisar	12,86	Karaman	37,71	Tekirdağ	15,96	Bilecik	15,38	Amasya	19,63
34	Düzce	12,78	Yalova	37,31	K.maraş	15,90	Ordu	15,31	Karabük	19,34
35	Sivas	12,76	Kırşehir	37,30	Aydın	15,90	Kırşehir	15,27	Kastamonu	19,27
36	Çorum	12,62	Trabzon	36,91	Sakarya	15,62	Isparta	14,95	Sivas	19,14
37	Bolu	12,57	Konya	36,76	Van	15,28	Trabzon	14,84	Kırklareli	19,06
38	Rize	12,54	Karabük	35,92	Şanlıurfa	15,27	Kırıkkale	14,70	Ordu	18,76
39	Burdur	12,53	Kastamonu	35,79	Hatay	15,00	Yalova	14,49	Giresun	18,72

40	Zonguldak	12,52	Muğla	35,54	Karabük	14,88	Amasya	14,47	Çankırı	18,36
41	Balıkesir	12,47	Bayburt	34,51	Amasya	14,65	Karaman	14,36	Nevşehir	18,23
42	Isparta	12,44	Aydın	34,10	Çorum	14,18	Artvin	14,28	Yalova	18,23
43	Tokat	12,43	Erzincan	33,18	Adıyaman	14,18	Hatay	14,28	Gaziantep	18,23
44	Uşak	12,17	Tokat	32,67	Siirt	13,90	Kırklareli	13,42	Kırşehir	18,03
45	Giresun	12,15	Kayseri	32,27	Trabzon	13,74	Burdur	13,38	Tokat	17,99
46	Van	12,07	Burdur	32,23	Osmaniye	13,66	Zonguldak	13,33	Aksaray	17,94
47	Malatya	12,07	Gümüşhane	31,50	Kars	13,59	K.maraş	13,15	Karaman	17,89
48	Çankırı	11,96	Zonguldak	31,43	Zonguldak	13,28	Nevşehir	12,27	Zonguldak	17,64
49	Sinop	11,78	Nevşehir	30,92	Çankırı	13,06	Niğde	11,93	Burdur	17,62
50	Iğdır	11,76	Sivas	30,08	Ağrı	12,47	Sivas	11,82	Malatya	17,54
51	Ağrı	11,66	Aksaray	28,89	Muğla	12,44	Düzce	11,00	Erzurum	17,46
52	Bartın	11,59	Yozgat	27,87	Kilis	12,39	Giresun	10,91	Düzce	17,32
53	Nevşehir	11,28	Malatya	27,55	Kastamonu	12,38	Çorum	10,78	Elazığ	17,03
54	Kırklareli	11,22	Niğde	27,17	Burdur	12,35	Malatya	10,70	Bartın	16,70
55	Yozgat	11,14	Mersin	26,89	Muş	11,75	Bartın	10,55	Artvin	16,42
56	Karabük	11,14	Adana	26,04	Kırşehir	11,33	Erzurum	10,28	Hatay	16,41
57	Şanlıurfa	11,14	Erzurum	25,83	Bitlis	11,33	Elazığ	10,25	K.maraş	16,11
58	Artvin	10,98	Çorum	25,79	Çanakkale	10,97	Yozgat	10,04	Çorum	15,84
59	Hakkari	10,91	K.maraş	24,80	Karaman	10,61	Tokat	9,80	Niğde	15,03
60	Niğde	10,63	Elazığ	23,46	Kırklareli	10,43	Gümüşhane	9,08	Yozgat	14,84
61	K.maraş	10,61	Ardahan	23,34	Niğde	10,39	Çankırı	8,78	Bayburt	14,05
62	Amasya	10,50	Osmaniye	22,76	Yozgat	10,32	Kars	8,41	Gümüşhane	13,89
63	Gaziantep	10,22	Hatay	22,41	Sinop	10,21	Tunceli	7,41	Osmaniye	13,34
64	Bayburt	10,04	Kilis	22,32	Iğdır	9,96	Osmaniye	7,30	Kars	12,81
65	Kilis	9,70	Hakkari	22,28	Rize	9,90	Bayburt	6,55	Kilis	12,53
66	Osmaniye	9,66	Adıyaman	21,90	Edirne	9,69	Iğdır	6,12	Iğdır	11,86
67	Bingöl	9,51	Iğdır	19,61	Şırnak	9,68	Ardahan	5,82	Adıyaman	11,66
68	Kırıkkale	9,15	Bingöl	19,10	Bingöl	9,24	Kilis	5,71	Ardahan	11,58
69	Muş	9,13	Tunceli	18,56	Aksaray	8,90	Şanlıurfa	5,69	Bingöl	10,41
70	Karaman	8,90	Kars	15,42	Ordu	8,79	Mardin	5,37	Hakkari	9,97
71	Bilecik	8,88	Gaziantep	14,78	Giresun	7,35	Adıyaman	5,37	Van	9,84
72	Bitlis	8,87	Siirt	8,37	Gümüşhane	6,12	Diyarbakır	5,00	Diyarbakır	8,56
73	Gümüşhane	8,87	Van	7,64	Bolu	5,96	Batman	4,42	Tunceli	8,36
74	Kırşehir	8,21	Şırnak	6,22	Yalova	5,93	Van	4,35	Şanlıurfa	8,02
75	Tunceli	7,49	Bitlis	5,83	Hakkari	5,62	Şırnak	3,90	Ağrı	7,82
76	Adıyaman	5,21	Batman	5,37	Düzce	5,31	Bingöl	3,80	Bitlis	7,23
77	Diyarbakır	2,47	Muş	4,92	Bayburt	5,11	Siirt	3,53	Batman	6,95
78	Siirt	1,93	Diyarbakır	4,22	Bartın	5,11	Ağrı	3,53	Siirt	6,93
79	Batman	0,90	Ağrı	3,64	Ardahan	4,17	Bitlis	2,89	Muş	6,45
80	Şırnak	0,37	Mardin	2,89	Artvin	1,10	Hakkari	1,07	Mardin	6,24
81	Mardin	0,00	Şanlıurfa	0,00	Tunceli	0,00	Muş	0,00	Şırnak	5,04

3.1. Economical Development

Economical Development indicator sets' frequencies (Table 9), presents stronger economic structure and weak KE infrastructure throughout the country. This result is not surprising considering that Turkey is in transition and has a goal of increasing competitiveness in KE. The provinces with higher scores are spread in northwest, west and middle Anatolia regions. Besides Istanbul, 5 of 81 of provinces show higher potential in KE.

Table 9 Frequencies of Economic Development Indicator Sets.

Scores	Economic Structure	KE Infrastructure	Total
0-5	2	29	5
5-15	3	43	60
15-25	0	4	11
25-50	47	4	4
50-100	29	1	1

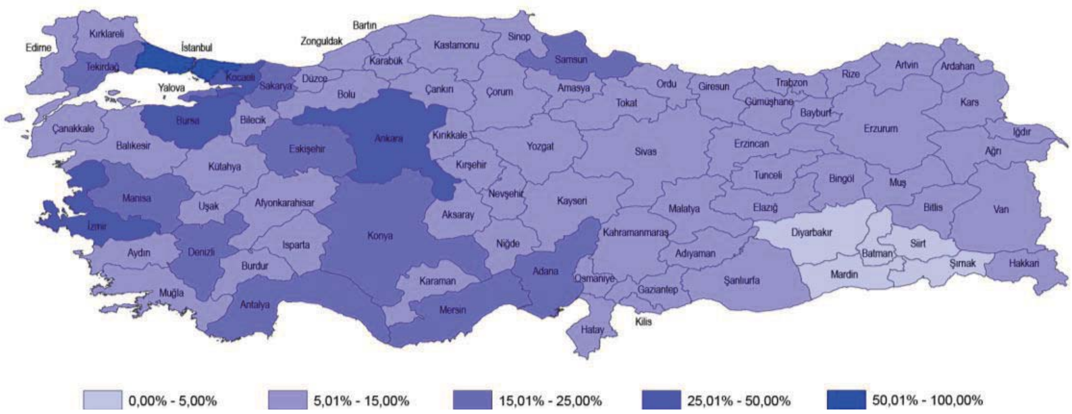

Figure 2 Economic Development category results of KBUD Potential Index of Turkish Provinces.

Ankara that has a plan for building a Science Valley (Ankara Development Agency, 2012), is the second with 44,36. Kocaeli and Bursa, are known with their traditional industrial development and their high scores are promising. Ankara has 46,33 in existing structure and 47,57 in KE infrastructure, while Kocaeli (47,21) and Bursa (52,99) has higher scores in existing structure. KE infrastructure, on the other hand, is higher in Ankara (47,67) whereas Kocaeli scored 45,6 and Bursa 40,58. Southeast provinces have lowest scores in both indicator sets. Mardin scored 10,31, Sirnak 14,05 and Batman 1,22 in existing structure while they have 3,57, 2,73, and 7,91 in order in KE infrastructure.

3.2. Societal Development

The country's overall Societal Development scores are higher than other categories. However, only 6,1% of the provinces indicate potential higher than 50. 20% of the provinces are higher than 50 in societal structure, whereas only 5% in knowledge worker infrastructure. In fact, 61% of the provinces scored lower than 25 in knowledge worker capacity.

Following Istanbul, Ankara and Eskisehir have higher than 60. It is important to note that Eskisehir has the highest number of students (2.497.011) because of correspondence school. Both provinces have highest knowledge worker infrastructure scores; Ankara is 80,46 and Eskisehir is 96,51. However, Eskisehir's societal structure is below 50 and Ankara scored 59,28. The pattern of southeast provinces having the lowest scores is valid in this category as well. Sanliurfa has the lowest score in societal structure and Mardin has 4,25, while knowledge worker infrastructure is 3,22 for Sanliurfa and 3,44 for Mardin.

Table 10 Frequencies of Societal Development Indicator Sets.

Scores	Societal Structure	Knowledge Worker Infrastructure	Total
0-10	8	15	10
10-25	5	35	13
25-50	51	27	53
50-75	16	1	4
75-100	1	3	1

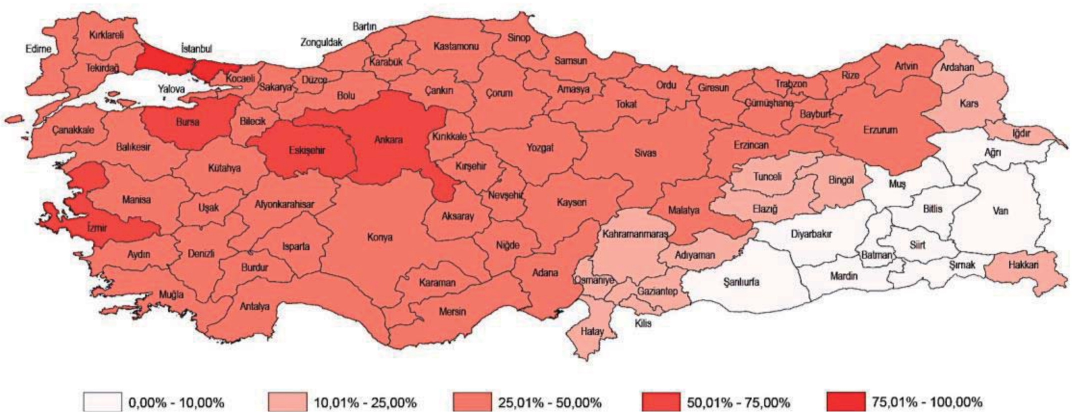

Figure 3 Societal Development category results of KBUD Potential Index of Turkish Provinces.

3.3. Spatial Development

Following Istanbul, Ankara, Izmir, Konya, Kocaeli and Gaziantep have the highest scores. Although both indicator sets have the majority of scores between 15-25, Knowledge-Intensive Activities and sustainability scores are in the lower segment of 15-25 interval, while Place and Life Quality's scores are in the higher segment. There is not a clear regional grouping or separation in this category.

Ankara has higher score in Knowledge-intensive activities and sustainability (47,83) and Place and Life Quality (54,08), while Knowledge-Intensive Activities and Sustainability are much lower in Izmir (35,95) and Konya (26,67). But, Konya ranked 11th in Economic Development and 37th in Societal Development, whereas Izmir is in first 3 provinces. Lowest scores are gathered by Tunceli and Artvin, where Artvin has lowest score and Tunceli has 11,43 in knowledge-intensive activities. Tunceli scored the lowest in Place and

Life Quality and Artvin has 16,78, mainly because it has lowest number of cultural facilities and one of the lowest doctors per person ratio.

Table 11 Frequencies of Spatial Development Indicator Sets.

Scores	Knowledge-intensive Activities and Sustainability	Place and Life Quality
0-5	1	1
5-15	27	6
15-25	39	49
25-50	13	22
50-100	1	3

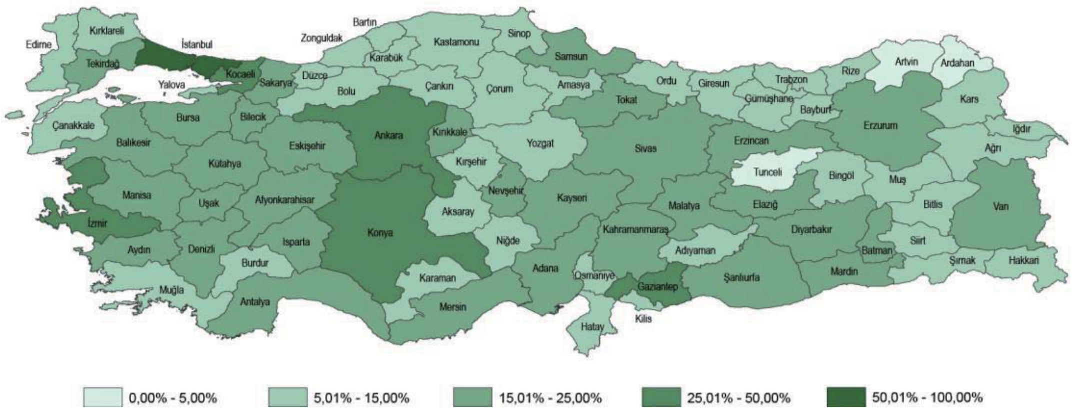

Figure 4 Spatial Development category results of KBUD Potential Index of Turkish Provinces.

3.4. Institutional Development

Institutional Development category has one indicator set because data-collecting process was troublesome. For instance, there is not any existing planning actions or vision towards KC development and, therefore, there is not a variable indicating that. Additionally, a variable for juridical structure of new technologies is not valid at provincial level. The results indicate that after Istanbul, Ankara (67,43) and Izmir (52,22) have highest scores. It’s interesting that Ankara, as the capital, has a lower score than Istanbul. Izmir has the highest 10-year average of incentives, while Ankara has the highest number of NGOs in the country. Southeast provinces have the lowest scores mainly because most of them have the lowest number of management employment and corporate technology.

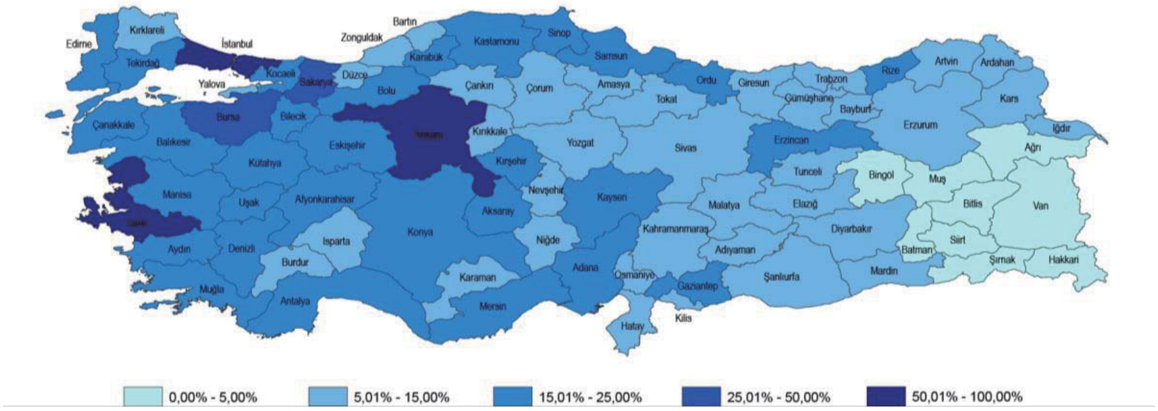

Figure 6 Institutional Development category results of KBUD Potential Index of Turkish Provinces.

4. Conclusion

KE and KC's hand-in-hand relationship is very clear today. Turkey's nation wide goals require a KC development to support increasing competitiveness in KE. It is important to determine which provinces to develop as KCs to channel resources efficiently and effectively. Evaluated existing models show that it is crucial to develop a framework locally and categorize into sub-indices is necessary since KBUD has economical, societal, spatial and institutional aspects within itself. KBUD Potential Index of Turkish Provinces was developed locally including all aspects.

It is known that Istanbul is the main economic pole in Turkey and it is not an unexpected result that the City has full score in all categories. However, production of scientific knowledge and cultural creativity is not limited to large cities (Sellers, 2002). Large cities may be the parts where creative economy clusters; but they are not the common-ground of where knowledge economy happens. Their essential role is to command and control global economy (Madanipour, 2011). For instance, Manchester and Boston are successful and well-known KCs, whereas London and New York are Global Cities and finance capitals. It is inevitable that New York and London are knowledge-based cities; but their main role in their nation and/or region is different. Therefore, this study suggests that Istanbul's role as a Global City and finance capital of the country should be viable and a KC development should be elsewhere.

MAKCi 2013 Awards nominated Istanbul as Knowledge City Region (WCI, 2013). Additionally, Istanbul was compared to Helsinki and Manchester under the single-city context and fell considerably behind (Carillo et. al, 2014). Istanbul's full score in Turkey means KBUD development potential is quite low through out the country. Generally, southeast provinces have the lowest potential while western provinces have the highest in Turkey along with Ankara in the middle. The neighbours of Istanbul and Ankara have higher scores while there is a possible potential formation in south provinces.

This study provides an understanding of similarities and differences between provinces in Turkey. The model was developed locally, which was a necessity for developing country context that has some gaps and limitations, especially on spatial and institutional development and data availability. One of which is nonexistence of KC vision in strategic plan for all provinces and difficulty in data finding on institutional development. Therefore, the study suggests that a further detailed study needs to be completed for provinces with higher potentials, Ankara, Izmir and Bursa. Developing urban development strategies is a complex issue. However, it is crucial to understand all pillars of KC to be able to channel resources effectively. Although there is a lack of spatial and institutional data, model and criteria developed for Turkey provides guidance for further studies.

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Abbreviations

ICTA: Information and Communication Technologies Authority
WCI: World Capital Institute
SSI: Social Security Institution
TSI: Turkish Statistical Institution
ME: Ministry of Economy
SIT: Ministry of Science, Industry and Technology
TPI: Turkish Patent Institution
ICTA: Information and Communication Technologies Association
LSS: Ministry of Labor and Social Security
SSPC: Student Placement and Selection Center
UCCE: The Union of Chamber and Commodity Exchanges of Turkey
HEI: Higher Education Institute
SAA: General Directorate Of State Airports Authority

TSR: Turkish State Railroads

A conceptual approach to the relationships between the social economy, social welfare, and social innovation

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Abstract: With the aim of finding a balance between social and economic benefits, the social economy has reemerged in the crisis of the welfare state. The Fordist welfare state can be characterized by state-provided welfare, the mediation of paid work and welfare by the labor market, and redistributive policies. Globally, neoliberalism and the market have given rise to social exclusion; in this context, the social economy is emerging as an alternative to the market domination of societies. In the social economy, reciprocity, democracy, self-help, and social capital at the local level are emphasized; this emphasis can be expected to affect the welfare provision system and the social relations surrounding welfare. Building the social economy requires a shift in focus: because the spirit of the social economy lies in the solidarity and autonomy of communities, micro policy at the local level should be emphasized rather than focusing on macro policy at the national level. Without such a shift, the social economy is likely to become oriented toward the state or the market, obviating self-governance. Civil society and local politics are necessary to balance social actors and sectors.

Keywords: social economy, social welfare, civil society, social innovation.

Introduction

Because of successive economic crises since the 1970s, states have increasingly found welfare provision a financial burden and have made cuts in public expenditures, turning over the responsibility for welfare to the market. Consequently, social exclusion caused by poverty, unemployment, underemployment, and social inequality has been increasing in Western welfare states as well as in developing countries. Social exclusion from the labor market can result in exclusion from welfare institutions and public services. In these successive economic crises, strong states that formerly had a capacity for welfare services provision have been stripped of their fundamental resources; the welfare state is now in crisis, beset by numerous social problems with no clear solutions. How can these problems be managed? In this context of unsatisfied needs and economic instability, a number of researchers have turned their focus toward the social economy as a possible engine of social change. As the role of the state as welfare provider has diminished, the social economy has emerged as an alternative for ensuring that social needs are unmet and that market-driven problems, such as social exclusion, are ameliorated. In recent years, the social economy has come under a great deal of discussion.

Although there has been scant movement and few activities oriented toward the simultaneous pursuit of social and economic benefits in Europe since economic crises in the 1970s, the social economy is not “novel” and can be traced to the 19th century. The third sector in Europe and the non-profit organization sector in the US have carried out the functions of welfare services providers with some state support. In recent years, social economy initiatives have been recognized as having potential. Social economy initiatives are expected to supplement the diminishing welfare state under neoliberalism. In the context of neoliberalism, there have been high expectations in regard to what the social economy can accomplish (Amin et al, 2002). Although social economy initiatives vary considerably, it is clear that the time for the reemergence of social economy has come, in Europe, the origin of the welfare state, and worldwide.

The renewed focus on the social economy has cast the social economy as a way to solve problems in the market, state, and communities. However, discussion has only taken place around how the social economy can supplement the state and market in resolving social and economic problems; relationships between the market, state, and communities have not been discussed from the perspective of social welfare.

What changes in the welfare regime can be expected in the reemergence of the social economy? From the perspective of social welfare, this study focuses on the theoretical underpinnings and tasks involved in the reemergence of the social economy and its transformation of the system for welfare services provision and delivery. Research has been undertaken to determine how welfare provision and delivery emerges in the interaction between the state, market, and communities. Pestoff (1996) presented the relations between these three actors and their role in welfare provision and delivery using the welfare triangle model.

The recent emphasis on the social economy raises various questions: is the social economy a distinctive sphere separate from other sectors? How can social economy contribute to social welfare and find a balance between social value and economic value? Social economy initiatives launched in communities differ from the powerful, "public," universal welfare states that were able to mediate the interests of the market and those of the working class. Given that welfare by state is no more effective, are social economy intiatives effective for contributing to the public good and the public interest—can they operate without being limited to the interests of a few or of a narrowly construed community? Can the social economy enhance social bonds? Answering these questions requires empirical research and theoretical elaboration, but in preparation for this, discourses on relationship between social economy and social welfare must be reviewed. As an alternative form of social welfare comes under renewed attention, such a review could assist in facilitating desirable change of social welfare. To formulate a new form of welfare provision, the preliminary work of reviewing the dynamics and characteristics of the social economy must be accomplished. This study is focusing on this point.

Reemergence of the Social Economy

Defining the Social Economy

The social economy, as it is known today, was first identified in France in the late 1970s in organizations such as cooperatives, mutual societies, and associations. The current accepted definition for the social economy spread in the 1980s from France to other countries, including Belgium, Portugal, and Spain, as well as to European institutions (Monzon & Chaves, 2008:553). Until the 1990s, the term hardly featured in English-speaking academic and policy discourse; older terms that were used, such as “third sector,” “non-profit activity,” “community business,” and “voluntary organization,” captured something more modest (Amin et al, 2002:2).

The social economy is generally understood as the entity of the third sector located between the state and the market. The third sector includes various kinds of organization: organizations in the voluntary sector, cooperatives, mutual aid societies, community organizations, and social enterprises. In Europe, the term “third sector” is specifically used to refer to the social economy; however, in the US, the term “non-profit organizations” is preferred.

Defining the social economy is an inexact science: the academic, policy, and practitioner literature offers a variety of definitions, but there is a general consensus that it includes the voluntary sector, community organizations, and social enterprises (HM Treasury, 2002). It is commonly used to refer to complementary sets of market relationships; sometimes, the term refers exclusively to social enterprises (Seyfang, 2006). Often, terms like “social economy,” “third sector,” “non-profit sector,” “voluntary sector,” “solidarity economy,” “alternative economy,” and so on, are used as synonyms. Although, strictly speaking, these terms differ substantially in meaning depending on the distinctive historical and social context in the country in which they are being used, in general, the terms “social economy” and “third sector” are used interchangeably in the European literature on the social economy. In the Anglo-Saxon literature, scant attention has been devoted to market agents (cooperatives, mutual aid societies, etc.) that have introduced modes of organization based on solidarity and reciprocity and serve niche markets composed of members or targeted user groups. In the European context, many of these organizations are neither charities nor foundations but unique articulations of the social in economic life that are undertaken by socioeconomic organizations, some of which are quite powerful; such market agents are not exclusively petty, underscaled, or undercapitalized local initiatives undertaken by communities in crisis (Moulaert & Ailenei, 2005:2043–2044).

Existing research has begun to map the contours and inner dynamics of the social economy and has identified its potential for reconceptualizing economic relationships along more equitable and sustainable lines. It has also sketched the limitations and contextual specificities of the sector that prevent it from easily being scaled up or generalized and delivering what policy increasingly asks of the sector (Seyfang, 2004).

The social economy is generally understood as the entity of the third sector located between the state and the market. The third sector includes various kinds of organization: organizations in the voluntary sector, cooperatives, mutual aid societies, community organizations, and social enterprises. In Europe, the term “third sector” is specifically used to refer to the social economy; however, in the US, the term “non-profit organizations” is preferred.

Anyway, the term “social economy” refers to something outside the realm of the state and market. As the social economy blurs the lines between these two areas, its meaning is difficult to construe. Some have regarded the social economy as coextensive with civil society; others have seen the social economy as engaged in non-profit activities and non-market exchange. In a narrow sense, the term "social economy" refers to social economy initiatives or organizations.

The social economy is composed of various organizational forms and multiple entities: a hybrid of market, non-market (redistribution), and non-monetary (reciprocity) economic activities, the social economy shows that the economy is not limited to the market economy but can include the principles of redistribution and reciprocity (Laville, 2001). That the social economy has its own specificity seems relatively uncontroversial. A more open question is whether the economy should be read as three separate systems (one of which would be the social economy) or as a single entity that blurs the distinction between the market, state, and third sector, with each domain considered highly variegated and possibly containing similar activities to other domains (Amin, 2009:8).

Amin et al (2002:vii) define the social economy as consisting of non-profit activities designed to combat social exclusion by offering socially useful goods on the market that are not provided by the state or private sector. The social economy generates jobs and encourages entrepreneurship by meeting social needs and, very often, by including the socially excluded. Moulaert and Aileni (2005) define social economy initiatives as comprising a wide swath of initiatives and organizational forms; for them, social economy initiatives are a hybrid of market, non-market (redistribution), and non-monetary (reciprocity) economic activities. William et al (2003:154) define social economy initiatives as private, formal associations for pursuing economically oriented collective self-help based on not-for-profit and cooperative principles. Social economy initiatives occupy the voids that are filled neither by the private and public sectors nor by informal networks of family, kin, neighborhood, and community.

To sum up, there are some commonalities in how the social economy has been defined; definitions have focused both on the goals of the social economy and the role played by social economy initiatives. Social economy initiatives have variously evolved into organizational forms located between the public sector and the for-profit market. A distinctive form of institutionalization is now appearing in local initiatives involving a hybrid of commercial, non-commercial, and non-monetary resources (Laville, 2009). The social economy refers to a broad range of activities that can provide opportunities for local people and communities to engage in all stages of the process of local economic regeneration and job creation, from the identification of basic needs to the operationalization of initiatives (Molloy et al, 1999).

What the term "social economy" empirically refers to depends on the historical background and socioeconomic context in the country in which it is being used. In some cases, the term is used to suggest that the social economy can fulfill intractable social needs arising from economic deprivation. In others, the term is used to broadly suggest the return of civil society from the perspective of social relations (Amin, 2009); in such instances, the social economy is viewed as a sociological phenomenon heralding a new stage of capitalism, participation, democracy, and welfare.

Features and Roles of the Social Economy

Theoretically, there is a recognition that the social economy is a wide-spectrum reality ranging from market firms with a partially social agenda to purely solidarity firms or LETS(Local Exchange Trading System) initiatives where the capitalist market mechanism is completely neutralized. The social economy is so embedded in historical, institutional, and local contexts that it seems to escape generalization (Moulaert & Ailenei, 2005:2049).

Pestoff explains the role and features of the social economy based on the concept of social dimension. Social enterprises can potentially contribute in three main ways: they can renew and enrich working life, empower consumers and clients, and enhance other social values and goal fulfillment in the public sector (Pestoff, 1998:15). According to Pestoff's analysis, the social dimension of social economy initiatives, including consumer and worker cooperatives and voluntary organizations, can contribute to recreating the public sector and welfare state by enhancing the provision of personalized social services. Thus, he argues for democratizing and cooperativizing the social economy rather than privatizing the welfare state. For Pestoff, the social economy is a service provider that can substitute for the weakened services provision of the welfare state. Moreover, Pestoff argues that the social economy is focused on localities and community autonomy rather than centralization and national standardization.

> *The provision of social services by social enterprises is local and small-scale in nature. Social enterprises can provide the producers of social services, the consumers or clients of such services with greater influence in their operation. This results in greater citizen control over the social services they demand and depend on and it also promotes local grassroots democracy (Pestoff, 1998:15).*

In 1990, the Wallon Social Economy Council (CWES, 1990) defined social economy initiatives as having four characteristics: social economy initiatives have a) the objective of serving members or communities rather than profit-making, b) autonomous management, and c) democratic decision-making processes. Moreover, they d) place individuals and labor over capital in the distribution of income.

The Charter of Principles of the Social Economy presented by the European Standing Conference on Co-operatives, Mutual Societies, Associations and Foundations (CEP-CMAF, 2002) defines the principles of the social economy as follows:

- Primacy of the individual and the social objective over capital
- Voluntary and open membership
- Democratic control by the membership
- An orientation toward integrating the interests of members/users and/or the general interest
- Defense and application of the principles of solidarity and responsibility
- Autonomous management and independence from public authorities
- Use of most surplus in pursuit of sustainable development objectives, services of interest to members, or the general interest

As above shown, social economy has been understood as comprising commercial and non-commercial activities undertaken by the third sector, community organizations, charity organizations, and social enterprises. Social economy initiatives put social needs rather than profit maximization first.

Social enterprises in particular and the third sector in general, as sites of both social integration and provision for social needs, are increasingly seen as sources of social capital of a particular sort (Amin et al, 2002:7). Consequently, the social economy has been recognized as synonymous with the solidarity economy. The social economy is seen as part of community-building and as a force for the revitalization of solidarity and the building of reciprocity in localities with problems in common through projects that meet social needs and inculcate values of mutuality. The social economy can inculcate an ideology of self-motivation and self-provision, helping individuals to become free-market agents (Amin et al, 2002:7).

The function of the social economy is, in part, to turn needs into markets (Grimes 1997). Social enterprises are firms that try to fulfill several goals simultaneously, recognizing that no single goal can constantly be maximized but that several can be satisfactorily fulfilled at one time. They provide rewarding occupations for employees, facilitate greater citizen participation, and set socially meaningful goals (Pestoff, 1998:13).

The goal of social welfare is to enhance people’s lives, in particular, those of the socially excluded; consequently, social welfare provision is an attempt to contribute to the social good and improve quality of life. On this point, social welfare shares traits with the social economy.

Three Perspectives on the Social Economy

While there may be some consensus on the growing role of the social economy in delivering welfare, jobs, and economic prosperity, there seems to be less agreement on whether this should be distinct from the role played by the market and state (Amin, 2009:6).

Emancipatory Perspective

Critics of capitalism see the present time as an opportunity to move on, to alter radically the meaning and social status of the economy so that the inequality, egotism, and recurrent crises built into capitalism can be overcome (Amin, 2009:3). These positive accounts emphasize the necessity of a new economic system that can serve social and environmental needs, empower producers and consumers, and reinforce human solidarity and moral care. The collective fellowship in a democratic productive system socializes the market economy by making paid work out of unpaid, unaccountable work.

In a strongly worded argument, Gorz (1999:80–96) proposes changing work and the city in order to move beyond a wage-based society. He believes that the possibility of transcending capitalist society is inherent in the evolution of capitalist society itself. Social production under neoliberalism requires less work and less and less in wages is distributed, rendering it increasingly difficult to obtain a sufficient, regular income from paid work. Paid work does not guarantee a stable, sufficient income. For Gorz, the social economy has the potential to change the work-reward system. In the case of the LETS (Local Exchange Trading System), unpaid work and time function as “money” in the local social economy. Cooperative circles believe in the equality of their members and of the equivalence and equal dignity of their members’ work.

Those who think the social economy represents an exodus of capital (Everling, 2003; Gorz, 1999; Lipietz, 1992) propose that the social state could eradicate social exclusion through small, alternative organizational forms such as local communities and cooperatives. Redistributing work and liberating free time could create jobs and ensure welfare and autonomous identity; furthermore, the establishment of small circles can enhance social bonds and social solidarity.

Complementary Perspective

This perspective maintains the reformist vision; it emphasizes that the social economy must complement the overall social configuration rather than replace it. Many studies have portrayed the social economy as an alternative to the market and state (Defourney, 2001; Laville, 2001; Amin et al, 2002; Amin, 2009). But this view accepts that the social economy has limitations.

The view that the social economy is located somewhere between the failure of the market and that of the government is not sufficient to explain the relationship between the social economy, market, and state; in other words, in this view, the meaning and role of the social economy is ambiguous. Amin et al (2002) indicate that the social economy has no conceptual meaning in the absence of references to the state and market. They point out that, as an alternative, the social economy does not represent a new generation of welfare resources but a new mode for the utilization and distribution of resources.

Based on the findings of UK Third Way policy experience, Amin et al (2002) see the social economy as a supplementation for the market and state. The social economy aims and contributes to create jobs, tackle social exclusion, provide work training, and develop local services and local markets. However, the record of the UK third sector shows that the social economy was not able to fully accomplish these goals. As they put it (Amin et al, 2002:29):

> *Our findings demonstrate quite clearly that social economy as it is currently constituted cannot deliver this range of outcomes. This is not only because of its own inherent limitations, but because of the different capacities of people and places to develop social economy activities*.

Pessimistic Perspective

This perspective argues that the social economy is a strategy and agent of neoliberalism and that the social economy is an outcome of privatization policies that are being implemented in Europe. Ascoli and Ranci (2002) analyzed the welfare system mix—comprising cooperatives involved in welfare and engaged with the state, market, and communities—to explain how the social economy has played a role as a service agent in the welfare market. Over the last decade, the European experience has shown that the third sector has become continuously bureaucratized in pursuit of collaboration with the public sector. The entrepreneurship and professionalism of the third sector has marginalized voluntary activities, impeding the autonomy of the social economy. From this perspective, the institutionalization of the social economy by its enclosure within the public sector has resulted in the loss of cultural features such as the emphasis on democracy, autonomy, and participation, rendering the social economy a subcontractor in the market economy. For them, this process was part of the neoliberal strategy to privatize the social welfare system. In a successful market economy, the social economy is likely to play no more than a marginal role.

History has demonstrated the importance of the material infrastructure for social economy initiatives; however, in recent years, this dimension has been neglected. The social economy cannot benefit from proper legal instruments guaranteeing sustainability and amateurism regarding finances (Moulaert & Ailenei, 2005:2048).

Change of Welfare Provision: From Fordism to Neoliberalism

Fordism and Welfare by State

The welfare state prospered between after World War Ⅱ until the mid-1970s, a so-called "golden age" (Pierson, 1998). During this golden age, welfare provision and delivery systems were established based on the Fordist production system. Fordism refers to the model of capitalist accumulation and regulation that predominated from the mid-1950s until the late 1970s. Fordism was characterized by full employment, consumer and welfare security, a social pact around national mass political institutions, and universalist beliefs (Amin et al, 2002:2). Because of the integration of the state and market, the social fabric met social needs; economic growth was stimulated based on the Keynesian regulation system.

Work and welfare were mediated by the labor market and state welfare systems (Figure 1). Workers could obtain social security through social insurance. Non-workers, unable to participate in the labor market due to a lack or paucity of skills, could obtain social security through public assistance. Sustaining family life and satisfying needs depended on labor as a commodity. Esping-Anderson (1990) used the term "de-commodification" to explain the degree to which everyday life could be maintained without participation in the labor market in the golden age of the welfare state; for Esping-Anderson, this degree represented the level of state welfare. Welfare states with high levels of labor de-commodification provided more welfare benefits and state programs, including pensions, sickness allowances, and unemployment cash benefits. The capability of the welfare state is influenced by the social contract between the mainstream economy and the state.

Though there are some differences between welfare states, they have characteristics in common. Welfare states focus on basic income security and social services (or social welfare services). Social insurance, based on individual contributions by citizens and public assistance based on tax financing for the poor, guarantees income security. Social services, such as services for health, childcare, education, housing, and employment, are provided mainly by non-government organizations and non-profit organizations. The most important trait of the welfare state is its policy orientation toward redistribution from the better-off to the worse-off. Simply expressed, social welfare policy is a state redistribution policy. Marshall (1965) mentioned that social welfare provision is ultimately accomplished by the state.

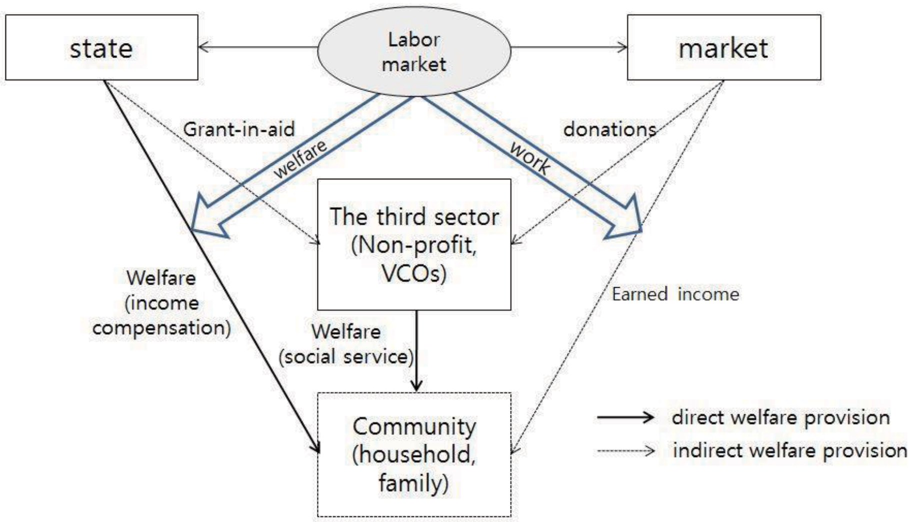

Figure 1. Social welfare provision in the welfare state

The welfare state system, comprising public insurance based on market insurance principles and public assistance by which wealth is partially transferred from the rich to the poor, has been challenged by changes in the dynamics of welfare regimes. Changes in welfare provision dynamics have resulted from economic crises and ideas strongly put forth regarding the power of the market.

To sum up, the relationship between work and welfare is the central concept in understanding the characteristics of capitalist society. The nexus of work and welfare is the labor market in the modern welfare state. Comprising informal non-commercial and non-monetary activity in the welfare state, the third sector fills an institutional vacuum between the market and state (Rifkin, 2000).

After Fordism and Welfare by Social Economy

The Fordist system and state welfare were able to function because of economic growth, which supported the financial capacity of the state. Based on the Keynesian model, the great social and economic actors in the welfare state were employer's federations, trade unions, and public authorities (Monzon & Chaves, 2008). The economic base of Fordist capitalism was characterized by mass production, efficiency, regular work, and even wages among workers; its political base was characterized by representative democracy, by which the people gave a mandate to the government and control it.

The economic shocks of the 1970s affected Fordism as a model of socioeconomic development and regulation. The crisis of Fordism renewed interest in the social economy's potential in regard to work and welfare (Amin et al, 2002:6). The post-Fordist and postmodern emphasis on decentralization, flexible specialization, and mass-customization rejects the Taylorist and Fordist model of production (Giddens, 1994). In the second half of the 1970s, Fordism experienced a major crisis: market capitalism failed, especially in regard to the distribution of social wealth. In the post-Fordist period, changes in the dynamics of welfare provision by the welfare state provoked the social economy to react against large institutions, paternalistic welfare agents, and public bureaucracy.

It was not until the crisis of the welfare state in the last quarter of the 20th century that some European countries saw a reawakening of interest in the typical organizations of the social economy. This reawakening sprang from the difficulties that these market economies were encountering in regard to long-term unemployment, social exclusion, welfare in disadvantaged rural and urban areas, health, education, the quality of life of pensioners, sustainable growth, and other issues. In recent years, the position of the social economy has been strengthened: it is regarded as able to ensure stable and sustainable economic growth, fairer income and wealth distribution, the matching of services to needs, increases in the value of economic activities serving social needs, the correction of labor market imbalances, and the deepening and strengthening of economic democracy (Monzon & Chaves, 2008:551–552).

By the end of the 20th century, the social economy no longer occupied a residual area between the market and state; its status came to be understood in radically different ways. The social economy is no longer seen as a historical leftover or of marginal social and economic value (Amin, 2009). Mainstream opinion has begun to recognize the social economy's potential in building socioeconomic capability and tapping latent economic potential based on welfare markets (Nicholas, 2006). In France, the contemporary (as of the 1980s) reemergence of the social economy as the "social and solidarity economy" is narrowly linked with the reaction against neoliberal principles and the ideology of individualism (Moulaert & Ailenei, 2005:2041). The solidarity economy creates synergies between actors (local authorities, private enterprises, the state, and citizens) and generates jobs by offering new services.

Welfare provision by the social economy and by the state are substantially different; moreover, the former is not a replacement for the latter. As was discussed earlier, state welfare offers standardized, universal services at the national level; by contrast, welfare provision by the social economy is based on individual and community needs at the local and community levels. The social economy is relatively more oriented towards locality, reciprocity, and participation. This orientation is enhanced through small-scale social economy initiatives that, in a non-standardized way, are targeted to specified needs, link welfare and self-help, and forge an identity for their members.

Social welfare in the social economy is provided for based on local and organizational units. Various types of social economy initiative mix work and welfare, in contrast to the labor market in the welfare state. Figure 2 illustrates welfare provision by the social economy and the features of social economy relevant to changes in relations and domains of the state, market, and communities under capitalism. During the golden age, social welfare referred to public social security provided by the national government, which included social insurance and public assistance. Social security could be offered because of the social contract between the state and market. The implicit and explicit social contract was meditated by negotiation between the interests of capital and of labor (Pierson, 1998).

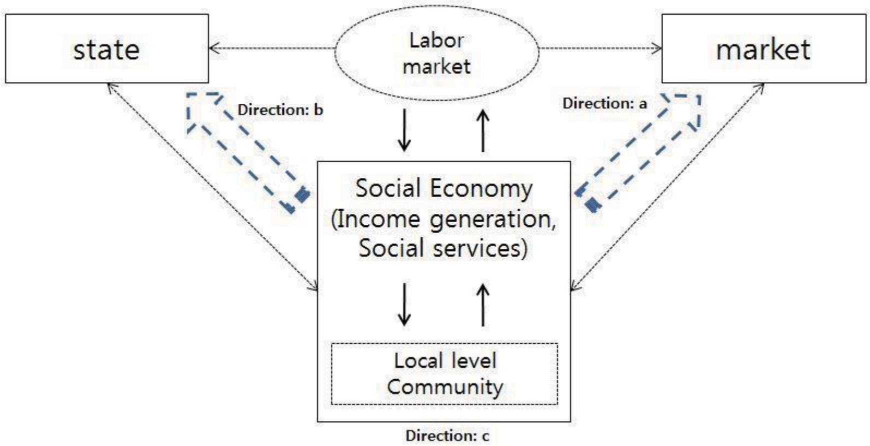

Figure 2. Social welfare in social economy

By contrast, the social economy focuses on welfare generation and the undertaking of social economy initiatives through voluntary and self-help activities. Because of the focus on self-help, cooperative participation and regional governance are required. In the transition from welfare provision provided by the state to that provided by the social economy, micro policies based on self-help pursued by local communities could be expected to replace, to a greater or lesser extent, the redistributive macro policy pursued by the state. Whether this would be sustainable would be dependent on the social fabric: whether the social fabric is based on voluntary solidarity rather than top-down social solidarity and whether the new economy is motivated exclusively by self-interest or by other factors as well.

Social Innovation and the Social Economy

The term “social innovation” has entered the discourse of social scientists with particular speed. However, there is no consensus regarding its relevance or specific meaning in the social sciences and humanities (Pol & Ville, 2009).

For Moulaert and Ailenei (2005:2050), social innovation refers to innovation in social relations as well as new modes of satisfying needs. Social innovation does not refer to the emergence of new social bonds from nothing but to the reproduction and reinterpretation of already-lived social relations within new contexts. Pol and Ville (2009) define social innovation as all new ideas with the potential to improve the quality or quantity of life. They stress that social innovation and business innovation are different yet overlapping concepts and that government intervention is necessary to enhance pure social innovation: they indicate that pure social innovation is located at the set SI-BI. Grimm et al (2013) understand social innovation as a new process that makes use of social relations to deliver products and services in more efficient ways. Howaldt and Schwarz (2010) argue that social innovation combines and configures social practices in new ways with the goal of better satisfying and responding to needs and problems.

The social economy may be a permanent stream of various social mechanisms that mix market exchange, state intervention, and collective civil sector organizations founded on social movements and driven by solidarity and reciprocity (Moulaert & Ailenei, 2005:2049). In this respect, the social economy is social innovation. Regardless of whether the social economy is understood as a remedy for sustainable economic growth against capitalism or as subordinate to capitalism, it changes the relations surrounding social welfare. Therefore, social economy is established on the base of social innovation. At the top of Figure 2, in the quadrangle of social economy that includes the local community level, self-generation of “the social” and “welfare” is possible through social innovation.

What is the condition of social innovation for functioning of social economy? Though numerous factors affect the successful development of the social economy, the capability of communities themselves is more important than other factors. Amin (2009) points out that what the social economy can deliver ultimately depends on the economic, cultural, and institutional context in which it develops.

Quebec is commonly mentioned as a case in which social enterprises were successful in contributing to employment generation, welfare provision, and market innovation. Based on the Quebec experience, Mendell (2009) proposed robust qualifications for a successful social economy: a long history of social activism and political leadership within the social economy combined with progressive state recognition. Hausner (2009) argues that the development of the social economy can provide a foundation for economic opportunity and social need, but that in Poland, the lack of public trust in the third sector and low levels of community participation, social trust, and cooperation hindered this development. Even in Sweden, there is a mounting political challenge to the legitimacy of the welfare stemming from the growing democratic deficit. As the market model for providing local services continues to spread, the democracy deficit will further increase (Pestoff, 1998:23). Pestoff argues that the importance of civil democracy and local politics is increasing.

There is a need for small-scale politics and micro policies. All discourse on the social economy should start from reciprocity and solidarity: “the common.” Community participation is associated with how localities and social economy initiatives are integrated. However, underdeveloped local areas are short of technological and community resources. Social innovation is necessary to ensure that the social economy can play an active role and that successful outcomes can be obtained. Social economy initiatives are not simply launched to ensure future workers, but they are a new welfare providers and responsible communities; that is, they are also active political subjects. They are providing an opportunity to respond to social change and engage in social innovation. Therefore, social economy initiatives acting in local society is the key player of social innovation for that.

Conclusion: Social Economy and Local Civil Society

The demand for welfare is increasing despite the diminishing role of the state and market in providing welfare. The transition from Fordism to post-Fordism and neoliberalism has facilitated the reemergence of the social economy. The social economy is not an unknown utopia. The social economy sector is neither new distinctive sphere, nor suddenly rising invention. It is a historical phenomenon that is now within civil society. The social economy is understood as various hybrids of the state, market, communities, and civil society. Thus, there are varied social relations in the social economy. With the appearance of the social economy, ensuring social welfare is emerging as a new task.

In the era of the social economy, we must find and develop new forms of social welfare that transform provision and delivery of welfare services. This requires a reconfiguration of the roles and functions of the major actors. The new dynamics of social sector are expected to influence the development of the social economy for new welfare provision. The welfare provision by social economy needs social innovation as a change of social relation surrounding welfare provision and delivery.

The provision and delivery of welfare service is dependent on the direction of social economy sector: it has potential to move toward three ways: a) toward market - associated with pessimistic perspective, b) toward state - complimentary perspective, c) between the market and state – emancipatory perspective(figure 2; the arrow denotes orientation). The possibility of oblique movement toward either the state or market means that the social economy could become equivalent to a welfare agency of the state or a submarket in the main economy. Otherwise, an orientation inward a narrower community base and closed membership would not assure the legitimacy of the social economy. The direction toward some destination is likely to, mainly, influenced by community power: cultural, historical, institutional power of local society. The citizens of local society searching for 'the common' must empower their capacity, balancing 'the public' and 'the private' as shown the case 'Quebec'

All human communities are held together by shared values and ideals. This makes them all inherently political (Hann, 1996). Politically inspired community activism was originally rooted in civil society. Civil democracy is a necessary corrective force that empowers individuals and enables them to redress the adverse decision-making balance within human services (Saltman & Otter, 1992).

In the 20th century, social welfare provided by the welfare state was a product of a mix of politics and the market economy. Similarly, the social economy also combines politics and the economy. It focuses on democracy, participation, reciprocity between citizens at the local level. Also it is founded on the self-generation : wealth, welfare, and work. The difference is in the level of hybridization. The welfare state operates at the national level whereas the social economy operates at the organizational or regional level; a shift from one to the other may entail a shift in focus from macro policy to micro or mezzo policy at the regional or organizational levels. In the social economy, it is micro policies driven by social actors at the local level that are important.

To fill the shortage of welfare provision caused by crisis of welfare state, we are now facing the problem of remaking civil society by social innovation combining technology, openness, knowledge platforms, and social capital at the local level. Endogenous local development is prerequisite for success of the social economy. The social economy advocates the self-generation of welfare through self-help and self-governance. Thus, the task that remains to us is to find the way to innovate the relation between the state, market, and communities.

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Learning Organization Activities and Innovativeness of Tech-based SMEs in Technopark: The Mediating Role of Learning Transfer

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Abstract

Developing talented human resources through learning entails nurturing innovation and improving competitiveness; to achieve innovation, SMEs must undertake learning organization activities (LOAs). Our results demonstrate that six dimensions of the LOA model have more validity or a better model fit than the previous seven dimensions of the LOA model. Furthermore, three important sub-variables of LOAs (i.e., creating continuous learning opportunities, establishing systems to capture and share learning, and providing strategic leadership for learning) have a positive and significant effect on learning transfer. Finally, transferring LOAs was found to mediate the relationship between LOAs and innovativeness by creating continuous learning opportunities (and future directions) and by providing strategic leadership for learning.

Keywords: LOAs, transfer of learning organization activities, innovativeness, six dimensions of the learning organization activity model

Society of Open Innovation Technology, Market & Complexity

DGIST

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SOItmC & KCWS 2015
June 14 ~ 18, DGIST, Daegu, Korea

June 16 (Tuesday)

R# : 202 Conference Room

Special Session 5

"Open Innovation for Smart Mobility & Complexity"

■ **Session Chair: WooSung Jung** (POSTECH)

- Paper 1: "Reflections on the innovative city: examining three innovative locations in a knowledge based framework" by **Tommi Inkinen(University of Helsinki, Finland)**
- Paper 2: "Measuring Thematic Causality for Public Research Institutions" by **HyeonChae Yang(POSTECH), WooSung Jung(POSTECH)**
- Paper 3: "The impact of graduate students on research productivity in Korea" by **KiSeok Kwon(Hanbat National University), SeungHwan Han(National Research Foundation of Korea), Duckhee Jang(Korea Institute of Ocean Science & Technology)**
- Paper 4: "Predicting Future Issues with the Keyword Network of National Policy Research", by **Hyunuk Kim(POSTECH), Taekho You(POSTECH), SangJin Ahn(KISTEP), WooSung Jung(POSTECH)**
- Paper 5: "Does the knowledge economy growth encourage clustering of knowledge workers in metropolitan cores and subcenters of metropolitan areas? A comparative study of Barcelona and Helsinki" by **Juan Eduardo Chica(University of Helsinki, Finland)**
- Paper 6: "Network analysis for the Korean national R&D development" by **MinWoo Ahn(POSTECH), WooSung Jung(POSTECH)**

Reflections on the innovative city: examining three innovative locations in a knowledge-bases framework

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Abstract

This paper combines three location-based cases with literature background focusing on knowledge-bases and cities. The paper considers the regional context of the city of Helsinki and its surrounding area (HMA). Analyzed cases include three specific locations highlighting urban form, connectivity and knowledge-intensive production. Conceptually innovative cities are experiencing extensive change as they transform and change in order to become competitive providers of first class living for highly skilled global work-force. The integration of spatial characteristics into analyses of knowledge intensiveness of cities brings forth new theoretical openings for urban analysis setting platforms for open innovation and economy. The paper focuses on extensive material resources collected in numerous projects. The data gives more reliable picture of the knowledge-intensive locations compared to single interviews or survey studies. The total data includes company surveys, stakeholder interviews and observation field work. Provided reflections are classified according to key issues presented in urban studies and economic geography.

MEASURING THEMATIC CAUSALITY FOR PUBLIC RESEARCH INSTITUTIONS

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Abstract

Scientific systems have undergone an evolution that involved a variety of disciplines interacting each other. To effective govern the research effort of the system, we need to be able to interpret the interwoven disciplines of science. However, it is a problem that a causality in such complex systems is hard to interpret. To address the problem, this paper adopts an information-theoretic indicator, called transfer entropy, for measuring causality between disciplines of an organizational research portfolio. It is known that transfer entropy is suited for detecting causality in nondeterministic and nonlinear systems. We also investigate into structural characteristics of a network, which aggregates causal relations into. The analysis for thematic causality of an organization is applied to public research institutions, i.e., the Korean Government-funded research Institutes (GRIs), the Max Planck Gesellschaft (MPG) in Germany, and the National Laboratories (NLs) in the United States (US), and its structural properties improves our understanding of evolutional features in organizational research. Major findings indicate that distinctive areas significantly attract thematic causality across organizations, which means organizations have own disciplines that dynamics of their research stem from and affect. Moreover, in order to further examine the concentrative causality, we score the disciplinary significance according to being influenced by the development of other areas based on the causal structure. In case of the GRIs, a sub-discipline within math and physics tends to be most influenced by other areas. The development of chemistry in the MPG shows the tendency of greatly following others, whereas infectious disease includes the most consequential sub-discipline in the scientific development of the NLs. Revealing the causality concentrated sub-disciplines is important in that the research dynamics toward those selected areas occur in overall subordinates at the same period. This study suggests the necessity for identifying developmental sources and recipients among research themes when making a plan for research organizations.

Keywords: public research, causality, transfer entropy, information theory, network analysis

The Impact of Graduate Students on Research Productivity in Korea

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Abstract

Even though graduate students are critical for carrying out research, they havenot been treated as important inthe existing literature on research productivity. Accordingly, this paper focuses on whether the number of graduate studentshas a significant impact on their supervisors' research productivity. In order to address this question, we have collected a large scale data on Korean academics' research performance. According to the results of the analysis, first, male researchers were found to have more graduate students than female researchers. Second, we found significant differences in the total number of graduate students employed by senior and junior researchers. Third, researchers from the capital were also found to manage more graduate students. Last,as we found the number of graduate students to correlate with significant differences in researchers' productivity, we put forwardsome suggestions for ways to support researchers who are female, young, and located in non-capital areas.

Keywords: the relationship between teaching and research, academic productivity, graduate students, economics of science, South Korea

Embracing Networks of National Policy Research in Future Foresight

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Abstract

Policy research on social issues has usually been led by the national government. Recently, the Korean government launched National Knowledge Information System (NKIS) which enables people to find national research papers easily. Based on the bibliographic data from NKIS, we conduct an analysis about social issue trends in Korea by exploring issue networks through centrality measures. Moreover, PageRank algorithm is implemented to determine the influence of each social issue in the network. Keyword networks of research papers in NKIS are also constructed to recognize keyword trends of social issues. Analysis on the networks of national policy research proposes a helpful approach not only to detect significant social issues but also to construe detailed trend in the issues.

Key words: Network analysis, Keyword network, Foresight, Complexity, Policy research

1. Introduction

Foresight has become more important with the changing in environment that we live in. Foresight activities led by national government reflect not only present problems but also future issues. The Delphi method is the most famous quantitative way of national foresight. RAND Corporation began to use this method in 1948. It is conducted by experts in several fields with iterative surveys. At every stage, experts' opinions are collected and used to deduce consensus about specific issues. It protects the anonymity of their opinions so that the Delphi method has an advantages on objectivity[1].

However, the Delphi method costs money and time to conduct continuous survey of experts. In order to make up for the weak points of the Delphi method, several methods were suggested. Network perspectives in foresight is one of proposed methods. Network analysis was applied on Miles's five step foresight process[2]. The authors of this paper utilized network analysis for the trend analysis based on "The Big Picture Survey" that were carried out by Saritas and Smith[3]. They insisted network analysis could enrich foresight analysis by combining result of public survey.

The world is complex than before due to the advancement of science and technology. At the same time, it allows us to collect huge amount of information what we want to investigate with the information system and the Internet. In this study, we employ bibliographic data of national policy research papers in Korea and apply network analysis for social issues as well as extracted keywords of selected social issues to disclose hidden trend and emerging social issues.

2. Data description and methods

2.1. Data description

The data used for our analysis is bibliographical information of national policy research papers on twenty eight social issues. We utilized list of social issues that could be found in the survey conducted by Korean Institute of S&T Evaluation and Planning. Purpose of this survey is to detect future issues from public awareness.

Bibliographical information from 2000 to 2014 was retrieved from National Knowledge Information System (NKIS) which provides policy research papers of national research institutes in Korea. NKIS database automatically accumulates policy papers of research institutes using application programming interface. The name of social issues and a word that is similar to issues were used to search policy research papers in the system. Policy research papers that contains these search words in their abstracts were collected through this process.

We used bibliographical information from NKIS on April 6, 2015. Statistics about policy research papers about twenty eight social issues are in Table 1. Many issues show rapid growth in terms of quantity while the growth rates vary by issues. In 2010~2014, almost 10,000 policy research papers were published by national research institutes. The number of papers in this period is about as twice as that in 2000~2004. 'North Korea & Korean Unification' issue was regularly published from 2000 to 2014.

Table 1. Statistics about policy research papers over 15 years

Issue	2000~2004	2005~2009	2010~2014	Total
Biodiversity	48	44	91	183
Changing of Family Ideology	212	348	485	1045
China's Climate Effect	8	2	20	30
Climate Change & Disaster	85	280	703	1068
Competitive Education	480	531	524	1535
Cyber Crime	68	29	36	133
Digital Economy	159	172	116	447
Disaster Risk	21	62	145	228
E-Democracy	22	42	23	87
Employment Risk	408	348	354	1110
Energy & Resource Depletion	338	624	1170	2132
Food Safety	14	45	59	118
Food Security	13	10	60	83
Gender Issues	413	700	942	2055
Geopolitical Conflict in Northeast Asia	276	205	209	690
Global Governance	4	41	58	103
Hyper-connected Society	0	0	3	3
Incurable Disease	287	568	931	1786
Industry Polarization	256	345	358	959
Social Inequality	457	751	929	2137
Innovation in Manufacturing	373	351	173	897
Instability of Future Generation	10	19	26	55
Low Economic Growth	50	88	173	311
Low-birthrate & Population Ageing	155	424	672	1251
Multiculturalism	7	131	308	446
North Korea & Korean Unification	742	717	883	2342
Nuclear Safety	8	4	41	53
Quality of Life	179	274	371	824
Sum	5093	7155	9863	22111

2.2. Methods

2.2.1. Constructing issue and keyword networks

Issue and keyword networks are constructed for every five years from 2000 to 2014. There are three datasets to create issue and keyword networks. The method to construct each network is as follows. There is no direction of edges in issue network as well as keyword network.

- Issue network
  When a publication is contained within search results for issues, these issues are connected with each other. The number of common papers in two issues' search results is assigned as a weight of edge between two issues. Weighted network enables us to examine which issues are important in predetermined timeframes. Fig 1 represents the structure of issue network in 2010~2014.
- Keyword network
  Topic keywords extracted from bibliographic information were utilized to make keyword network of social issues. Topic keywords in a paper are linked together completely.

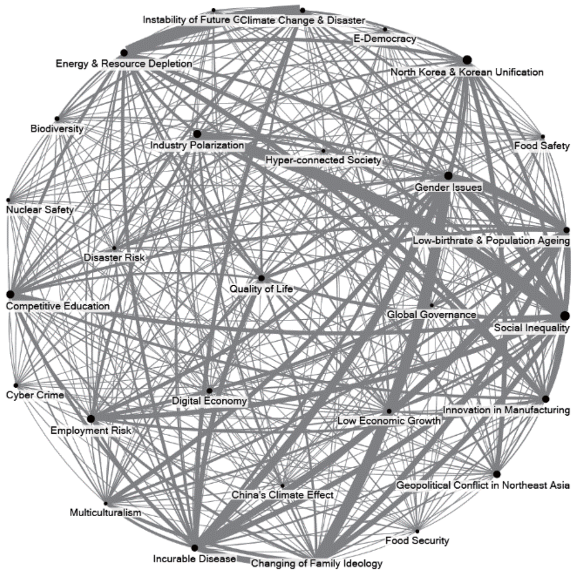

Figure 1. Issue network (2010~2014, NodeXL)

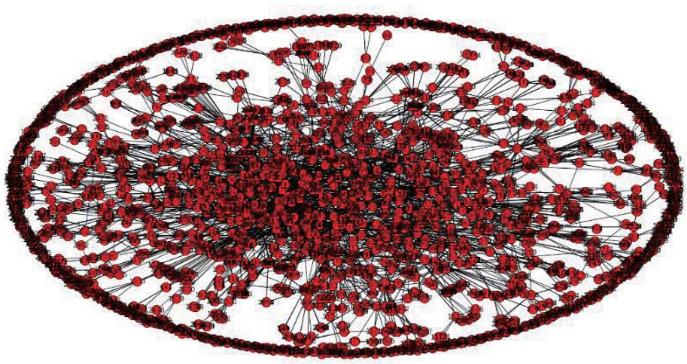

Figure 2. Keyword network of 'Energy & Resource Depletion' (2010~2014, NetworkX)

2.2.2. Network analysis based on centrality measures

Centrality measures in network analysis helps to explore the importance of specific issues or topic keywords in constructed networks. We applied basic centrality measures proposed by Freeman[4] such as degree centrality, closeness centrality, and betweenness centrality to reveal characteristics of the networks.

- Degree centrality

  Degree centrality is the number of neighbors that a node has. A node which connects with more other nodes could be considered as an important node.

- Closeness centrality

  A shortest path is a path that contains the smallest number of edges from a node to another. Distance between two nodes is the number of edges in a shortest path. Closeness centrality is calculated as the sum of the reciprocal of distance to other nodes. It gives an insight about how fast an information at a node spread to others.

- Betweenness centrality

  Betweenness centrality can be calculated as $C_B(k) = \sum_{i \neq k \neq j} \frac{\sigma_{ij}(k)}{\sigma_{ij}}$, where σ_{ij} is the number of shortest paths from node i to j and $\sigma_{ij}(k)$ is the number of shortest paths from node i to j that pass through node k. By comparing betweeness centrality of nodes, it is able to know which nodes are influential in a network as an intermediary spreader or a broker.

2.2.3. PageRank algorithm

PageRank algorithm[5] proposed by Larry Page and Sergey Brin who are co-founders of Google calculates the influence of nodes in network by iterative value assignments. PageRank is generally used in the directed network. It is known that PageRank value in undirected network is proportional to the degrees of each nodes but not the same[6]. However, instead of simply comparing degrees, we used PageRank algorithm because the fundamental mechanism of PageRank has a meaning when comparing importance of each node. It is good to compare influence of nodes in a network due to the fact that the sum of PageRank values is equal to 1.

At the 1st stage of the algorithm, every node has a PageRank value $1/n$, where n is the number of nodes in network. The values are divided by out degree and transferred to its neighbors. Nodes updated its old PageRank value to the sum of transmitted PageRank values. We set a damping factor of PageRank algorithm to 0.85 for our analysis based on the recommendation by Larry Page and Sergey Brin in their paper.

3. Results and discussion

3.1. Issue trend analysis in the Korea

Changes in centrality measures are in the Table 2, 3 and 4. Degree centrality and closeness centrality tends to be larger over 15 years for all issues. It is because that the number of policy research papers has increased while total number of issues is same throughout the whole period. Issues are highly connected so that the distance between two issues has become shorter. It causes closeness centrality of all issues to have the highest value in last 5 years.

In table 2, we can show that 'Disaster Risk', 'Global Governance', and 'Multiculturalism' began to have a lot of exposure in the national policy research after 2005. 'China's Climate Effect' highly connected with other issues while it only connected with five issues in 2005~2009. 'Food Security' and 'Nuclear Safety' show similar behavior to 'China's Climate Effect'. It indicates that these issues become important in recent years. Some of issues above are related to risks that can be occurred in Korea.

Betweenness centrality shows us what issue plays an intermediate role among important social issues. In the early 21st century, national security issues such as 'Geopolitical Conflict in Northeast Asia' and 'North Korea & Korean Unification' shows high value in issue network. 'Energy & Resource Depletion' is identified as the most influential intermediate issue in 2005~2009 and 'Digital Economy' is highly interacted with other issues in 2010~2014.

Table 2. Degree centrality (2000~2004, 2005~2009, 2010~2014)

Issue	2000~2004	2005~2009	2010~2014
Biodiversity	19	15	19
Changing of Family Ideology	18	23	26
China's Climate Effect	6	5	16
Climate Change & Disaster	20	21	26
Competitive Education	20	24	26
Cyber Crime	18	19	17
Digital Economy	22	20	22
Disaster Risk	11	21	25
E-Democracy	14	16	17
Employment Risk	20	23	23
Energy & Resource Depletion	22	21	26
Food Safety	11	16	19
Food Security	9	2	19
Gender Issues	24	24	24
Geopolitical Conflict in Northeast Asia	25	21	25
Global Governance	6	18	21
Hyper-connected Society	0	0	1
Incurable Disease	22	22	26
Industry Polarization	19	23	25
Innovation in Manufacturing	19	22	26
Instability of Future Generation	15	16	19
Low Economic Growth	17	21	23
Low-birthrate & Population Ageing	18	23	26
Multiculturalism	5	20	22
North Korea & Korean Unification	25	23	26
Nuclear Safety	10	4	17
Quality of Life	20	24	24
Social Inequality	23	23	26

Table 3. Closeness centrality (2000~2004, 2005~2009, 2010~2014)

Issue	2000~2004	2005~2009	2010~2014
Biodiversity	0.443	0.415	0.771
Changing of Family Ideology	0.435	0.474	0.964
China's Climate Effect	0.365	0.360	0.692
Climate Change & Disaster	0.450	0.458	0.964
Competitive Education	0.450	0.482	0.964
Cyber Crime	0.435	0.443	0.730
Digital Economy	0.466	0.450	0.844
Disaster Risk	0.391	0.458	0.931
E-Democracy	0.409	0.415	0.730
Employment Risk	0.450	0.474	0.871
Energy & Resource Depletion	0.466	0.458	0.964
Food Safety	0.391	0.422	0.750
Food Security	0.380	0.338	0.750
Gender Issues	0.482	0.482	0.900
Geopolitical Conflict in Northeast Asia	0.491	0.458	0.931
Global Governance	0.365	0.429	0.818
Hyper-connected Society	0.036	0.036	0.466
Incurable Disease	0.466	0.466	0.964
Industry Polarization	0.443	0.474	0.931
Innovation in Manufacturing	0.443	0.466	0.964
Instability of Future Generation	0.415	0.422	0.750
Low Economic Growth	0.429	0.458	0.871
Low-birthrate & Population Ageing	0.435	0.474	0.964
Multiculturalism	0.360	0.450	0.844
North Korea & Korean Unification	0.491	0.474	0.964
Nuclear Safety	0.386	0.355	0.711
Quality of Life	0.450	0.482	0.900
Social Inequality	0.474	0.474	0.964

Table 4. Betweenness centrality (2000~2004, 2005~2009, 2010~2014)

Issue	2000~2004	2005~2009	2010~2014
Biodiversity	11.890	0.000	0.791
Changing of Family Ideology	1.111	2.442	3.295
China's Climate Effect	0.183	0.000	0.257
Climate Change & Disaster	4.879	5.301	3.295
Competitive Education	2.710	8.359	3.295
Cyber Crime	1.450	1.262	0.281
Digital Economy	7.257	0.788	26.810
Disaster Risk	0.000	4.485	2.794
E-Democracy	2.702	0.239	0.321
Employment Risk	4.058	2.442	1.601
Energy & Resource Depletion	7.730	22.356	3.295
Food Safety	0.333	9.692	0.497
Food Security	0.171	0.071	0.538
Gender Issues	13.639	7.209	1.848
Geopolitical Conflict in Northeast Asia	16.209	4.305	2.674
Global Governance	0.100	0.439	0.587
Hyper-connected Society	0.000	0.000	0.000
Incurable Disease	8.155	2.193	3.295
Industry Polarization	1.521	2.442	2.838
Innovation in Manufacturing	2.570	1.830	3.295
Instability of Future Generation	0.327	0.470	0.164
Low Economic Growth	1.958	1.636	1.520
Low-birthrate & Population Ageing	1.008	2.442	3.295
Multiculturalism	0.000	0.760	1.237
North Korea & Korean Unification	16.209	6.037	3.295
Nuclear Safety	1.184	0.000	0.522
Quality of Life	5.050	8.359	2.064
Social Inequality	9.597	2.442	3.295

PageRank values are useful to identify the importance of issues because the sum of values is 1 whether edge attributes change during fifteen years. As shown in Table 5, 'Social Inequality' has always been the most important issue in Korea. 'Gender Issues' is also took a high rank in the 21st century. 'Low-birthrate & Population Ageing' and 'Incurable Disease' continuously moved up in the list.

'Employment Risk' dropped in the list of PageRank values to 13^{th} in 2010~2014. It is contrasted to the fact that the employment risk usually appears in news media. It requires deeper analysis by incorporating other related issues. We examine 'Industry Polarization' with it because its rank also fell in 2010~2014.

Surprisingly, 'North Korea & Korean Unification' at the 9th while this issue ranks at 2nd in 2000~2004. The possible reason of high rank in 2000~2004 is that the first Korean summit and naval conflict at the Yellow Sea occurred in that period. A detailed explanation about this is in the next part of this paper with topic keyword trends in 'North Korea & Korean Unification' issue with keywords of 'Geopolitical Conflict in Northeast Asia'.

'Energy & Resource Depletion' which is the most important issue for betweenness centrality in 2005~2009 took a higher place in 2010~2014. 'Energy & Resource Depletion' would also be treated with topic keyword trends to see detailed changes in the issues. 'Digital Economy' which is at the top of betweenness centrality in 2010~2014 will also be treated for the same reason in the next section.

Table 5. PageRank values for 28 social issues in Korea

Rank	2000~2004	2005~2009	2010~2014
1	Social Inequality	Social Inequality	Social Inequality
2	North Korea & Korean Unification	Gender Issues	Gender Issues
3	Gender Issues	Competitive Education	Incurable Disease
4	Industry Polarization	Industry Polarization	Energy & Resource Depletion
5	Competitive Education	Incurable Disease	Low-birthrate & Population Ageing
6	Employment Risk	Changing of Family Ideology	Changing of Family Ideology
7	Geopolitical Conflict in Northeast Asia	Low-birthrate & Population Ageing	Climate Change & Disaster
8	Energy & Resource Depletion	North Korea & Korean Unification	Industry Polarization
9	Innovation in Manufacturing	Energy & Resource Depletion	North Korea & Korean Unification
10	Changing of Family Ideology	Employment Risk	Innovation in Manufacturing
11	Incurable Disease	Innovation in Manufacturing	Competitive Education
12	Quality of Life	Quality of Life	Quality of Life
13	Low-birthrate & Population Ageing	Climate Change & Disaster	Employment Risk
14	Digital Economy	Geopolitical Conflict in Northeast Asia	Multiculturalism
15	Climate Change & Disaster	Digital Economy	Geopolitical Conflict in Northeast Asia
16	Low Economic Growth	Multiculturalism	Low Economic Growth
17	Biodiversity	Low Economic Growth	Digital Economy
18	Cyber Crime	Disaster Risk	Disaster Risk
19	E-Democracy	Global Governance	Biodiversity
20	Food Safety	E-Democracy	Global Governance
21	Disaster Risk	Food Safety	Nuclear Safety
22	Food Security	Biodiversity	Food Safety
23	Instability of Future Generation	Instability of Future Generation	Instability of Future Generation
24	Nuclear Safety	Cyber Crime	Food Security
25	China's Climate Effect	Nuclear Safety	E-Democracy
26	Global Governance	Food Security	Cyber Crime
27	Multiculturalism	China's Climate Effect	China's Climate Effect
28	Hyper-connected Society	Hyper-connected Society	Hyper-connected Society

3.2. Keyword trend analysis

Considering relative importance in Korea and results on centrality analysis, we selected seven issues and combined these issues into three groups. Keyword networks are constructed to identify influential keywords in selected issues through betweenness centrality measures as analysis on issue networks.

First group consists of 'Low-birthrate & Population Ageing', 'Employment Risk', and 'Industry Polarization' that are related to national growth.Finance and national pension fund are important issues in 2000~2004 to prepare ageing society. In 2005~2009, national policy research on labor market and social welfare conducted, especially focused on the effect of retirement. Several policies are suggested to boost low-birthrate in 2010~2014. When we closely look at keywords in 'Employment Risk', vocational education is a major keyword to connect other keywords in the first ten years. However, in the last five years, free trade arose as a crucial factor for employment risk. Keywords in 'Industry Polarization' indicates that technology is important for the rapidly changing global environment.

Table 6. Rank of betweenness centrality of keywords in issues related to national growth

Low-birthrate & Population Ageing			
Rank	2000~2004	2005~2009	2010~2014
1	Finance	Low-birth rate	Low-birth rate
2	Ageing	Labor market	Ageing
3	Ageing society	Ageing	Policy
4	Impact	Family	Fund
5	Response	Baby sitter	2012
6	National pension fund	Social welfare	Fertility
7	Childcare	Social integration	Population policy
8	Labor market	Economic growth	Research
9	Current state	Economy	Agenda
10	Perspective	Female	Rural
Employment Risk			
Rank	2000~2004	2005~2009	2010~2014
1	Labor market	Labor market	Labor market
2	Actual situation	Employment	Ageing
3	Vocational competency	Ageing	Employment
4	Human resource	Tax policy	Free trade
5	Korea	Employment policy	Economic crisis
6	OECD	Social welfare	Social welfare
7	Vocational high school	Vocational education	Job creation
8	School education	Vocational competency	Job
9	Research	Evaluation	Education
10	Vocational education	Labor	Green growth
Industry Polarization			
Rank	2000~2004	2005~2009	2010~2014
1	Formation	Labor market	Labor market
2	Korea	Japan	Japan
3	Regional innovation	Employment structure	Job creation
4	FTA	IT	FTA
5	Global competitiveness	China	Subcontract
6	Human resource	Korean society	S&T
7	Change	Change	Korea
8	Policy implication	Employment	Green growth
9	Comparison	Polarization	Employment relationship
10	North & South Korea	Education	Ageing

Table 7. Rank of betweenness centrality of keywords in issues related to national security

'North Korea & Korean Unification'			
Rank	2000~2004	2005~2009	2010~2014
1	North Korea	North Korea	North Korea
2	North & South Korea	China	Unification
3	China	Special economic zone	North Korea policy
4	Research	Clean Development	Research
5	US	Climate change	Analysis
6	Change	Economic cooperation	Korean peninsula
7	Policy	North Korea policy	China
8	Korea	North Korean economy	Refugees
9	Northeast Asia	Inter-Korean cooperation	FTA
10	WTO	US	US
'Geopolitical Conflict in Northeast Asia'			
Rank	2000~2004	2005~2009	2010~2014
1	Northeast Asia	Korean peninsula	China
2	FTA	China	Unification
3	China	North Korea	Korea-China-Japan
4	Contest for supremacy	North Korea policy	North Korea
5	North Korea	Cooperation	North Korea policy
6	Korea	Northeast Asia cooperation	International cooperation
7	Korean peninsula	Nuclear issue	Northeast Asia
8	Change	Economic cooperation	Analysis
9	North & South Korea	Territorial development	Korea
10	Energy cooperation	Russia	Korean peninsula

National policy toward North Korea commonly depends on the direction of the government. Overall, China and the United States affect North Korea policy due to a long-standing relationship among countries. In 2005~2009, economic perspective on North Korea is highlighted through activities in special economic zone. Unification comes to the fore with other keywords such as refugees in 2010~2014. Keywords in 'Geopolitical Conflict in Northeast Asia' also show influence of neighboring countries around Korean peninsula. Korean peninsula is usually considered as a place for a contest for supremacy. International cooperation about nuclear issue is required to achieve unification in the near future.

To secure a supply of energy resources, the Korean government began to discuss energy cooperation In Northeast Asia including North Korea. Countries in Northeast Asia, such as China, Japan, and Russia are deeply concerned with energy issues. Greenhouse gas is regarded as a main cause of global climate change. Abrupt changes in global environment leads national perspective on energy resources and its consumption. The world agreed on the climate change convention and also planned to impose carbon tax for environment protection. Renewable energy is suggested as a solution of energy depletion from the mid- 21st century.

Digital economy is a new paradigm based on science and technology. It facilitates networks between people and economy. Information technology is a fundamental basis of this revolution. In Korea, digital media industry flourished in 2005~2009. Policy for governing digital media industry and intellectual property of cultural products are suggested as a next-generation growth power of Korea. In 2010~2014, information technology evolves into ICT that embraces communication technology. Digital economy gains public attention by showing framework for integrating the society.

Table 8. Rank of betweenness centrality of keywords in issues related to global trends

'Energy & Resource Depletion'			
Rank	2000~2004	2005~2009	2010~2014
1	Environment	US	Green growth
2	Research	Japan	Climate change
3	Greenhouse gas	China	Greenhouse gas
4	Energy	New renewable energy	US
5	WTO	Energy policy	New renewable energy
6	Energy cooperation	Russia	Energy
7	North & South Korea	Greenhouse gas	China
8	Economy	Energy consumption	Energy saving
9	North Korea	Green growth	Carbon tax
10	Development	Climate change	Japan
'Digital Economy'			
Rank	2000~2004	2005~2009	2010~2014
1	Paradigm	Information technology	Convergence
2	Economy	Information-oriented	ICT
3	Digital economy	Media	Network
4	Policy	Digital trends	Digitalize
5	National competitiveness	Technology	Digital convergence
6	Info-communication	Competition policy	Digital
7	Change	Governance	Fusion
8	Science and technology	21th century	Media
9	Network	Digital convergence	Change
10	Vitalization	Industry	Culture

4. Summary

We constructed issue and keyword network from bibliographic data of national policy research papers contained in National Knowledge Information System (NKIS) of Korea. Measures in network theory are implemented to detect important issues of society. When we analyze results from network analysis, PageRank values and betweenness centrality are considered as good indicators for identifying influential social issues. Keyword network of social issues helps to obtain detailed trend from 2000 to 2014. It seems plausible to enrich our understandings of society and its future by combining network analysis of policy research papers with traditional and powerful methods such as the Delphi method in foresight.

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Does the knowledge economy growth encourage clustering of knowledge workers in metropolitan cores and subcentres of metropolitan areas?
A comparative study of Barcelona and Helsinki

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Abstract

Many contributions on the analysis of employment growth in knowledge-based industries focus on values found in the centres of large cities, arguing that they are the preferred locations for knowledge workers (KWs) in housing location choices. Physical proximity as well as amenities and innovative and liveable environments found in metropolitan centres are factors that encourage this process. In addition, the location of companies in those industries stresses the values of face-to-face contacts that are provided in the centres of cities. This paper studies how proximity to metropolitan cores and other large employment areas of metropolitan areas encourage spatial clustering of KWs. To do this, we analyse commuting flows and residential density patterns of KWs in the Barcelona (BMA) and Helsinki (HMA) metropolitan areas. In addition, through a regression model, we examine, in Barcelona´s case, the effects of the distance to the metropolitan core and subcentres in KWs location patterns. Results show that metropolitan cores in both metropolitan areas retain a large amount of commuting; although, physical proximity to the metropolitan core becomes a key factor for spatial clustering of KWs in Barcelona´s case. In Helsinki, spatial clustering of KWs follows both concentration and suburban spatial patterns; in that sense, short and long commutes to the metropolitan core happen.

Keywords:
Knowledge workers' spatial clustering; commuting patterns; Helsinki; Barcelona

Network analysis for the Korean national R&D activity using keyword of research project

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Abstract

R&D activity is one of important factor for the national development of Korea. Thus, the size of national R&D activity (the size of investment, the number of projects, and so on) has been annually increased. However, it is hard to understand the current state of R&D activity as the size of R&D activity gets bigger and bigger. In this context, mapping can contribute for understanding the whole structure of R&D activity and for managing R&D activity for efficient investment. In this research, we employ network analysis for mapping national R&D activity from the data. We used NTIS database from 2006 to 2010 as information of national R&D activity, which contains information about research projects such as keyword, title, research program and science technology classification (such as 6T classification). From the data, we considered two kinds of networks. First, keyword network was employed to identify current trends of national R&D activity. Second, research program network is used to observe relationship among research programs. We expect to figure out the underlying structure of the national R&D activity and to manage R&D process more efficiently from these two networks.

Keywords: Network analysis, R&D activity, NTIS database, Keyword network, Research program network

June 16 (Tuesday)

R# : 203 International Conference Hall

Special Session 6

"City of Future, Future of City: Open Innovation and Ubiquitous City"

■ **Session Chair: SangHo Lee** (Hanbat National University)

- Paper 1: "Incentivizing innovation: insights from Brazilian innovation support programs" by **Tan Yigitcanlar(Queensland University of Technology, Australia), Eduardo Moreira da Costa(Federal University of Santa Catarina, Brazil), Jamile Sabatini Marques(Queensland University of Technology, Australia)**
- Paper 2: "Human Interaction and Perceptions to Media Facade" by **JungHoon Han(University of New South Wales, Australia) and SangHo Lee(Hanbat National University)**
- Paper 3: "Designing ICTs Aided Community Center for Neighborhood Residents" by **Fan Qiangqiang(Northeastern University, China), Seyun An, Soyeon Kim, Hannah Ju, Ho Kim(Hanbat National University)**
- Paper 4: "Smart City as an Urban Innovation Platform: What's next?" by **JungHoon Lee(Yonsei University)**
- Paper 5: "Can ICTs Contribute to Urban Renewal for Deprivated Cites?: Recent ICTs-base Urban Planning and Design Cases of Korea and Japan" by **YounTaik Leem(Hanbat National University), Seiji Sato(Oita University, Japan)**
- Paper 6: "Location Allocation and Use Characteristics of Bounded Carsharing Service for Urban Public Housing Residents" by **Jungbeom Lee (Daejeon Development Institute), Wanhee Byun, Hoyoung Kee (Land and Housing Institute), Myungsik Do(Hanbat National University)**
- Paper 7: "How Does IT(Information Technology) and ET(Environment Technology) makes New Innovative Urban and Architecture Model" by **JuHyung Han(Hanbat National University) and SangHo Lee(Hanbat National University)**
- Paper 8: "Can CSR be a platform for open innovation to support a creative city development?" by **Avvari V Mohan(University of Nottingham Malaysia Campus, Malaysia), Naga Lakshmi Chelluri(University of Hyderabad, India)**

Incentivizing innovation: insights from Brazilian innovation support programs

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Abstract

Innovation is the transformation of knowledge of any kind into new products or services in the market. Its importance as an important production factor is widespread today. In the age of the knowledge-based economy innovation it became critical for any company or even country to compete globally. Many countries are encouraging innovation through various mechanisms, and one of the most widely used is the provision of special incentives for innovation. This paper investigates incentive systems for the growth of technology companies as a strategy to promote knowledge-based economic development. As for the case investigations the study focuses on an emerging economy, Brazil. The research is based upon the available literature, best practices, government policy and review of incentive systems. The findings provide insights from the case study country context and some lessons learned for other countries using incentive systems to boost the innovation capabilities of their technology companies.

Keywords: Innovation; incentive programs; technology companies; knowledge-based economy; knowledge-based economic development; Brazil.

Smart City as an Urban Innovation Platform: What's next?

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Abstract

In recent years, Smart City is taking the center stage as a solution to tackle the problems that are arising with rapid urbanization. However, the concept itself is too comprehensive and unclear, that it is hard to apply in real practices. Furthermore, there are various Smart City initiatives which promote civic engagement to create new innovative services and infrastructures while there are lacks of coordination and control within the city. The complexity of Smart City initiatives often challenged by ineffective innovation activities. Therefore, this presentation attempts to make a holistic views on how smart city initiatives play as an urban innovation platform to support creative economy. Furthermore, we have analyzed various smart city initiatives and defined new typology based on open innovation literatures. Through these analyses, the research attempt to identify the main important components that form the typology of Smart City initiatives and also propose future trends to maintain successful Smart City initiatives.

Keywords: Smart City, New Innovative Service and Infrastructure, Urban Innovation Platform

Human Interaction and Perceptions to Media Façade: An Australian Example

Jung Hoon Han & Sang Ho Lee

Abstract

The aim of this paper is to investigate human interaction and perceptions to the media skin/façade newly built in Central Park, Sydney, Australia. Recently the digital media façade/skin has been increasingly applied to new building design in public place in Australia. This significant change in smart digital technologies and public perceptions remains largely ignored in recent studies. This paper will conduct a random sampling survey to the people who live or visit such place and evaluate the impact of the new digital technologies adapted in media skin/façade on public interaction and perceptions to its safety, communications, public engagement, and building design and environment. The research outcomes will contribute to fill our knowledge gap between emergent digital technologies and human interactions.

Key words: digital technologies, media façade, human interaction, smart cities

Human Interaction and Perceptions to Media Façade: An Australian Example

1. Introduction

With over half the world's population now living in cities (Moere & Hill, 2012), an increasing demand for integrated technologies and developing concepts such as smart cities, the role of media façades can be an intersection between architecture, information and culture in the public space providing a new means of communication and creative engagement (Barker, Beilharz, & Haeusler, 2010). Media façades are a recent innovation that fuses information technology and architecture to create a shared experience between members of the public. This new form of smart technology integrates electronic media into public spaces, either through a dedicated screen built into a façade or as a temporary projection overlaying the surface of an infrastructure (i.e. Sydney Opera House). Currently, the dominant spheres of use for media facades are advertisement and commerce, making it difficult to realise more creative ways of using public screen displays (Barker et al., 2010; Fischer, Zollner, Hoffmann, Piatza, & Hornecker, 2013). This has led to varying views on the necessity of media facades and their place in the future (Čikić-Tovarović, 2011). However, recent examples of their usage have already begun to enlarge the potential for integrating media facades into public spaces. Though Australia has generally been slow to engage with this new form of technology, at the time of writing, Sydneysiders are enjoying a multitude of temporary media façades as part of the Vivid Sydney Festival, which runs from May 22 to June 8 2015. The scale and popularity of this annual event indicates that there is a strong public interest in media façades, yet the low number of permanent installations indicate that there are unresolved issues preventing Australia to completely engage with this emergent technology. This paper therefore seeks to investigate media façade design considerations, review their range of possible application and provide a brief discussion of the regulatory limitations. It is also evident that further research must be conducted to better understand this unique hybrid of architecture, technology, psychology and human-computer interaction.

While a media façades are a feature of many smart cities, they are still a rarity in Australian cities. This perhaps is not surprising when the one looks at extremely low numbers of Australian cities that identify themselves as a smart city. As part of their interpretation of previous Smart 21 Communities finalists, Nam and Pardo (2011) identify the lack of Australian cities on the list. To date Australia's largest city, Sydney, has never been listed and Melbourne was listed only in 2006. Ipswich, Whittlesea, Gold Cost City, Ballarat, Prospect, Sunshine Coast and Coffs Harbour are the only Australian cities to be listed between 2006 and 2015 (IFC 2015). This, however, does not indicate that Australians do not engage with new technology. Haeusler, Tomitsch and Tscherteau (2012) assert that Australia has a "very high saturation of smartphones". As a smartphones are a key device to allow contact with media façades, this indicates that there is the potential for high levels of public interaction in Australia with such new technologies. The very interactive and connective nature of smart city technologies makes it impossible to study media façades in isolation – a city's propensity to adopt smart technologies must also be considered.

2. Introduction to design considerations, application possibilities and regulation

Past studies from around the world have documented the suspicion of media façades as another avenue for urban advertising. The definition of what constitutes a media façade, as apposed to say an unban screen or illuminated billboard, is still not clearly defined in academic literature, as lamented by Haeusler (2013). For this project the definition of a media façade is taken from Haeusler, Tomitsch and Tscherteau (2012) who define this new technology as "a façade into which dynamic communication elements (images, graphics, texts) are embedded". As part of this project, it was important to provide an overview of the design considerations, application possibilities and regulatory limitations related to media façades.

2.1 Design considerations

Size, shape and integration level

There are no specific limitations to the size of a media façade; for example, the screen in Frimon St in Las Vegas is 427m long. They are also not restricted to one surface, being able to curve and flor around edges (the "2.5D" principle). The level of integration ranges from completely independent to completely integrated.

Locational factors

In designing a media façade, consideration must be given to locational factors such as street illumination, traffic lighting, street noise, presence of tall trees or other potential blockages, water surfaces, and other nearby media facades which may result in competition (Čikić-Tovarović, 2011). Subspaces within the area can be designed to minimise gaps and increase the potential interaction space for users to engage with the media façade (Fischer et al., 2013). Users will interact differently in different spaces and social contexts.

Durability

The screen's required durability depends on whether it is a permanent or temporary display. Impacts from weather and changes in temperature as well as economic and environmental sustainability in its production and use are all considerations that must be accounted for in the media façade's design (Čikić-Tovarović, 2011). In addition to its material robustness, an effective façade needs to also be straightforward and obvious to the distracted urban dweller who may often overlook more subtle designs (Moere & Hill, 2012).

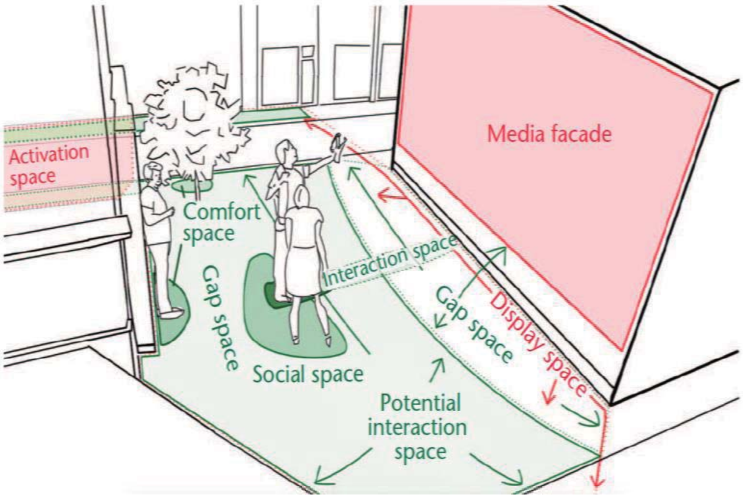


Figure 1: Subspaces in an urban HCI model (Čikić-Tovarović, 2011)

2.2 Current Functions and Applications

A framework for identifying the dimensions of a media façade require posing the question of its role, intended nature and location of the user(s) and whether interaction is implicit or explicit (Diniz, Duarte, Guimar, & es, 2012). There is a whole host of roles and applications for media façades that have begun to be explored ranging from aims to spark community discourse, for example The Climate Wall in Aarhus (Dalsgaard & Halskov, 2010), to merely creating a playful space for interactions such as the BBC BigScreen Red Nose game (O'Hara, Glancy, & Robertshaw, 2008). Approaching the concept architecturally expands the value of public displays beyond simply information and utility (Fischer et al., 2013). Apart from media and advertising, below are a few examples of the potential uses for media façades.

Art installations

In the project ParticipArt in Helsinki (Jacucci et al., 2010), different participative strategies were developed that explore the role of interaction technologies. One installation, Still Life II, involved three white canvasses with movement sensors and lights that detected spectators and generated light-spots, reshaping the traditional role of the artist and enable spectator authorship. Hypersurface Architecture REDUX, designed by students from UNSW, featured an interactive light wall at Customs House in Sydney, transforming a static wall into a vibrant and dynamic work of art (MAI, 2012).

Museums also are beginning to explore mobile and GPS-based technologies as platforms for augmented reality, transforming the role of visitors from passive receivers to engagers with the interactive infrastructure (Dindler, 2014). Aarhus by Light engaged users with three different design elements in a media façade against the Concert Hall Aarhus: an evolving lineart skyline, silhouettes of the users and luminous creatures that would interact playfully with the scaffold and the users' silhouettes (Brynskov et al., 2009).

During Vivid Sydney 2009, an idea for a prototype Janus Screen was explored as part of the SmartLight festival (Barker et al., 2010). This would be a face-shaped pixel façade that aimed to animate and morph based on photos contributed by users. Although this was not ultimately achieved due to time and cost constraints, the concept highlights the great potential for further research and development of interactive art instalments.

Public interaction

Figure 3: SMSlingshot in use (Fischer 2013)

The SMSlingshot in Germany (see Figure 3) encouraged social interaction in an urban space, allowing users to type a text message on a keypad integrated into a slingshot-shaped device and "shoot" it at a façade where it would appear in a coloured splat (Fischer et al., 2013). Multi-user interaction is also possible, explored in the Touch Projector in Germany that allowed users to paint on the façade and solve puzzles from their mobile devices (Boring et al., 2011). Another approach is the augmenting of existing urban infrastructure such as the simple but effective Lonely Traffic Light developed by a student at the University of Sydney, which would interact with users by a proximity sensor and hidden speaker (Moere & Hill, 2012).

Visualisation of urban data

Originally designed for the World Financial Centre in New York, Time Translations uses multiple cameras to stream pedestrians movements onto plasma monitors to display real time visualisations and capture urban commute patterns through the area (Jacucci et al., 2010). This new way of presenting urban data may be able to provide a solution for conveying actionable knowledge to the community (Moere & Hill, 2012). Urban screens may prove an effective technique in generating and collating public feedback.

Further, media façades may also have the potential to increase social responsibility and awareness. Melbourne Smart City (Arup, 2011) presents a myriad of potential applications including real-time street-wide display of water and electricity use and a floating LED cloud artistically conveying patterns of urban activity (see Figure 4). A 10-week study of public displays on house façades in Sydney showed promise in their effectiveness of externalising household energy consumption in triggering social comparison or pressure (Abrahamse, Steg, Vlek, & Rothengatter, 2005).

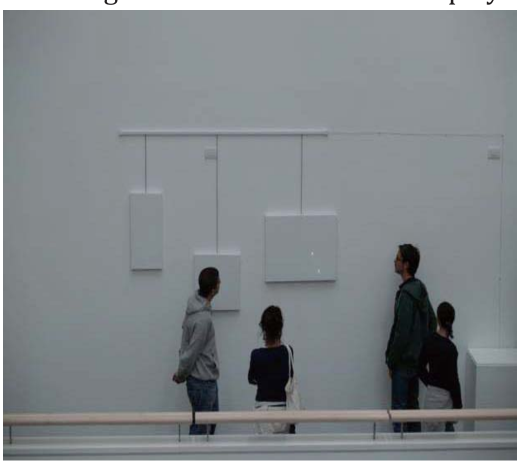


Figure 2: Still Life II, three white canvases

2.3 Regulation Limitations

Haeusler, Tomitsch and Tscherteau (2012) assert that the opportunity for the development of media façades are mostly determined by the planning regulations of a particular city. Pervious global studies of cities with media façades conclude that planning regulations may cite light pollution and traffic safety as the main concerns related to the installation of permanent media façades (Kronhagel 2012; Pop 2012; Griffin 2012). In the Australian context, the existence of either permanent or temporary media façades is still very limited.

In Australia the installation of a media façade, either as a retrospective addition to an existing building or as part of a new development, would be subject to the assessment and conditions of the relevant planning authority. Australia has a very complex government system, which comprises three levels of government (Federal, State and Local). State Governments are generally responsible for the establishment of their own planning and environmental legislation, so in practice the requirements for the approval of a media façade may differ from State to State. For this research project, the state of New South Wales (NSW) will be used as a case study. It should be mentioned that there are areas of Commonwealth managed land in NSW and a media façade on these sites would be subject to federal legislation and different approval processes. A review of relevant NSW planning instruments is provided below.

Strategic Documents

The NSW Department of Planning and Environment (DPE) is responsible for the preparation of strategic planning documents that guide development in NSW. The latest strategic plan, *A plan for growing Sydney* was released in 2014 and makes no specific mention of media façades.

Legislation

The Environmental Planning and Assessment Act 1979 is the key piece of legislation that outlines the operation of the planning system in NSW. While it would be unusual for a piece of legislation to specifically mention a building feature such as a media façade, the Act does include definitions of key development terms to ensure consistency across the State. There is no definition for media façade in the Act.

Local Environment Plans

The NSW DPE has prepared a standard instrument to assist the 152 Local Councils in preparing their individual key planning instruments, the Local Environment Plan (LEP). Media façades are not included in the standard instrument's list of definitions, indicating that it is not a feature common enough to warrant a universal definition. ‘Advertising structure’ and ‘signage’ are the closest terms to media façade that exist in the Standard Instrument.

Development Control Plans

Development Control Plans (DCP) provide the most specific objectives for development in a Local Government Area (LGA). Though these documents are not legally binding, their provisions are supported by the LEP. It would not be practical to analyse the DCPs of all 152 Local Councils in NSW. Therefore a case study DCP, prepared by the City of Sydney Council, was reviewed for this project, as this is the LGA where a number of media facades currently exist, including the temporary media façades that are part of the Vivid Festival.

In the City of Sydney DCP there are no provisions or definitions specific to media façades. An assessment of a new media façade would need to make reference to a number of other provisions, such as:

- 3.1.5. Public Art
- 3.2.3 Active Frontages
- 3.2.8 External Lighting
- 3.16.4 Illumination and animation of signs

This is not dissimilar to the experience of those seeking approval of another form of smart city technology - the urban screen. Researches studying the emergence of urban screens in Australia have noted that planning policy often “treats large screens as if they were static billboards” (Papastergiadis et al 2013 and Yue et al 2014). Sydney has a number of media facades but their location and application highlight the difficulty in introducing such technology to the city.

Table 1. Characteristics of Media Facades in Sydney

Name	Indoor/Outdoor	Permanent/Temporary	Interactive

Darling Quarter	Outdoor	Permanent	Yes
Central Park	Indoor	Permanent	Yes
Vivid Sydney	Outdoor	Temporary	Some sites
Bankstown Sports Club	Indoor	Permanent	No

Source: Authors'

Media façades located inside buildings are not subject to the stringent planning restrictions placed on external media facades. Temporary media facades, whose scope is usually achieved by illuminating existing building facades, such as those that are part of the Vivid Festival, would be subject to a different set of 'outdoor event' regulations and require a different form of assessment. To further highlight the complexity of the planning system in NSW, it should be noted that a separate Sate agency, the Sydney Harbour Foreshore Authority, administers areas of development that are close to the foreshore. If the approval process for two of Sydney's media facades is compared, say Darling Quarter and Vivid, it can be seen that these two media façades would be subject to completely different sets of regulations – the starting point being that two different levels of government administer their sites, even thought geographically they are in close proximity to one another.

In summary, the complexity in gaining approval for a media façade comes from two main aspects: a) there is not one approval process for media façades – the level of government or specific agency responsible for the approval will depend on the location of the media façade site; and b) that media façades are not specifically listed under any regulation but rather a development application would require the assessment under a number of areas (such as lighting, signage, public art, night-time activities etc). Planning regulations and general feelings around media façades have meant that most in Australia can be categorised as: temporary outdoor or indoor permanent. Australia is still in the early stages of accepting media facades, both socially and in a regulatory sense and Haeusler et al (2012) observe that Australia is still focused on temporary media façades that aim to raise public awareness of this new technology. This therefore provides a unique opportunity for this research to shape the future direction of media façades in Australia.

3. Case Study and Research Methods

3.1 Case study

The case study is the Central Park precinct that is 5.8-hectare, $2 billion urban redevelopment project on the on the southern edge of Sydney's central business district, bordered by Broadway, O'Connor, Wellington and Abercrombie Streets in Chippendale, Sydney, Australia. The mixed-use project is a joint venture between Frasers Property and Sekisui House to redevelop the old Carlton and United Brewery, which was closed in 2005 (Frasers Properties 2013). The project includes residential apartments, offices, shops and cafés. The project as won numerous awards in a range of categories, including sustainability, landscape architecture, design and innovation.

Central Park installed a 15-metre long interactive LED screen ("The Digital Wall") features inside the Central retail precinct. The wall is located around the retail precinct's elevators. There are another media façade as well as heliostat, which catch an eye of people. It uses interactive LED screen which forms the size of 15m x 24m screen used a Big Screen Project 7mm LED module. Also the kiosk, microphone, and cameras are installed for the real interaction with people. Ramus Illumination, who acted as creative directors for the media façade, state that it is the largest indoor media façade of its kind in a retail precinct in the world (Ramus 2014). Visentin (2014) notes that the aim of including the media façade within the Central Park retail precinct was to distinguish it from other modern "sterile and soulless shopping malls".

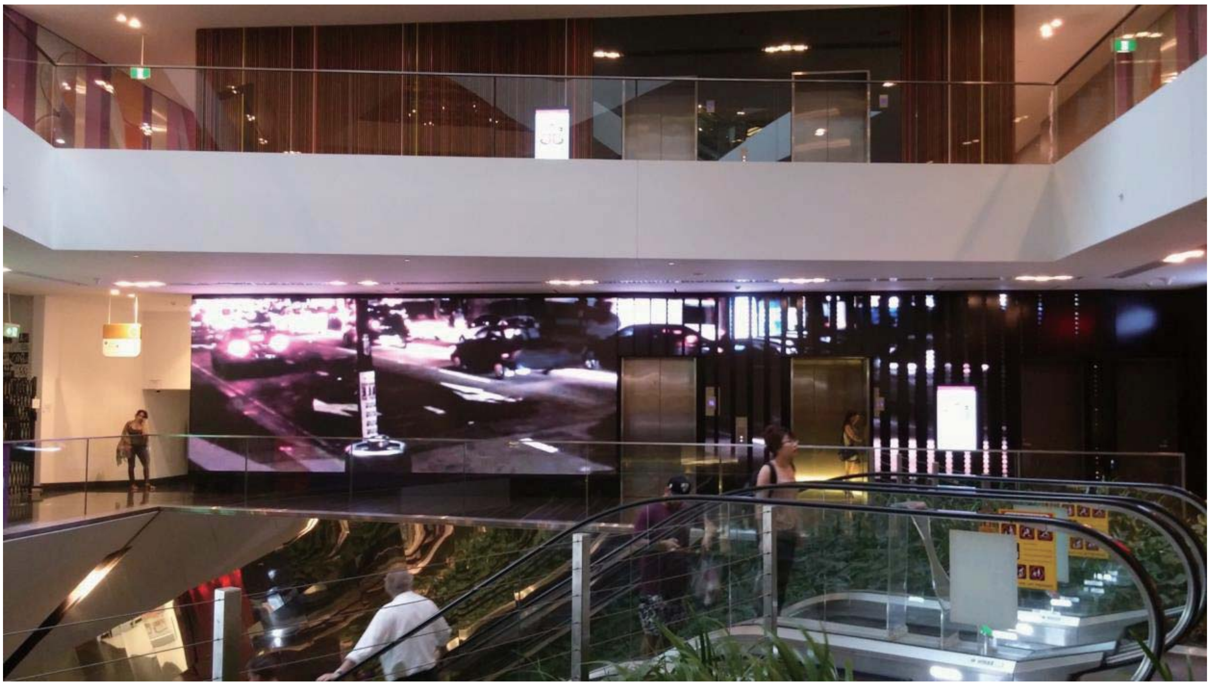


Figure 3: CCTV view displayed in the Digital Wall in Central Park (photo by author)

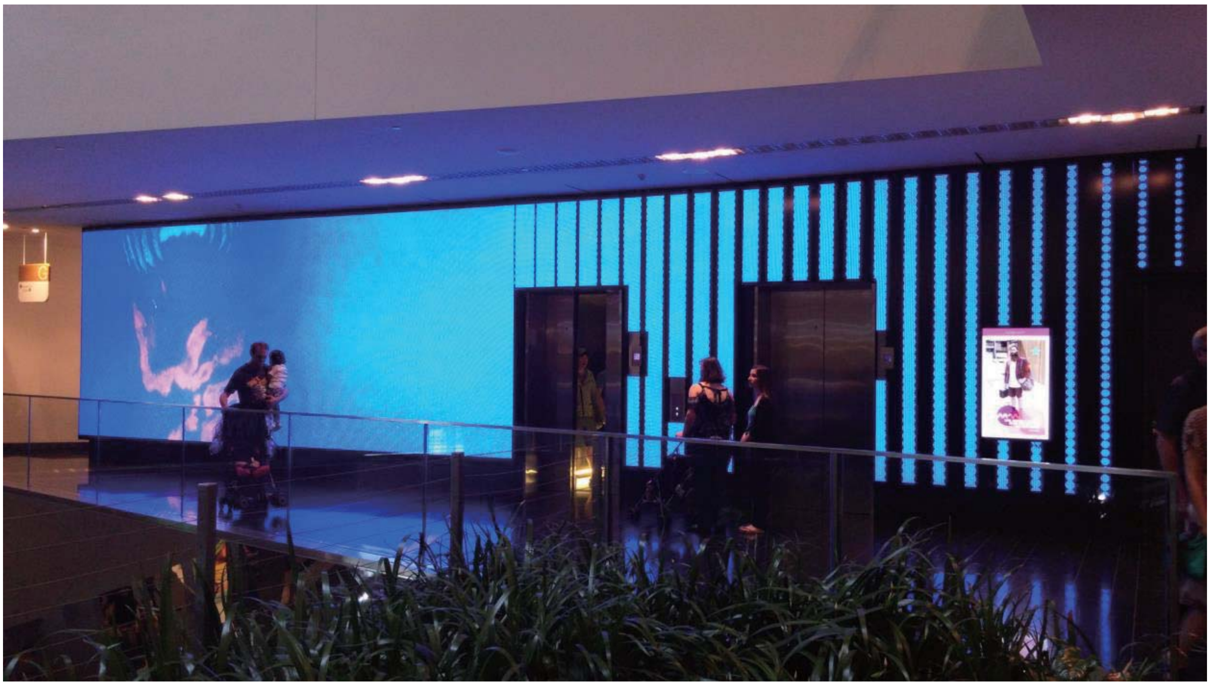


Figure 4: Access to the lifts (elevators) by the Digital Wall in Central Park (photo by author)

While scale of the Digital Wall gives it huge commercial potential, the project appears to be consciously trying to avoid becoming an “advertising billboard or an incessantly-looping foyer artwork” (Holder 2013) through the ever changing range of interactive activities that are offered to shoppers. Gorman (2013) notes that the media façade acts “as a canvas for visitors to play with via the touch screen interface”.

Apart from showcasing local community art and playing a library of videos, The Digital Wall offers shoppers opportunities to:

- Play games via the kiosk
- Engage with social media. During University Orientation Week in 2014, a custom Instagram app developed by Ramus Illumination allowed students to hashtag their photos and display them on The Digital Wall (Holder 2013)

Change the content of the wall simply by walking through the space. Cameras and microphones around The Digital Wall map the area in front of the screen, sensing people’s movements and then cast those people’s shadows onto the screens (Holder 2014). Ramus (2014) describes this as “reflective content: it reflects the environment where the installation sits”.

3.2 Data and Methods

The data presented are compiled from an original sample survey developed for this project. Between 15 May and 17 May 2015, the research team collected 200 written surveys from members of the public visiting or residing the Central Park retail precinct. The survey contained 26 questions, which were divided into three categories: perception of the media façade, digital interaction and quality of life/demographics. The survey questionnaire is designed to find various human interactions and perceptions of media façades. The installation of media façades in Central Park aims to increase the number of platforms for digital interaction and knowledge sharing. It is important to ensure their satisfaction with the digital screen and what they want to interact with the screen, and how their interest can be sustained especially if a media façade is intended to display more permanently. This study first investigates current perceptions and levels of satisfaction with interactions of media façades among Sydneysiders at Central Park and then identifies the key factors that determine the human interaction to the media façade using the logistic regression analysis. Initially, the ordinal data with the perception to the media façade were analysed descriptively. The logistic regression model was then used to predict how the independent variables might support active interaction to the media façade.

In the logistic regression model the dichotomous dependent variable- if they are interested in interacting with the media facade or not is selected. Table 4 shows the list of independent variables with measurement and categories. For the externality effects the five externality effects with social activity, safety, asthenic appearance, motivation and freedom of consumption were selected involved Likert scale data (ordinal) with a level of satisfaction and engagement to the media façade. The variables that may affect the perception to the media façade were include visualisation frequency, the contents of media façade, contents preference, interaction methods and level of satisfaction with the information and service. At a personal level a range of variables relating to individual familiarity to the digital technology and socioeconomic and demographic characteristics (i.e. hours use internet, online shopping, age, gender, employment) were selected.

In the logistic regression model the independent variables can include the non-metric (categorical) information, such as household socio-demographic characteristics, the contents of media façade and interaction methods. The categorical independent variable nominates a reference category against which other categories are compared. The reference category is the last category in the variable.

Table 2. List of independent variables

Effects	Variables	Data Type	Measurement/Categories
Externality	Social activity	Ordinal (Likert Scale)	1. much more; 2. a little more; 3. the same; 4. a little less; 5. much less
	Safety & Security	Ordinal (Likert Scale)	1. much better; 2. a little better; 3. the same; 4. a little worse; 5. much worse
	Asthenic appearance	Ordinal (Likert Scale)	1. much better; 2. a little better; 3. the same; 4. a little worse; 5. much worse
	Motivation	Ordinal (Likert Scale)	1. much more; 2. a little more; 3. the same; 4. a little less; 5. much less
	Freedom of consumption	Ordinal (Likert Scale)	1. much better; 2. a little better; 3. the same; 4. a little worse; 5. much worse
Perception	Contents of Media Façade	Ordinal	1. Mostly good quality content is available; 2. Some good quality content is available; 3. Little good quality content is available; 4. No good quality content is available
	Frequency of contents	Ordinal	1. Everyday; 2. Weekly; 3. Monthly; 4. Quarterly
	Information preferences	Categorical	1. Commercial advertisement; 2. News;3. Videos; 4. General information; 5. Other
	Interaction methods	Categorical	1. Your own messages; 2. Your own drawings or graphic images; 3. Your own photos; 4. Your own work related advertisement; 5. Other
	Satisfaction with Media Facade	Categorical	1. Not satisfied 2. Satisfied (ref cat)
Digital Familiarity	Daily internet use	Ordinal	1. None; 2. Less than one hour; 3. 1-2 hours; 4. 2-3 hours; 5. 4-5 hours; 6. 5-6 hours; 7. 6 hours or more
	Online shopping	Ordinal	1. Never; 2. Less than once a month; 3. Once or twice a month; 4. Three to five times a month; 5. Six or more times a month
	Confidence in digital technologies	Ordinal (Likert scale)	1. Very confident; 2. Somewhat confident; 3. Neutral; 4. Somewhat less confident; 5. Not at all confident
Personal Characteristics	Age	Continuous	Age
	Ethnic background	Categorical	1. Australian; 2. Non-Australian (ref cat)
	Gender	Categorical	1. Male; 2. Female (ref cat)
	Employment	Categorical	1. Full-time; 2. Part-time or casual; 3. Self-employed; 4. Retired or Unemployed (ref cat)

The odds ratio (Exp B) is an indicator of the change in odds resulting from a unit change in the predictor. If the Exp B value is greater than 1, the dependent variable will increase as the predictor increases. If the Exp B value is less than 1, it indicates that as the predictor increases, the odds of the dependent variable decrease. The model adopted a forced entry method estimating the coefficients for all independent variables and forced them into the model simultaneously in order to report coefficient estimates with a significance level for each predictor.

4. Quantifying people's experiences with media façades

4.1 Descriptive Analysis

Questions 1 to 13 of the survey asked respondents about their perceptions of the media façade in relation to the following five aspects: social activities; local safety and security; aesthetic appearance; motivation to visit; and ease of spending money.

Social Activities

While 52% of respondents felt that the media façade neither enhanced nor detracted from their social activities at Central Park, 26% of respondents indicated that they would enjoy their social activities a little less if the media façade did not exist and 6% would enjoy their social activities a lot less if the media façade did not exist. Only 16% of respondents indicated that they would enjoy their social activities more if the media façade did not exist. This demonstrates that for almost a third of the shoppers at Central Park, the media façade positively contributes to their enjoyment of social activities.

Table 3. Media facades with social activities

If the media facade did not exist here, I would enjoy my social activities					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	much more	12	6.0	6.0	6.0
	a little more	20	10.0	10.0	16.0
	the same	104	52.0	52.0	68.0
	a little less	52	26.0	26.0	94.0
	much less	12	6.0	6.0	100.0
	Total	200	100.0	100.0	

Local safety and security

64.5% of respondents indicated that the level of safety and security they experienced would be the same if the media façade did not exist. However for almost a quarter of respondents, the media façade did play an important role in promoting a feeling of safety, with 18.5% stating that safety and security would be a little worse if the media façade did not exist and 4.5% stating that it would be much worse.

Table 4. Media facades with safety and security

If the media façade did not exist here, local safety and security here would be					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	much better	7	3.5	3.5	3.5
	a little better	17	8.5	8.5	12.1
	the same	129	64.5	64.8	76.9
	a little worse	37	18.5	18.6	95.5
	much worse	9	4.5	4.5	100.0
	Total	199	99.5	100.0	
Missing	System	1	.5		
Total		200	100.0		

Aesthetic appearance

In four out of the five aspect categories (social activities, local safety and security, motivation to visit and ease of spending money) the response "the same" attracted the highest number of responses. This indicated that most people felt that the presence of a media façade did not impact on these aspects of their visit. However, when asked about aesthetic appearance, 68.5% of respondents felt that the aesthetic appearance of the place would be a little worse or much worse if the media façade did not exist. This highlights the importance of the media façade in improving the visual experience of the Central Park retail precinct.

Table 5. Media facades with asthenic appearance

If the media façade did not exist here, asthenic appearance in this place would be:					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	much better	8	4.0	4.0	4.0
	a little better	17	8.5	8.5	12.5
	the same	38	19.0	19.0	31.5
	a little worse	98	49.0	49.0	80.5
	much worse	39	19.5	19.5	100.0
	Total	200	100.0	100.0	

Motivation to visit

Though 69.5% of respondents felt that their motivation to visit would be the same if the media façade did not exist, 23% indicated that their motivation to visit would be a little less or much less if the media façade did not exist. This response illustrates that for almost a quarter of visitors to Central Park the media façade itself is part of their motivation to visit.

Table 6. Media facades with motivation

If the media façade did not exist here, my motivation to visit this place would be:					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	much more	3	1.5	1.5	1.5
	a little more	12	6.0	6.0	7.5
	the same	139	69.5	69.5	77.0
	a little less	38	19.0	19.0	96.0
	much less	8	4.0	4.0	100.0
	Total	200	100.0	100.0	

Ease of spending money

The existence of the media façade had the least amount of impact on respondent's spending habits, with 74.5% of respondents felt that their ease of spending money would be the same if the media façade did not exist.

Table 7. Media facades with consumption freedom

If the media façade did not exist here, ease of spending money would be:					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	much better	2	1.0	1.0	1.0
	a little better	17	8.5	8.5	9.5
	the same	149	74.5	74.5	84.0
	a little worse	31	15.5	15.5	99.5
	much worse	1	.5	.5	100.0
	Total	200	100.0	100.0	

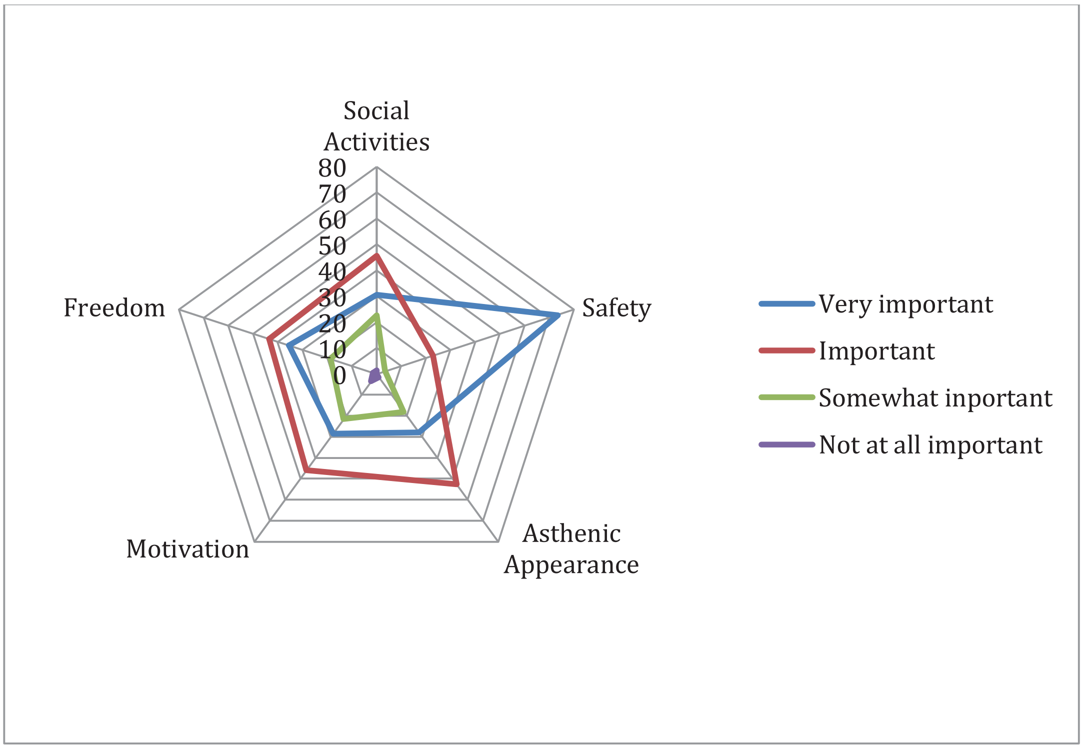
Further analysis conducted to compare the five aspects. Figure 4 shows the radar chart with respondent's level of importance ratings across the five aspects. The rating "not at all important" had the lowest percentage of responses across all categories. Zero respondents indicated that safety and security was "not at all important" and only 1.5% of respondents rated social activities, aesthetic appearance and freedom to spend money to the same level. 3.5% of respondents rated motivation as "not at all important".

Across four of the five categories (social activities, aesthetic appearance, motivation and freedom to spend money) a similar percentage of respondents (on average 20%) indicated that these aspects were "somewhat important" (22.5%, 18%, 21.5% and 18.5% respectively). Only 3.5% of respondents felt that safety and security were "somewhat important".

Across three of the five categories (social activities, motivation and freedom to spend money) a similar percentage of respondents indicated that these aspects were "important" (45.5%, 46% and 43.5% respectively). 52.5% of respondents indicated that aesthetic appearance was "important" to them but only 23% thought that safety and security was.

73.5% of respondents rated safety and security as "very important". Across the remaining four categories (social activities, aesthetic appearance, motivation and freedom to spend money) the responses fell into a range between 28% and 35.5%.

Figure 4. Rader Chart Analysis of the Five Aspects



Satisfaction and Interaction levels

Satisfaction levels with the media façade were very high, with 62.5% of respondents indicating a very high or high level of satisfaction. A third of respondents felt neutral about the media façade and only 4.5% of visitors surveyed felt low or very low levels of satisfaction. Respondents had high regarded for the content shown on the media façade. 23% thought that mostly good content was available and 63% thought that some good content was available. One the other hand the frequency of changes in display contents is important. 60.5% of respondents would like to see the content on the media façade change every week and 19.5% would like to see the content change every day. As the retail precinct has been designed to cater mostly for local residents, including those who live on-site, this high demand for content change reflects the regular and frequent nature of shopper's visits.

Table 9. Overall satisfaction with media facade

Overall my satisfaction with this media façade is

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	very high	22	11.0	11.0	11.0
	high	103	51.5	51.5	62.5
	neither high or low	66	33.0	33.0	95.5
	low	6	3.0	3.0	98.5
	very low	3	1.5	1.5	100.0
	Total	200	100.0	100.0	

4.2 Results of Logistic Regression Analysis

These tables present the outcomes from the logistic regression with the exponential of the beta coefficients (exp B). The exp Bs are interpreted as odd ratios that present the likelihood of interact with the media facade given a particular outcome on the independent variable. Table 10 shows the results of the logistic regression analysis of all the independent variables in the four types of effects (externality, perception, familiarity, and personal characteristic). In the individual socio-demographic variables are associated with respondents who interact with the media façade. The variable of ethnic background is significantly associated in some way with interaction with the media facade. Compared with respondents who are non-Australian (reference category), Australian four times as less likely to interact the media façade as a user. However, other socio-demographic characteristics such as age, gender and employment status do not significantly affect to the likelihood of interacting with the media façade. Most importantly the likelihood of interaction increases when the level of satisfaction with the media façade service is higher.

The likelihood of interaction significantly increases if the respondents believe the asthenic appearance improved after the media façade installation. The quality of contents available in the media façade is one of the most important attributors to the likelihood of interaction (exp B = 8.27). The significant variables in separating respondents interacting, and not interacting, the interaction methods were displaying personal messages and their work-related advertisement. However, these respondents are less likely to interact with the media facades. Interestingly all the independent variables such as daily hours use internet, level of confidence in digital technology and online shopping experience within the digital familiarity do not significantly affect to the likelihood of interacting with the media façade.

Overall the statistical results suggest that the quality of contents, the level of satisfaction with service, the improvement of asthenic appearance, the interaction methods and ethnic background were key independent variables differentiating respondents interacting with the media façade (at $p < 0.05$).

Table 10. Overall satisfaction with media facade

	B	S.E.	Exp(B)
Q3a_SOCIAL	.100	.412	1.11
Q4a_SAFETY	.098	.460	1.10
Q5a_ASTHENIC	-1.292	.414	0.27**
Q6a_MOTIV	.256	.533	1.29
Q7a_SPEND	.480	.582	1.62
Q10_CONTENT	2.112	.694	8.27**
Q11_FRQ_INFO	-.171	.410	0.84
Q12a_LTS_ADV(1)	-1.114	.792	0.33
Q12b_LTS_NEWS(1)	.281	.702	1.32
Q12c_LTS_VDOS(1)	-.326	.754	0.72
Q12d_LTS_INFO(1)	-.443	.673	0.64
Q13a_PHN_MSG(1)	-1.299	.632	0.27*
Q13b_PHN_IMG(1)	.040	.706	1.04
Q13c_PHN_PHO(1)	1.384	.767	3.99
Q13d_PHN_ADV(1)	-1.397	.806	0.25*
Q14_HR_INT	-.056	.234	0.95
Q15_SHP_ONL	-.713	.383	0.49
Q17_CMP_TEQ	-.520	.504	0.59
Q21_AGE	.067	.054	1.07
Q22_NAT(1)	-2.059	.773	0.13**
Q20_GEN(1)	-1.004	.709	0.37
Q23_EMP_Cat			
Q23_EMP_Cat(1)	-.521	.890	0.59
Q23_EMP_Cat(2)	-.459	.941	0.63
Q23_EMP_Cat(3)	.930	1.737	2.53
Q8_SAT_Dummy(1)	3.089	.839	21.96***
Constant	-.569	3.592	0.57

Note: N=195, -2LL = 86.937 ***$p < 0.01$, $p^{**} < 0.05$

5. Conclusion

As media façades have often been developed for a specific temporal and/or spatial context, there are many opportunities and challenges that need to be further explored. Issues of scale, spatial organisation and environment are unique to each individual media façade project but guidelines or principles could be developed to better approach their design and contents (Abrahamse et al., 2005; Dalsgaard & Halskov, 2010).

While the complexities of the Australian planning system may be hindering the development of media façades, there are still opportunities to gather information about people's experiences with media façades. The documentation of such encounters also raises important questions about whether media facades might be more successful and accepted if they contain interactive opportunities.

The findings in this paper revealed that programmable LED media façades near main access (i.e. main entrance & lift) is effective to leveraging human-computer interactions with urban space. The analysis of radar chart with the five major externalities (social activities, aesthetic appearance, safety, motivation and freedom) reveal that the aesthetic appearance and safety aspects should be considered in the adaption of urban planning to smart technology of revitalizing public spaces. The survey found that space with the media facade can enhance a dynamic social activity and consumption behaviour. In particular the asthenic appearance of media façade plays a key role in encouraging the viewers to remain in the space and possibly interact with it.

The logistic regression analysis used in this paper has several limitations. It is important to acknowledge that this analysis does not aim to identify causal relationships. Rather, the four effects are identified that exist between a range of independent variables (externality, perception, digital familiarity, and personal characteristics) and the dependent variable of interaction with the media façade. The socio-demographic factors in the human interaction require further investigation. Gender and age are commonly known to part-of-role but the independent variables used in the model proved non-significant. In the meantime, ethnic background, distinguishing Australian, non-Australian appeared significant in the likelihood interaction of media façade. Digital familiarity effect was also totally relegated as they were read as attributes of a particular individual and are arguably better expressed through social network service interactions (i.e. Facebook, Twitter, Linkin etc.). This has important implications for planners, architects and policy-makers implementing creative media contents and innovative interaction methods that seek to change the socio-demographic characteristics of particular users of the media façade and to attract visiting to the retail sector in the area. Our findings also have important design implications not to support for a 'one size fits all' approach to residents when installing or varying media facades.

Indeed a firmer understanding of social interaction patterns in public spaces can improve the effectiveness of media façades in meeting their full intention. One particular challenge in an urban setting is to ensure people notice the screens and learn to interact with them, and how their interest can be sustained especially if a media screen is intended to display more permanently.

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Designing ICT-Aided Community Center for Neighborhood Residents

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A community center is situated near the residential areas and is the public facility that acts as the core of local cultural activities. A community center, as the general cultural activities increases, is transforming into a facility that promotes the community restoration and living convenience such as welfare, sports, art activities, and education etc. beyond location of simple leisurely activities. As a part of developing experience zone in the residential area style U-city in Sejong city, this study considers local residents' accessibility through the renovation of preexisting community center. A particular interest is laid upon the provision of experience-oriented space to facilitate social coherence, and eventually recovery into a communicative and experiencing space that the U-city is intending.

This study offers a direction of developing community center into a communicative and experience-oriented facility in two major approaches: (1) Analyze the achievement, limitation and problems of this project against the previous cases. A particular evaluation will focus on the comparison with similar facilities available within Sejong city; and (2) As an effort to achieve an user-based space design, survey over actual Sejong city residents would help understanding the use pattern within the residential areas, contents of experience and local needs. It would allow to grasp an idea of managing programs and contents useful in the community center. This effort is highly useful since it provided a blueprint of bidirectional development, characterized by local residents' voluntary participation and experience, of the community center beyond simple one-way communication like viewing- or lecture style events. Another role of community center is use of the center as the core of community restoration as an alternative means applicable to the residential area style U-city service. The future studies shall include survey of the residents' satisfaction and preference of the renovated facilities to measure the sustainability of the project.

Key words: ICT-Aided Community Center, U-city, Space Experiential Marketing Evaluation, Ubiquitous lifestyle

1. Introduction

1) Background and Objectives

As comprehensive demand for cultural activities increase recently, the number of community centers are on the rise, with the focus on their characteristics as spaces for restoring community and enhancing quality of life. The current study is a part of residential U-city experiential district development project in the city of Sejong, which is designed to enhance the residents' accessibility to participation in cultural activities. In particular, by providing spaces centering on experiencing the technology, the project aims to restore this urban space into a U-city comprising communication and experience. Information and Communication Technologies, or ICT, possesses a significance as a local resource, in that they are media catalyzing or controlling local residents' voluntary participation[1]. South Korea, with a strength in "smart" technologies, still lacks competitiveness in the field of IoT, or Internet of Things[2]. As such, the ultimate goal of the current study is to understand how ICT are used to galvanize local communities, and what can be done to facilitate these restoration attempts using ICT, given the prevalent use of "smart" media in the current South Korean environment. What sets this study apart from previous ones that look at the same subject is the perspective: while other studies view the urban planning through ICT from the perspective of the city manager or designer, the current study attempts to understand practical services required by the users, or the residents. As such, the authors of this study were advised by subject matter experts in order to more precisely understand the needs of the users who may not necessarily have a full knowledge of the U-city concept.

The current study 1) analyzes the achievements, limits, and issues of the project by conducting case studies of urban communities using ICT; 2) identifies usage behavior, experiential elements, and the needs in the residential areas to plan a user-centric space, which is to be achieved by surveying the residents of Sejong; and 3) extract elements in which ICT can contribute to in making local communities more active, based on the results of the analysis and the survey.

Korean Cases		Overseas Cases	
no	Project Name	no	Project Name
1	Seoul Village Community	1	Kinsale, Ireland
2	Maeul (Cillage) Renaissance		
3	Solhyang Gangneung	2	My Yorkshire
4	Maeul Media	3	K-net's For Seven
5	Seongbuk-gu Social Economic Support Group	4	Smart communities intelligent community
6	Seoul Life Double-Cropping Support		

[1] Korea Information Society Development Institute (KISDI) (Dec 2013), Devolution of Urban Communities in Korea and the Role of ICT.

[2] According to a report by Accenture, a global consultancy firm, the U.S. and four European countries (Switzerland, Finland, Sweden, and Norway) have the most advanced IoT technologies, while South Korea is ranked twelfth despite its reputation as a leader in ICT (http://www.g-enews.com/ko-kr/news/article/news_all/201505060759140143977_1/article.html).

	Center	5	The Blacksburg Electronic Village
7	Hope Doremi Corp.	6	Southwarkcircle
8	Youth Hub	7	Coinstreet
9	Gimpo U-City	8	Anarchist Community Christiania
10	Yongin U-City	9	Open street map
11	Paju U-City		
12	Pangyo U-City		

<Table 1> Case analysis of ICT-Based Resident Community Institutions

2) Subjects of the Study and Methodology

Demand for services were obtained by surveying a group of experts and another of users. Expert survey was conducted on ten subject matter experts, from January 19 to 21, three days in total. Convenience sampling method was used to obtain the sample of professors and researchers in urban engineering, architecture, space design, computer, and information and communication technology. Expert survey was designed to be a preliminary investigation to draw items through which a survey of U-city service users could be executed: the expert survey collected the ideas of experts and draw services required for Sejong residential u-city experiential district. The results of this preliminary investigation will be put under the review of authors of the current study, upon which a survey for the users will be created and conducted to generate a plan to develop U-city service that residents can experience. The user group survey was designed to be easy and simple, because the general public does not have pre-existing knowledge about U-city or lacks it at most. This survey was conducted for 4 days, from April 2, 2015 to April 5 of the same year. Considering the characteristics as an “experiential district,” needs for experiential activities in the residential area and detailed usage behavior in the spaces was studied.

2. Theory Review

1) ICT-Based Communities

With the multifaceted advancement in technology, economy, culture, and ethics in the modern city, individual residents saw their zone of activity expand out of the physical space, thanks to ICT. Although physical relationship between the residents have been reduced due to the development, a new space was created online to bring a revival of urban communities[3]. Resident communities formed in urban areas are

[3] Community restoration not only refers to the improvement of physical environment in the community, but also its vitalization by leading residents and other community agents to participate in the space to resolve local issues and other (Maeng Da-mi, Jang Nam-jong, O Jeong-hyeon. 2011. How to Build and Use a Comprehensive Diagnostic Table for Reviving Sustainable Communities in Seoul. The Seoul Institute.

operated by the resident themselves, and plays a role in gathering residents' opinions local issues, such as increasing communication between the residents and restoring local communities. There is a need to focus on various positive effects brought on by the ICT, other than restoration and revival of resident communities.

2) Cases Study: ICT-Based Resident Communities

(A) Subjects of the Case Study

The author of the current study looked at ICT-based resident community institutions that actively operate social and cultural communities with a distinct local flavor. There are twelve cases of ICT-based resident communities in Korea, which were studied using preliminary research, website, and others. There were nine cases overseas, which were studied using preliminary research. Areas in which resident community institutions are located, provided services, and users were surveyed, and then classified according to the type of each community.

(b) Case Analysis

Overall, the author saw that the resident community institutions encouraged the residents to see themselves as a part of the community rather than isolate individuals. The residents were stimulated to share experiences and form networks together. In contrast, there was a lack of stimulus to the communities, such as experiential factors such as sensory stimuli that could lead to designs reflecting the features of the community.

In Korean cases of local community vitalization, there were various programs focusing on the relationship between community members. In cases of economic sponsorship and activity, the resident community institutions operated facilities providing information, thereby influencing the residents' values. There was a high proportion of technological information provided using ICT in U-cities, and there were similar programs provided across the border, such as traffic and transportation, medical, life information, environmental information, community center programs, and photo and video uploads. All overseas cases showed a strong trend towards the marketing element, in which online networks based on ICT were used. There was also an active participation for uploading and sharing information between the residents.

The following observations were made after looking at programs provided by each community studied: (1) there was a relative lack of experiential elements in resident community institutions, in which aesthetic elements were applied, or characteristics of the community was shown; (2) There was a strong tendency to unite the residents to create a sense of community among them, and lead them to participate and communicate with each other. Along with offline interactions, online webpages were playing such role, and there seems to be a need to use ICT more actively in order to improve interaction and communication between the residents.

Korean Cases				
no	Project Name	Type	Location	Contents
1	Seoul Village Community	Local Community Vitalization	Seoul	• Information exchange and notices through community webpage and Facebook • Operate various projects (multicultural village community, village business vitalization, village arts and crafts, safe village vitalization) through resident groups, and find and resolve various issues

2	Maeul (village) Renaissance		Suwon	• Provide a voluntary participation platform for the residents, construct village community, create a Korea-wide village-building network, distribute Maeul Renaissance contents, plan private sector-government cooperation network projects
3	Solhyang Gangneung		Gangneung	• Collect and manage various village-building projects, and provide information on and offline to the residents • Build a flexible network of residents, administrators, experts, and civil society • Introduce and share various sites, post community news, status of cooperation among local school/experts/civil societies/villages on the websites
4	Maeul Media		Seoul	• Induce communication within the village by supporting media creation • Residents own and operate the center, which facilitates communication, cultural activities, leisure activities, and meetings • Three centers in Seoul (culture and arts/resident meeting/Seoul village community) collaborate to form a network
5	Seongbuk-gu Social Economic Support Group	Economic Support Activities	Seongbuk-gu, Seoul	• Panel discussions for the development of 4 northeast Seoul districts, apartment complex community project planning, support festivals in the district, open social parties, and strengthen networks • Build and research social economic clusters
6	Seoul Life Double-Cropping Support Center	Communities for Specific Classes	Seoul	• Support voluntary and independent community activities (senior center coordinator, case management supporter, humanities study) • Vitalize various on/offline meetings (by subject) • Receive ideas, coordinate volunteer activities, and academies through webpage
7	Hope Doremi		Seoul	• Notify yearly reports and introduce various activities on the webpage, and move on to vitalize offline group meetings • Provide SNS notifications for webpage activities • Operate educational projects for professional knowledge and field experience, as well as consulting to support business
8	Youth Hub		Seoul	• Encourage college students to engage in activities, vitalize youth activities • National online activity without local boundaries (offline activities are held in Seoul)
9	Gimpo U-City	U-City	Gimpo	• Real-time traffic information service in Gimpo, CCTV in Gimpo, route search available on navigation and smartphone applications • Web bulletin board (classifieds, free talk boards, etc.) • Advertisements for local businesses and used goods transaction on the webpage
10	Yongin U-City		Yongin	• Yongin public office locations can be seen on the webpage • Bus information page provides bus routes and traffic information • Life information notifications (education programs, air quality, water pollution, weather, etc.)
11	Paju U-City		Paju	• Medical/convenience/public facilities locations provided • Information about and application for Paju educational program are on the webpage • U-Service offers Paju weather information, air information, and traffic information • Students in Paju can communicate on their webpage
12	Pangyo U-City		Pangyo	• U-Service provides traffic information and CCTV information in Pangyo • U-Service provides environmental information (weather, temperature, chance of rain) in Pangyo • Community bulletin board enables the residents to find jobs, share videos and photos
Overseas Cases[4]				
no	Project Name	Type	Location	Contents

[4] Shim, Heong-jin et al. (2013). The Evolution of Urban Communities in the Korean Society and the Role of ICT. KISDI.

1	Kinsale, Ireland	Local Community Vitalization	Kinsale	• Geography-based community for hobbies and offline activities • Campaigns can be promoted on the webpage, and users may obtain resources and communicate via SNS to hold offline events • Residents can share community activity photos on the webpage and use it as a town archive; SNS supplements this function
2	My Yorkshire		Yorkshire	• Individual residents can upload videos, photos, and stories about Yorkshire, which become the city's history • By uploading and sharing digital stories, residents form a sense of belonging and identity as citizens of Yorkshire
3	K-net's For Seven		Canada	• Communities are form via internet, cable, radio, and cell phones • Telehealth, videoconferencing, and other business/welfare services are provided on the web • Identity is formed through ICT, and discussions and participation are naturally conducted via the platform
4	Smart Communities Intelligent Community		Canada	• ICT-user communities are connected via network, which create synergy for inducing local participation • Two communities sharing the same vision can partner up with each other
5	The Blacksburg Electronic Village		Virginia, US	• Using networks, local resources are used, and mutual discussions are stimulated which lead to resident participation
6	Southwarkcircle	Economic Activity-Related Communities	UK	• Senior citizens save costs for health care, restaurant bill, and others, through group purchase. They socially bond in the process • Helpers can be recruited for senior citizens on the webpage; helper networking takes place through the platform
7	Coinstreet		UK	• Residents who have a pre-existing network form businesses • The webpage works as a type of command center • SNS, blogs, or other platforms are connected to the webpage
8	Anarchist Community Christiania		Denmark	• News about the community members are shared through websites or SNS • Political issues are discussed and resolved through public forums, which end with a unanimous resolution • Recently, residents are buying lands to keep the community independent, whose funding is secured by donations received through the web
9	Open street map	GIS-Based Local Community	-	• When users upload local information on the wiki-type map, it is collectively made into a more precise map • Location-based local information is shared through the application

<Table 2> Case analysis of ICT-Based Resident Community Institutions

3. Service Demand Analysis

1) Expert Survey

The current study surveyed experts before conducing a survey on U-city service uses. This expert survey was conducted as a preliminary investigation to draw items required to conduct the user survey: it was designed to understand potential services needed in Sejong residential u-city experiential district from insights of the experts. The results of this preliminary investigation will be used for the user survey, which in turn will help in creating U-city services which the residents can experience. The following paragraphs detail the survey.

Overview of Survey	Period: January 19, 2015 ~ January 21, 2015 (3 days) Subjects: Experts related to urban engineering, architecture, spatial design, computers, and information communications Survey Method: Written Survey Participants: 10 people
Contents of Survey	Demographics (area of expertise, sex, age, family relations, family members, offspring, and age of offspring) U-city Service Areas (areas of service, service satisfaction) Additional U-city Service Demands (desired service, improvements, service pursuits, vision to pursue)

<Table 3> Overview of Preliminary Survey of Experts

The current study followed convenience sampling method, choosing professors and researchers at Hanbat University in urban engineering, architecture, space design, computer, and information and communication technology related to U-city project. Convenience sampling method was used in order to obtain data quickly in this exploratory stage of the research. We asked the subjects which areas are the most necessary in the u-City services currently provided, and asked them to rank the answer by importance, from first to third.

The subjects collectively answered that health, medical, and welfare services are the most necessary in U-city services[5], followed by crime and disaster prevention, traffic, facilities management, and environmental services. The collection of answers revealed that the highest ranking area was traffic, followed by crime and disaster prevention, health/medical/welfare, facilities management, and environment, in order. The results were similar to the conclusions made in study in the literature review[6]. The author of that study surveyed twenty-eight experts participating in the u-City project and those in the field of ICT service. Questionnaires were submitted to the experts first, followed by sessions of in-person interview. The experts answered that health/medical/welfare (21%), crime and disaster prevention (21%), traffic (14%), environment (11%), facilities management (11%) are the most necessary in u-city services. The experts also answered that traffic (41%), crime and disaster prevention, facilities management (11%) were managed well, while employment and labor (25%), culture/tourism/sports (19%), education (13%), health/medical/welfare (13%) are not managed. A summary of the results in the current study and the referenced study show that crime and disaster prevention, traffic, health/medical/welfare, and facilities management are seen as important services, while health/medical/welfare needs improvement in terms of vitalization.

In the expert survey, level of satisfaction for each services drawn by literature review was asked. The results showed that U-healthcare, U-parking, smart work system had the highest ratio. U-healthcare is a service enabling health checkup through a wearable bracelet that measures the wearer's health and sends the information to the local clinic. The results reflect the importance of health/medical/welfare services emphasized by the experts in the survey, and that the services were low-achieving and therefore requires more work.

An open-ended question about what other U-City services might be required in the future. The experts suggested various services in detail, including push notification for location of accidents and surveillance

[5] The classification of areas was based on u-city service classification notified by the Ministry of Land, Infrastructure, and Transport.

[6] Hwang Seong-jin et al. Plan for Vitalizing U-city services. KISDI. 2010.

of areas with high crime rates on a data wall. Their suggestions were mostly in the fields of safety, energy conservation, and monitoring. The experts also touched on convenience and entertainment, such as applications that enable users to control objects through ICT.

An additional question on the direction and the vision of residential spaces in the U-city. This keyword was extracted from a literature regarding U-city planning[7] reviewed in the initial phase of the current study. It was chosen in order to plan the direction of the services provided in the Sejong residential U-city experiential district in more detail[8].

In the question about the direction of U-city residential spaces, the answer most frequently given as having the highest priority was safety of the city. The most frequently provided answer overall was convenience and comfort of the city.

The last question was an open-ended one on what other items should be included in the survey of Sejong residents that will be designed to extract required services in the Sejong residential u-city experiential district. Although the response rate for this question was low, the experts suggested that we ask the residents how their life was improved by technological services, and that we conduct the investigation to meet the level of the residents. More research on deducing practical services based on user requirements and user satisfaction of such services will be needed in the future.

The expert survey came to the following conclusions.

First, there need to be programs supporting residents in the areas of health/medical/welfare + crime prevention + traffic.

Second, U-City needs to support eco-friendly service programs for preserving and saving energy, and encouraging existence of humans and the nature. Services that can decrease the burden on the residents by cutting management costs or giving mileage benefits should be considered.

Third, convenience and comfort based on residential safety must be sought after. The U-City must have comfortable spaces and provide services that guarantee the safety and convenience of women and children who use the facilities in the residential district often.

2) User Survey

The additional question that was posed in the expert survey gave rise to the concern that the general public may not have any beforehand knowledge about the concept of a U-city, or have minimal understanding at best. In order to determine the level of satisfaction on the facilities and whether the service is sustainable, the survey asked the users if they would be willing to pay for service costs, needs for the experiential activities in the residential district, and specific usage behaviors in the space. After drafting the overall questions in the survey, the researchers reviewed them for improvements.

The current study obtained subjects by sampling a certain quota of the population living in Sejong; the referred population size was from a statistics by the city government. Surveyors who were trained in the objectives and the contents of the current study visited a test U-city site to survey the subjects, who were people at the test site from 10 A.M. until 6 P.M. between Monday, April 2, 2015 and Sunday, April 5,

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[7] Lee Sang-ho et al. An Analysis of U-City Plan Characteristics. Korea Planners Association. 2008.
[8] Lee Sang-ho, Im Yun-taek. An Analysis of U-City Plan Characteristics. Korea Planners Association. 2008.

2015. The respondents wrote on the survey sheets. A total of one hundred survey sheet were distributed, with 100% retrieval rate, which was achieved because the surveyors collected the sheets on site after the respondents finished writing. In addition, the surveyors observed the test site during the survey time to record the users' space utilization and behaviors.

Item	Category	Detail
	General Demographics	Sex, age, family, occupation
A	Preliminary awareness	U-city awareness Items necessary for the development of U-city Major U-city service areas
B	U-city service area	The respondent's experience with Sejong city webpage Plans to use the Sejong city webpage Usage of major contents in the city webpage
C	Evaluation of pilot space and lifestyle service	Pilot space evaluation with experiential marketing survey items (24 items), 28 digital lifestyle items

<Table 4.> Overview of Survey Form

The survey sheet asked for the respondent's general information, and went on to inquire 1) whether the respondent knew about the U-city, what would be needed for U-city's development, and the respondent's general awareness of U-city, including major U-city services; 2) the respondent's experience with Sejong city webpage, plans to use the webpage, usage of major contents in the city webpage; 3) analysis of experiential marketing in the U-city test site, U-city service demands depending on the ubiquitous users' lifestyle types.

(A) Respondents' General Characteristics

The current study employed quota sampling method, which took a portion of population in Sejong, which was obtained from the city's population statistics. As a result, a total of one hundred respondents were surveyed. More males were in the sample, with 53% being men and 47% women. By age, people in their 50s or up was the plurality at 27%, followed by teenagers at 24%, 12% of people in their 20s, 19% of 30s, and 18% of 40s. By occupation, salaried workers were the most numerous at 33%, with 32% students, 18% self-employed, 10% homemaker, and 7% other.

(B) Analysis of Awareness

The following are the results of inquiry into the level of pre-existing awareness. 65% of the respondents answered "no" when asked whether they knew about the U-city before answering this questionnaire, and only 35% did so. A cross-analysis of U-city awareness was conducted by sample characteristics. 65% of respondents answered "no" when asked about whether they knew about U-city services, and only 35% answered "yes." According to a chi-square test, there was a difference in the level of U-city awareness depending on the respondents' age, household, and occupation.

The survey asked the respondents what are most needed for the U-city to develop further. Because this question was a close-ended one eliciting few subjective responses, it was excluded from the analysis. One overlapping answer was considered as missing, after which 99 responses were analyzed. 35.4% of the respondents answered that “residents’ voluntary participation” is the most important. 24.2% answered “the feasibility of the master plan and its realization” to the question, further followed by 22.2% who answered sustainable model, and 18.2% saying generating new revenues via cooperation between the private sector and the government. There have been a recent rise in residents’ voluntary participation in programs, which in turn create unique local cultures and vitalize communities. It seems that the U-City should consider feasible goals and sustainability which residents can actually use, rather than focusing on the plan itself.

The survey also asked the respondents on what they consider the most necessary service provided in the U-City. Because there were no respondent chose logistics, labor and employment, and other as the answer, they were excluded from the analysis. Overall, crime prevention (29%) was chosen the most, followed by education (21%) and traffic (21%) services. This is understood to be a reflection of heightened awareness of safety caused by a recent surge in violent crimes. Chi-square test revealed that the responses did not have statistical differences by sample characteristics.

In order to deduct services based on communication with the residents, the survey delved into the respondents’ awareness of Sejong city webpage. We configured the questionnaire to set the direction for Sejong U-city service’s integrated operation platform, and to investigate the current level of resident awareness. The question asked whether the respondents have used Sejong city webpage (www.sejong.go.kr). 68% answered “no,” and only 32% have ever used the page. A cross-analysis of Sejong homepage usage experience by conducted by sample characteristics. According to the chi-square test, only the differences in response by age was statistically significant.

The survey sheet further asked the 32 respondents who have used the city webpage about their objectives in accessing the site. 43.8% the positive respondents answered that they reached the site to receive civil affairs services. There was no statistically significant difference by sample characteristics.

Future plans to use the webpage was asked to the respondents; the goal of the question was to understand the residents’ level of interest in creating a city webpage for communication with the residents. 59.6% of all of the respondents answered “yes,” which displayed a positive tone in using the city webpage. A chi-square test gave a value $p=<0.05$ for age, indicating that it was a statistically significant factor.

We asked the respondents what contents they consider important among the ones provided in the city webpage. Excluding two cases of a non-answer and an overlapping answer, 37.8% of all respondents said that civil affairs services were the most important contents. This was followed administration, public data, and other public information retrieval, at 30.6%. The answers about future plans to use the webpage displayed the same pattern as the answers about objectives for using the webpage: when configuring a platform for the residents in the future, there will be a need to provide civil affairs services online so that the users are not restricted by time, or encourage the residents to voluntarily participate by using open source data. A chi-square test resulted $x^2=17.391$, $df=8$, $P=.026$, indicating that household configuration was statistically significant in differences in the given answers.

(C) Evaluation of U-Special Zone through Experiential Marketing Scale

The survey had questions to analyze experiential marketing factors in the U-City test site. 24 questions on a 5-point Likert Scale was posed to the respondents.

Q	Description	Q	Description
1	This place makes me happy.	13	I think the atmosphere here suits me.
2	This place makes me feel good.	14	I think the people who visit this place would go well with me.
3	This place makes me feel comfortable.	15	This place clearly expresses the emotions and images of local community.
4	I am excited because I feel like I am experiencing something new before others.	16	I can experience various things in this place.
5	This place emotionally stimulates me.	17	I can understand the local community more easily in this place.
6	This place makes me feel the energy.	18	I can experience a new lifestyle in this place.
7	This place makes me feel different.	19	The appearance of architectural structures here (shapes, scale, etc) stimulates my five sense.
8	I want to visit this place and take a picture.	20	The streetside facilities (light, fence, etc) here stimulate my five senses.
9	I want to share what I have experienced here.	21	The public signs (sign boards, advertisements, etc) here stimulate my five senses.
10	I want to come in here when I see this place from outside.	22	The lighting here stimulates my five senses.
11	This place brings a change to my life.	23	The fragrance here (atmosphere, fragrance in facilities) stimulates my five senses.
12	I want to use the facilities in this place.	24	The colors (architectural structures, environment) here stimulate my five senses.

<Table 5> Pilot Space Experiential Marketing Evaluation Items

In order to determine whether the sample data is adequate, we used KMO Scale and Bartlett's test of sphericity to test the sample data. Because KMO value was higher than 0.5 at 0.875, and significance probability was 0.000, we determined that the correlation between the variables is statistically significant.

The Standard type of propriety of Kaiser-Meyer-Olkin measurement.		.875
Bartlett's test of sphericity	Chi-Square Approximation	1578.133
	Degree of Freedom	276
	Significance Probability	.000

<Table 6> KMO and Bartlett's test for the evaluation of pilot space

With 24 measurement items serving as a basis, we conducted principal component analysis and varimax factor analysis. With the inherent value of 1 or higher as the criterion, five factor were extracted. Factor 1 was shown to have the highest explanatory power, with 16.845%. Factor 2 explained 16.407%, factor 3 13.245%, factor 4 11.949%, and factor 5 9.853% of the variables, and overall aggregate was 68.299%.

Factors	Eigenvalue	Percentage Variance	Cumulative Percentage
1	4.043	16.845	16.845
2	3.938	16.407	33.251
3	3.179	13.245	46.496
4	2.868	11.949	58.445
5	2.365	9.853	68.299

<Table 7> Eigenvalue of major component analysis and Verimax factor analysis for the evaluation of pilot space

Factor loading by measured items were all 0.3 or higher and statistically significant. In order to define evaluation of U-City test site by the respondents in similar types, we conducted factor analysis. As a result, we obtained factors different from five experiential marketing factors suggested by Schimitt (2006). According to the survey questions, we named factor 1 emotional service, factor 2 relationship and identification, factor 3 physical environment, factor 4 experiential value, and factor 5 sensory stimulation.

In order to verify reliability of measurement items for evaluation the test site, we conducted Cronbach's alpha test. All reliability coefficients were 0.7 or higher, indicating that the measurement tool had a high consistency.

With the five factors drawn from the factor analysis, average value of each measured items were compared with each other. Emotional service had 3.19 points, relationship and identification 3.04, physical environment 2.85, experiential values 2.79, and sensory service had 2.65 points. Considering that the respondents in this survey were residents who have visited the U-city test site, the familiarity and comfort offered by the space near their residence is analyzed to have positively influenced emotional service factor or relationship and identification factor. In contrast, physical environment, experiential values, and sensory stimulation factors were relatively negatively evaluated. As revealed in the visit to the test site, there is a need for redesign in sidewalk facilities into ones that can induce new experiences.

Factor	measured items	Question	Average Value	Standard Deviation	Variance
1	C1_1	emotional service	3.39	.963	.927
	C1_2		3.33	1.025	1.052
	C1_3		3.38	1.033	1.066
	C1_6		2.90	1.133	1.283
	C1_7		3.03	1.193	1.423
	C1_13		3.10	.990	.980
			3.19	1.06	1.12
2	C1_11	relationship and identification	2.81	1.125	1.267
	C1_12		3.49	1.02	1.04
	C1_14		2.98	1.005	1.01
	C1_15		3.13	1.031	1.064
	C1_16		2.95	0.989	0.977
	C1_17		3.04	1.004	1.008
	C1_18		2.96	1.082	1.17
	C1_20		2.94	1.023	1.047
3	C1_19	physical environment	2.96	1.053	1.109
	C1_21		2.79	0.967	0.935
	C1_22		2.86	0.964	0.93
	C1_24		2.77	1.004	1.007
			2.85	1.00	1.00
4	C1_8	experiential value	2.7	1.159	1.343
	C1_9		2.78	1.031	1.062
	C1_10		2.9	1.078	1.162
			2.79	1.09	1.19
5	C1_4	sensory service	2.67	1.101	1.213
	C1_5		2.65	0.978	0.957
	C1_23		2.62	0.993	0.985
			2.65	1.02	1.05

		3.04	1.03	1.07

<Table 8> Comparison of average values of factor analysis items for the evaluation of pilot space.

(D) Analysis of Ubiquitous Lifestyle

28 questions were configured to understand the demand for U-city services based on the users' ubiquitous lifestyle types.

In order to test the reliability of measured items, Cronbach's alpha test was conducted. Overall reliability coefficient was 0.875, and each measured item had a value of 0.7 or higher, indicating a high consistency of the measurement item. The sample data was verified using the KMO scale and Bartlett's test of sphericity. Factor loading in the measured items were all 0.5 or higher except for item 25 (0.490); the said item was excluded before continuing with the analysis. As a result, eight factors was extracted. KMO value was higher than 0.5, at 0.729, and significance probability was 0.000, indicating that the correlation between the variables was statistically significant.

The Standard type of propriety of Kaiser-Meyer-Olkin measurement.		.729
Bartlett's test of sphericity	Chi-Square Approximation	1237.907
	Degree of Freedom	351
	Significance Probability	.000

<Table 9> KMO and Bartlett's test for Ubiquitous lifestyle

Based on the 27 measured items excluding item 25, we conducted principal component analysis and varimax factor analysis. The overall explanatory power was 70.447%.

In order to define the respondents' lifestyle by type, we conducted factor analysis. Factor 1 was named self-development, factor 2 digital daily life, factor 3 relationship-oriented, factor 4 family-centric, factor 5 digital family exchange, factor 6 convenience-seeking, factor 7 eco-friendly-seeking, and factor 8 interest in health.

Factors	Eigenvalue	Percentage Variance	Cumulative Percentage
1	2.904	10.755	10.755
2	2.670	9.890	20.645
3	2.576	9.542	30.187
4	2.571	9.522	39.709
5	2.210	8.187	47.897
6	2.193	8.122	56.018
7	2.013	7.455	63.473
8	1.883	6.974	70.447

<Table 10> Eigenvalue of major component analysis and Verimax factor analysis for Ubiquitous lifestyle

Based on the eight factors extracted from the factor analysis, each measured items were compared for the average value. Self-development scored 3.72, digital daily life 3.35, relationship-oriented 3.38, family-centric 4.00, digital family exchange 3.21, convenience-seeking 3.33, eco-friendly-seeking 3.59, and interest in health had 3.37 points. As in the primary comparison of average values of each item, the respondents sought a lifestyle with an emphasis on family life. This was followed by self-development or seeking for eco-friendly lifestyle. All measured items had a score of 3 or higher, indicating that the respondents answered more positively than not.

Factor	measured items	Question	Average Value	Standard Deviation	Variance
1	C2_21	self-development	3.87	1.060	1.124
	C2_19		3.55	1.048	1.098
	C2_18		3.86	1.005	1.011
	C2_20		3.60	1.005	1.010
			3.72	1.03	1.06
2	C2_5	digital daily life	2.82	1.104	1.220
	C2_6		3.37	1.070	1.145
	C2_8		3.67	1.045	1.092
	C2_7		3.55	1.048	1.098
			3.35	1.07	1.14
3	C2_10	relationship-oriented	3.33	1.264	1.597
	C2_11		3.4	1.119	1.253
	C2_9		3.42	0.991	0.981
			3.38	1.12	1.28
4	C2_13	family-centric	4.23	1.008	1.017
	C2_12		4.03	1.087	1.181
	C2_14		3.73	1.033	1.068
			4.00	1.04	1.09
5	C2_16	digital family exchanged	3.40	1.035	1.071
	C2_17		3.11	1.109	1.230
	C2_15		3.12	1.037	1.076
			3.21	1.06	1.13
6	C2_2	conveniece-seeking	3.05	1.553	2.412
	C2_1		3.37	1.468	2.155
	C2_3		3.65	1.149	1.321
	C2_4		3.26	1.088	1.184
			3.33	1.31	1.77
7	C2_23	eco-friendly-seeking	3.74	.860	.740
	C2_24		3.54	.915	.837
	C2_22		3.49	.948	.899
			3.59	.91	.83
8	C2_26	interest in health	3.57	1.281	1.642
	C2_28		3.33	1.240	1.536
	C2_27		3.20	1.295	1.677
			3.37	1.27	1.62

<Table 11> Comparison of means of factor analysis items for categorization of Ubiquitous lifestyle

According to an analysis of variance by sample characteristics in items extracted from the factor analysis, there were no differences between groups. Cluster analysis was conducted in order to classify the eight factor items into similar clusters. Because each sample characteristics did not show large differences, we conducted a cluster analysis to typify the respondents. Such work can be helpful in suggesting a direction for the concept of services offered in the U-City test site. There is a controversy on what is the adequate number of clusters in cluster analysis (Joseph F. Hair, 1987, p.305), and the current study chose to conduct cluster analysis with three to five clusters and chose the case that had the highest hit ratio[9]. The result showed that the ratio was highest with 95.9% when there were four clusters. With four clusters, however, there were only three cases in a cluster, which was not an adequate number to typify. As such, the current study decided to create three clusters of 30, 33, and 35 cases to analyze their characteristics.

Determining the number of clusters	Hit Ratio(%)
3	94.9%
4	95.9%
5	90.8%

<Table 12> Determining the number of clusters

The values of factors extracted from the factor analysis and cluster types were put under an analysis of variance. Factors displaying significance probability of 0.05 or higher and not having statically significant differences between clusters were digital daily life and convenience-seeking. Cluster 1 was interested in health, used digital technologies to form relationship with others, but relatively lacked exchange or activity with family. Cluster who was highly interested in self-development and sought eco-friendly lifestyle and was relatively interested in health, but did not show interest in exchange with others or family using digital technologies. Cluster 3 was interested in exchange with others or family activities, but less so on eco-friendly lifestyle or health.

Classification		Cluster 1	Cluster 2	Cluster 3	F	Significance Probability
1	self-development	-1.36782	0.5906	-0.00212	23.623	0
2	digital daily life	0.03739	0.35172	-0.17753	2.75	0.069
3	relationship-oriented	0.01704	-0.75351	0.36024	15.126	0
4	family-centric	-0.52863	-0.15668	0.18501	3.146	0.048
5	digital family exchanged	-0.71518	-0.06696	0.18029	4.356	0.015
6	conveniece-seeking	0.11944	-0.05291	0.00083	0.123	0.885
7	eco-friendly-seeking	-0.06163	0.73256	-0.3409	13.78	0
8	interest in health	0.80741	0.15533	-0.24204	6.64	0.002

<Table 13> Factor analysis value and analysis of variance of groups

The following are typified cluster characteristics.

Type	Lifestyle	Characteristics
Cluster 1	Health	Interested in health; uses digital for social relationships, but relatively lacks exchange or activities with family.
Cluster 2	Self-development	Interested in self-development and pursues eco-friendly lifestyle; somewhat interested in health, but lacks interests in exchange with others through digital or activities with family.
Cluster 3	Social	Interested in exchange with others or activities with family, but lacks interests in eco-friendly life or health.

<Table 14> Categorization of Lifestyle by Characteristics of Groups

[9] Lee, Ji-yeol. A Research of Lifestyle to Create Department Store Marketing Strategies. Yonsei University Master's Thesis. 1989.

A cross-analysis of each cluster was conducted by sample characteristics. People in their 50s or higher had the highest proportion in cluster 1, the health-seekers; cluster 2, self-development, was composed the highest of 40s and 50s; teenagers had the overwhelming proportion in cluster 3, those who focus on relationships.

Chi-Square 26.659 Degree of Freedom 8 Significance Probability 0.01

			Age					Total
			Under 20s	20s	30s	40s	Over 50s	
Cluster of case number	1	Frequency	5	5	7	5	8	30
		Percent of cluster of case number	16.7%	16.7%	23.3%	16.7%	26.7%	100.0%
	2	Frequency	4	1	3	12	13	33
		Percent of cluster of case number	12.1%	3.0%	9.1%	36.4%	39.4%	100.0%
	3	Frequency	15	6	7	1	6	35
		Percent of cluster of case number	42.9%	17.1%	20.0%	2.9%	17.1%	100.0%
Total		Frequency	24	12	17	18	27	98
		Percent of cluster of case number	24.5%	12.2%	17.3%	18.4%	27.6%	100.0%

<Table 15> Comparison of ages of groups

By occupation, salaried office workers were the group with the highest proportion in cluster 1, with self-developer cluster, cluster 2, dominated by salaried workers and self-employed people, and cluster 3 with people putting importance on relationships was populated mostly by students.

Chi-Square 18.493 Degree of Freedom 8 Significance Probability 0.018

			Occupational Cluster					Total
			Salaried office worker	Student	Etc.	Self-employed	Housewife	
Cluster of case number	1	Frequency	15	7	2	4	2	30
		Percent of cluster of case number	50.0%	23.3%	6.7%	13.3%	6.7%	100.0%
	2	Frequency	9	6	4	10	4	33
		Percent of cluster of case number	27.3%	18.2%	12.1%	30.3%	12.1%	100.0%
	3	Frequency	8	19	1	4	3	35
		Percent of cluster of case number	22.9%	54.3%	2.9%	11.4%	8.6%	100.0%
Total		Frequency	32	32	7	18	9	98
		Percent of cluster of case number	32.7%	32.7%	7.1%	18.4%	9.2%	100.0%

<Table 16> Comparison of occupations of groups

The result of analysis of variance on experiential marketing on U-City test site showed that cluster 1 answered positively to all items, while cluster 3 showing negativity. Experiential values was especially negative.

Classification		Cluster1	Cluster2	Cluster3	F	Significance Probability
1	emotional service	0.504476	-0.09372	-0.34838	6.732	0.002
2	digital daily life	0.457053	-0.1001	-0.28365	5	0.009
3	physical environment	0.433995	-0.11656	-0.26074	4.474	0.014
4	experiential value	0.491173	0.022219	-0.45557	8.195	0.001
5	sensory service	0.396377	-0.00464	-0.34814	4.764	0.011

<Table 17> Comparison of pilot space evaluation by type of Ubiquitous lifestyle

4. Conclusion and Future Research Topics

The current study analyzed cases of ICT-based urban communities. In addition, experts and users were surveyed to extract the direction of service in residential U-city experiential district. The result of the analysis is as follows:

First, case analysis revealed that there was a lack of direct experience, with aesthetic elements reflected in the resident community facilities or community characteristics being made apparent. In contrast, there were many cases in which the resident community institutions gave the residents a sense of community, under which they could participate and communicate.

Second, the respondents answered that they are interested in crime prevention, education, and cultural services.

Third, the respondents pointed to voluntary participation of the residents when asked about what could be improved to further develop U-city. This indicates the need for a space in which they can voluntarily and consistently participate in the community. Rather than a service "provided" by the government or institutions, there is a need for a service in which the user can proactively use information. That is, a service that induces new experience or specific activity is required, along with service and design that can lead the user to such experience.

Fourth, three clusters of health-seekers, self-developers, and relationship-centrics were identified as demand types in the U-city lifestyle in terms of experiential marketing. There is a need for services that can support such lifestyles. Health-seekers may be supported by services that preserve energy through or eco-friendly service programs, which were also suggested in the expert survey. Services that cut management costs or those that can reduce resident cost burden through mileage benefits may be considered. For people who focus on relationships, family-friendly services may be proposed. They were shown to use digital technologies to maintain relationship with others, but lacking in exchanges with family members. But considering their high interest in family-centric lifestyle, they may utilize spatial programs that can induce exchange between families.

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Acknowledgement

This research was supported by a grant(13AUDP-B070066-01) from Architecture & Urban Development Research Program funded by Ministry of Land, Infrastructure and Transport of Korean government.

Can ICTs Contribute to Urban Renewal for Declined Cites?

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ABSTRACT
Urban spaces are becoming intelligent very rapidly. Without the charming terms to call these kinds of cities, IT infrastructures and devices are spreading from the center to the end of urban areas. However, lots of urban places over the whole world have declined and are becoming slum at the same time. In this paper, global trends of the development of ICTs-base urban planning and development in EU countries and Korea were investigated. Together with this, we groped the way on which the state-of-art technologies play a core role to overcome the current urban phenomenon.
At first, ICTs-based urban planning and development theories and practices were listed and philosophy and strategies of these ideas were reviewed. Concepts of IT-based urban planning and management – e-City, ubiquitous city, pervasive space and smart city - and national or regional strategies such as INTELCITY Roadmap (Curwell & Hamilton, 2003) were investigated. Both in EU and Korea, living, working, recreation and transportation (including communication) were the most important aspect to be considered in the usage of ICTs in urban region. Even they are pursuing the balance, communication and sharing via ICTs (Lee et. al., 2008), the implementation in each projects shows different aspects.
As a case study, 3 projects in EU including Zaragoza, Spain, Arabianranta Verkkolehti in Helsinki, Finland and 22@Barcelona, Spain were analyzed while 3 cities of Busan, Anyang and Youngju in Korea. The situation of deprivation of the place, goal and strategy of each project are descripted. For the projects where the planning was implemented, the impact of the ICTs-based planning was described simultaneously. In European countries, representative characteristics of each place were emphasized by ICTs; culture in Arabianranta or high-technology in Cross-roads. However, comprehensive planning to revitalize a certain declined area in the cities were common solutions in Korea.

For the policy suggestion, the effect of ICTs-base urban planning and process to evaluate current situation, select suitable technologies and services, plan and design urban spaces for their own goal and manage them as a part of urban system were discussed briefly.

Keywords: ICTs, Urban Renewal, Declining City, EU, Korea

1. INTRODUCTION

They say that two mainstreams in urban planning are information and urban renewal.

Along with the development of ICTs, strategies to provide IT infrastructure such as IntelCity Roadmap (2003) by EC were suggested in EU countries while Asian countries build integrated systems which were applied to physical and administration sectors such as E-government in Korea. Recently this trend shows IT-based urban spaces which ranges from intelligent homes to u-city or smart cities.

In spite of development of space embedded high-technologies, some areas of many cities in the world are lagged behind. Declined areas are emerged as quickly as the speed of the progress of high technology. This global phenomenon requires more effective urban renewal strategies in many countries in the world. Until recent years, these two urban trends were considered as different matters. However some projects in European countries and Korea involved ICTs for urban regeneration or renewal. Authors are focused on this kind of works as a conspicuous issue in urban planning and management. If ICTs exist to improve the quality of lives, it should be adapted to the urban renewal from the whole urban scale to each of the people who lives in the declined urban area.

In this paper, global trends of the development of ICTs-base urban planning and regeneration in EU countries and Korea were investigated. Together with this, we grouped the way on which the state-of-art technologies play a core role to overcome the current urban phenomenon.

2. LITERATURE REVIEW

2.1 ICTs for Urban Planning and Urban Regeneration

Along with the development of ICTs, technology and spaces have mutually influenced for long time. European Committee(2003) announced a roadmap of urban development together with ICTs toward knowledge society and sustainable society in smart cities. ICTs have changed the role of planning and design and this also has changed along with time (Drewe, 2005).

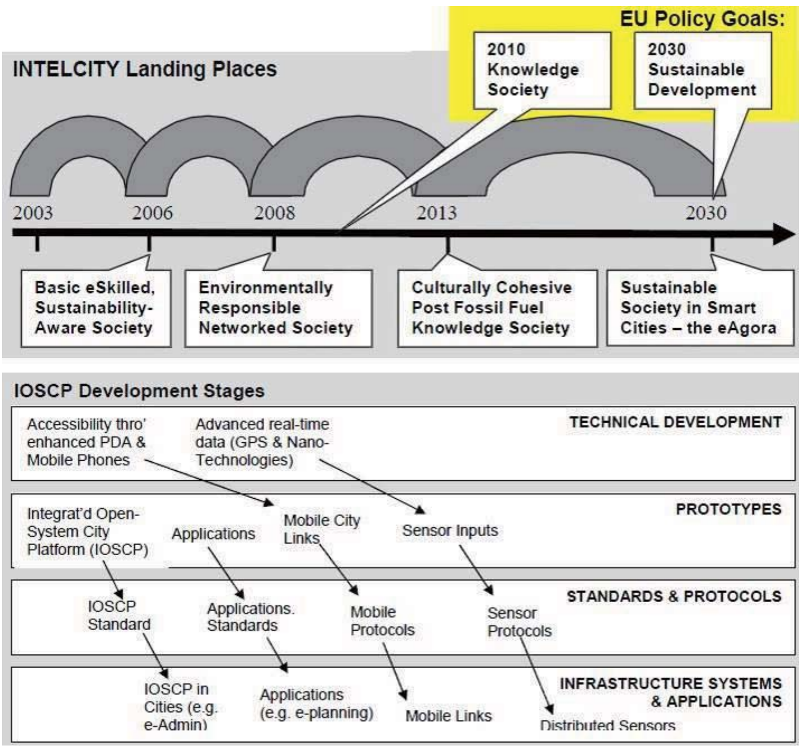

Fig. 1: Intelcity Roadmap (Curwell & Hamilton, 2003)

It was the early 21st century when ICTs were involved to urban regeneration. On-line interactive system was adapted to GIS research for public participation (Kingston et. al., 2005). Private companies who deal with ICTs also paid attention to urban regeneration as a key player to create, maintain and support the regeneration of new and existing communities (Rout, 2006) and suggested technical solutions for old problems (Green, 2011). They tried to provide a communication platform which suppresses a barrier of non- professionalism and IT applications such as PPGIS (Participatory Planning GIS), 3D models and computer games (Hanzl, 2007).

Analysis of urban regeneration works and integrated projects were assessed and reviewed helped by ICTs. Agent-based model can assess the impact of ICTs in urban regeneration (Jordan et. al, 2014) and kinds of industry which are more effective when they involve ICTs were analyzed (Jeong et. al., 2010). In recent years, problems and further considerations on ICTs' involvement to urban regeneration such as digital divide or information access are discussed as well.

2.2 Introduction and Analysis of ICTs-based Urban Regeneration

Along with ICTs, urban regeneration projects which are directed to knowledge intensive societies and economies were emerged over the world. Especially in European countries, they pursued urban (re)development to unleash the concealed or internal economic potential of cities and districts. Arayici (2014) introduced knowledge intensive regeneration project for ideopolises in the world and deeply analyzed Mediacity project in Manchester, UK. Da Chiara & Selada (2009) also studied some urban regeneration cases with creativity – it was called to iHubs. Including the processes, they distilled best practices for the design and planning of the intelligent spaces. Caragliu et. al. (2009) listed smart cities in Europe to urge that urban performance is rely on human and social capital than physical capital.

Urban regeneration cases with ICTs which were analyzed in this paper were also dealt with in independent studies from the unique sight. Ayuntamiento Zaragoza (2012) prepared comprehensive urban strategy based on ICTs which embraces Milla Digital project. Some critical comments on the ICTs involved urban regeneration projects (Duarte & Sabate, 2013; March & Ribera-Fumaz, 2014).

3. ICTs FOR URBAN REGENERATION IN EC COUNTRIES

3.1 Milla Digital, Zaragoza, Spain – Digital Miles Projects

Zaragoza is a city located in Aragon, the Northeastern Spain which has plenty of historical and artistic heritages. During the economic recession in Spain, they decided to transform the old city to a future-leading urban place in Spain on the occasion of the arrival of the high-speed train to Zaragoza. The urban transformations that will take place in the areas around the former "El Portillo" station and the new "Delicias" station constitute an opportunity to develop an innovative technological-urban development project: Milla Digital. Milla Digital will make use of the spaces of both the areas developed to configure a **City of Innovation and Knowledge**, where housing, companies and facilities will exist together under a common orientation fully engaged in knowledge-intensive activities, an urban development of great quality and advanced telecommunications infrastructures which both the residents and the businesses located in the Milla will benefit from. Milla Digital is a basic project of Zaragoza City Council to help companies, institutions and citizens position themselves to form part of the economic and social means of the 21st century.

The goal of Milla Digital Project was to integrate urban place and ICTs to let the old town to become a vivid and prosperous area. Through the provision of urban infrastructure and supports to invite new companies, the city intended to create 4,000 ~ 5,000 jobs and finally to provide innovative information services to all citizen in everyday life.

Portillo, Almozara and Rivergate area were planned with physical and digital factors and a media street was designed to connect 3 event spaces. Water wall, digital bus stops, memory paving, urban pixels (LED lighting), digital façade and displays, digital awnings and smart parking system were allocated to place and place to improve urban landscapes and activities (http://www.milladigital.es/ingles/09_urbanDigital.php).

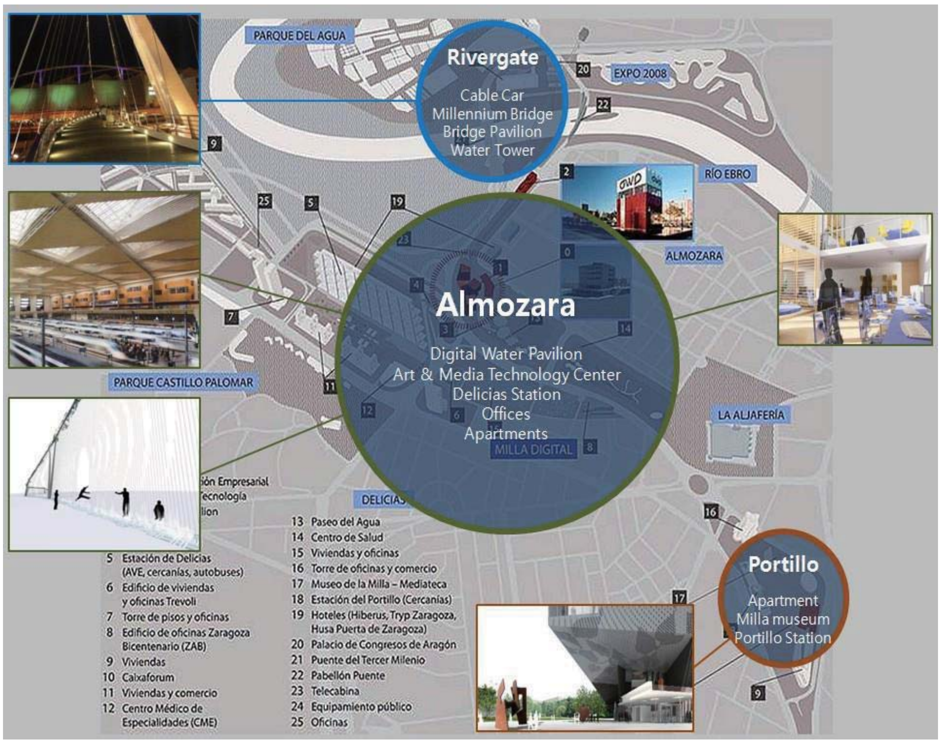

Fig. 1: Master plan of Milla Digital, Zaragoza, Spain

3.2 Arabianlanta, Helsinki, Finland

Helsinki experienced a rapid population growth and shortage of housing and industrial facilities as its consequence. By the urban planning implemented from 1990, Arabianlanta was one of the most focused area where can make Helsinki to be European design and culture hub. A declined urban fringe at one time there were the biggest porcelain factories in Europe was changed to a high technology equipped area. Moving of the University of Art and Design in 1986 and Pop&Jazz Conservatory in 1995, this area aims to assemble the leading center of art and design in the Baltic Sea region.

On the basis of IT infrastructure, they connected all offices, shops, school and universities and houses via internet and wireless communication to be a cyber village (www.helsinkivirtualvillage.fi). Digitally prominent spaces such as Helsinki Living Lab which is composed of network facility, future home and artistic façade were designed and developed while analogue spaces where were digitally supported and serviced. Especially the street and public places were planned to encourage urban mutual activities, Street Sociability.

Most of all, this area promoted companies located inside and outside the Arabianlanta. By the internet, IP telephone, Lan & Wan service, R&D in universities and high level livability can support private companies. As a result, Arabianlanta was embossed its own cultural characteristics via ICTs and became more competitive region regenerated from recessed urban area.

3.3 22@BCN, Barcelona, Spain

In the year of 2000, City Council of Barcelona made decision to develop an old industrial area where covered with obsolete factories and slum housing. This project was intended to transform two hundred hectares of industrial land of Poblenou into an innovative district offering modern spaces for the strategic concentration of intensive knowledge-based activities. This initiative is also a project of urban refurbishment and a new model of city providing a response to the challenges posed by the knowledge-based society (http://www.22barcelona.com/content/blogcategory/49/280/lang,en/). Besides of physical planning to provide public spaces, housing, education and industry related facilities, they allocated media, energy, bio and ICT industry related facilities and supporting organizations. This project also provided intensive infrastructure for the urban regeneration. It pursued 3 kinds of innovations; urban, economic and social. As urban innovations, district segmentation with the consideration of urban activities and industrial location for economic innovation was drawn. For social innovation, human and cyber communication was stressed as a locomotive to be an innovation creator.

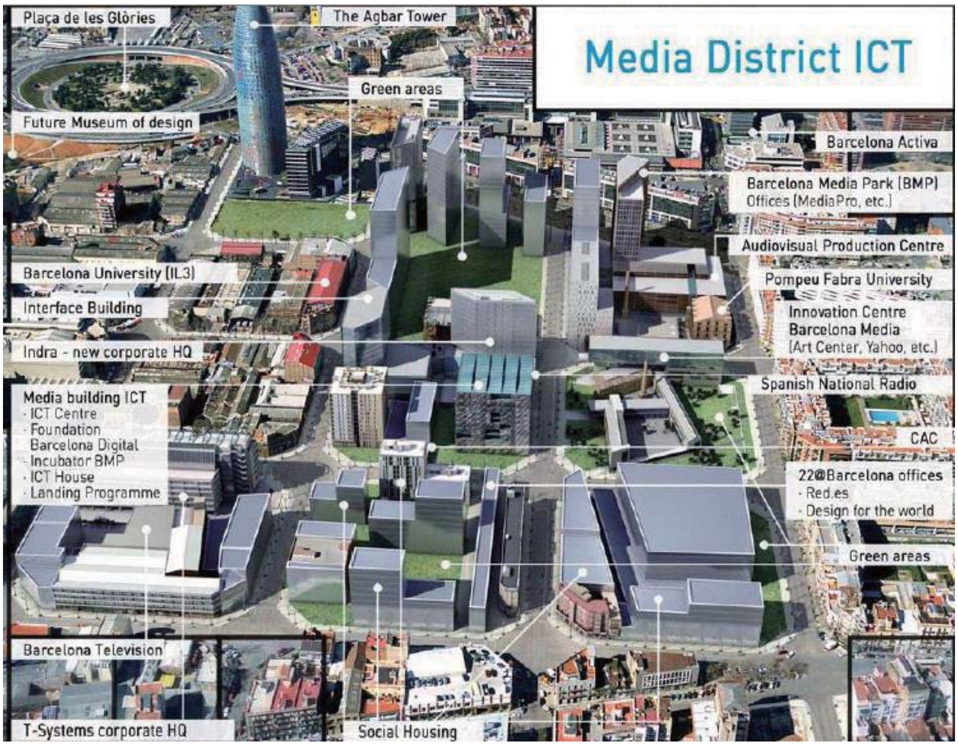

Fig. 2: 22@BCN, Barcelona, Spain

Urban infrastructures were very intensively implemented in this area to activate the declined area to be an industrial center of a Mediterranean city. Table 1 shows the infrastructure supplied to 22@BCN especially for companies and residents.

Table 1: Infrastructure in 22@BCN

	Infrastructure Services
Energy	Gas, Electricity, HVAC, Sun light
Water	Water supply, Sewage network
Communication	Cable network, Wi-Fi, Radio communication system

Waste	Waste collection and treatment system
Mobility	Public transportation

4. ICTs FOR URBAN REGENERATION IN KOREA

4.1 Busan; A Major Factor of Urban Regeneration Project

In Korea, urban regeneration became one of the most important urban planning issues in recent decades. After effectuation of a law to support urban regeneration, Korean government had advertised for local governments who want to compete for urban regeneration. Busan, the 2nd largest city in Korea, has had suffered serious urban decay from the end of 20th century. Busan won the competition and got government subsidy by a proposal to regenerate the high-speed rail station and its adjacent slum areas. Before this proposal, Busan prepared "U-City Comprehensive Plan" in 2012 and ICTs were adopted to play an important role to regenerate declined area and it also included the proposal for the past hearts of the city.

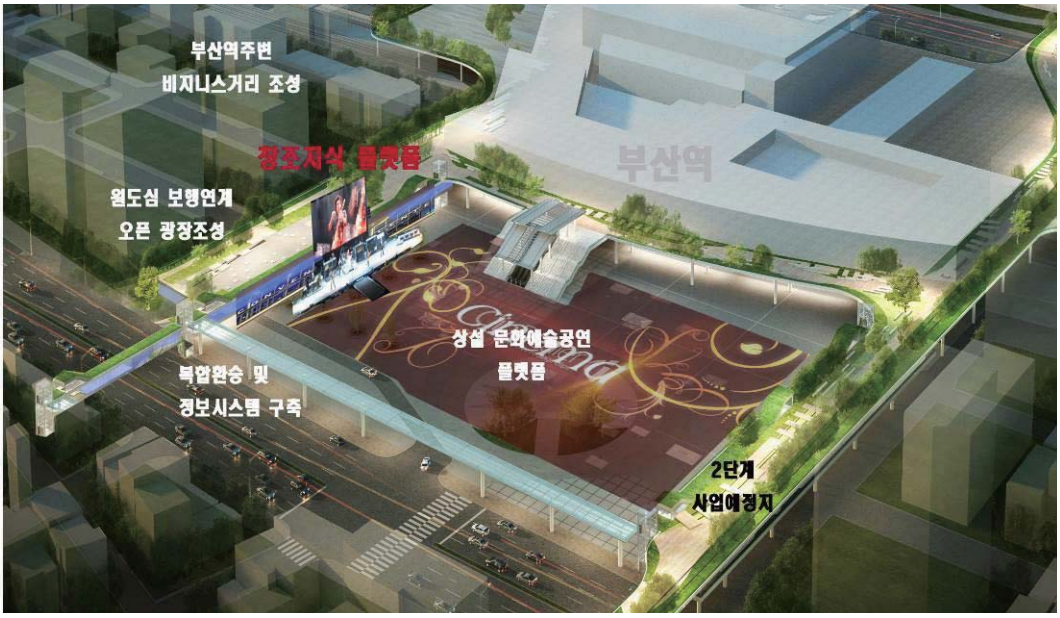

Fig. 3: Creative knowledge platform for Busan station area regeneration, Busan, Korea

This proposal is composed of 3 platforms; Creative knowledge, Culture and tourism, and Living and welfare. For creative knowledge, ICTs support business and transportation. It is also expected to help the activation of culture and tourism using AR and other high technology. Even though there is digital divide problem, the city also invited ICTs to the welfare programs for the poor. They expected ICTs can play core roles to connect the gate, business and living places of the city.

4.2 Anyang; Linking Urban Facilities to Revitalize CBD

Anyang is a representative satellite city in Korea which shares its border with Seoul, one of the world cities with 10 million of population. The CBD of the city is also in decline while the other side of the city is under new development.

Urban engineers of the city paid attention to the CCTVs provided by each division for their own purpose. Like other cities, the CCTVs are operated for ITS (intelligent transportation system), security surveillances especially around the children's safety zone, illegal parking, bus-only lane violation and other objects (Leem et al., 2014). They integrated and connected each CCTVs to a control system. This system shows CCTV networks for crime prevention, traffic control and public facility management to provide extended urban services, such as disaster prevention, police investigation and others.

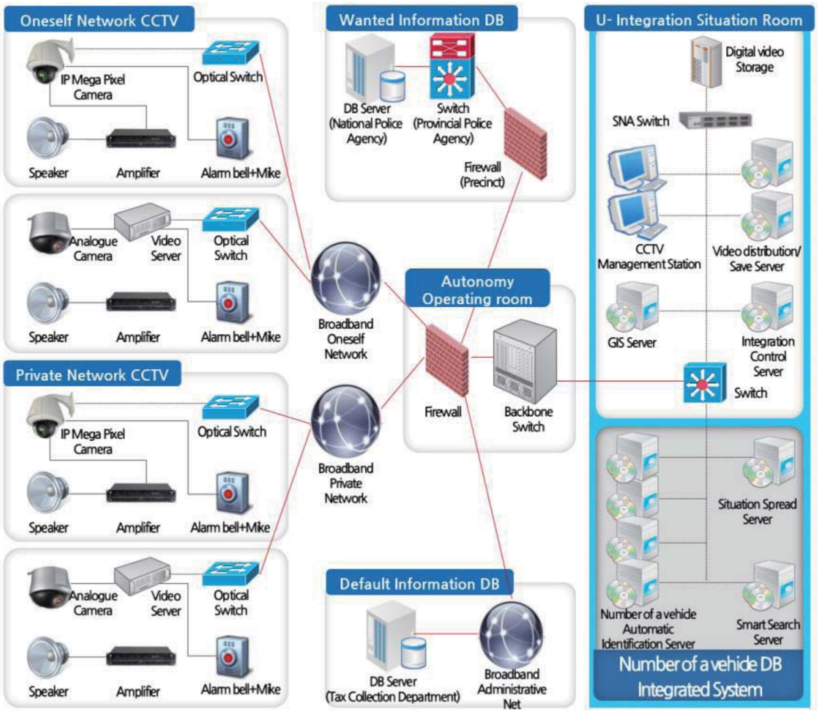

Fig. 4: Structure of Integrated System for Imagery Data Sharing in Anyang city

Source: Leem et. al, 2014

Not only linkage of CCTVs between urban agencies, but also administrative sharing of data enhanced the work efficiency of the city government. For example, CCTV imagery data caught by ITS CCTVs recognize the car plate numbers and if it were listed on the crime suspects, immediately sent to police officers to verify the location of the suspects. Similar data sharing is being done between police, ITS agency and tax office.

By qualitative and quantitative effects analyses, it was revealed that integration of ICTs system contributed to the enhancement of urban living especially in declined area. For 3 years 9,636 image data which contained the number plate photos were handed over to the police agency and 177 suspects were arrested due to such cooperation between the agencies. Other image data sent to the local tax office also helped to solve the nonpayment of taxes problems. From June 2012 to November 2013, 453 times of alert were sent to the tax office from the U-City Control Center (Leem et. al., 2014).

4.3 Youngju; Transforming Old Market to a Community Center

Even though located at the heart of the rural region, Youngju has its name as a historical and cultural center of northern Gyeongsangbuk-do Province. This old city has been an intersection point of railroads and collection and distribution center of agricultural products of surrounding areas. During the industrialization of Korea, same as almost of rural cities, Youngju also experienced the steep decline of rural economy with the rapid decrease in population.

As a trigger of urban regeneration, Husaeng market was selected to be planned. This 80 years old chilly market which is composed of wooden 2 story buildings is losing its function day by day. ICTs were adopted in two purposes; one is to prevent fire disaster and another is to re-vitalize the landscape of past and future. After analysis of the current situation and building goals, Creation of U-Husaeng Community, services and physical planning were designed in 3 ways. At first, history and culture rehabilitation works were suggested. Safer space was built from fire using sensors and alarming system. Finally public participation and communication spaces were provided both in physical and cyber space.

Fig. 5: Images of Husaeng market project in Youngju city, Korea

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This project was implemented on the subsidy from central government and local government in 2014. By the project, the utility of residents, visitors and tourists are expected to be upgraded and the physical condition of urban area also improved.

5. DISCUSSIONS

In this paper, 3 European urban regeneration projects were introduced and analyzed and 3 projects in Korea as well. On the basis of the long range vision such as Intelcity Roadmap, most of European projects were required to be a urban locomotives to lead the city to a knowledge society. Together with the preparation of physical infrastructure, they tried to find clues which can be connected to grand vision; manufacturing and design of Arabianlanta, Helsinki and history with culture of Milla Digital, Zaragoza. After then, they aggressively tried to invite universities and companies to the site and the infrastructure and living environment could be good incentives for the researchers and other employees.

In Korea, on the foundation of world best IT infrastructure, site-based planning and design of the projects are more general. Busan station area project was focused on the cross point of high-speed rail and international ferry and Youngju Husaeng Market project was declined market itself as well. These points of view can lead the project itself to the goal while very easily fail to be an innovation hub of the city or region. The example of Anayang city shows that possibility to link urban facilities such as CCTVs and the exchange data between agencies to increase urban competitiveness. However, it also should be prepared comprehensive strategy and planning for efficiency and other critics.

As a conclusion, ICTs are revealed to be very effective and efficient tools for urban regeneration. However, it should be adopted under the grand vision of the place and considered together with information infrastructure and social and cultural situation as well.

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Location allocation and use characteristics of bounded carsharing service for urban public housing residents

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ABSTRACT

Research practices and the introduction of the shared transport have been performed in recent year. Carsharing service locations have been arranged unspecified customers to easily access a location. However, the car-sharing service in this study enforced through the agreement of the residents within the House of Commons is operated as a closed service that the user is limited to public housing residents. This closed carsharing service in the House of Commons is different from the typical car sharing. Users return a carsharing vehicle to the same parking location after using it. In addition, the general carsharing locations are determined based on the profit of the service operator and the service can be stopped because there are plenty of other alternatives for mobile. However, if the closed carsharing service in the House of Commons is designated canceled, there is no other alternative for existing users. Therefore, site selection for the initial introduction of the House of Commons in a closed carsharing service is a very important issue. This study used one month data of 22 complexes for location analysis of the closed carsharing services to public housing residents in urban areas. In order to analyze the relevance of the presence and use characteristics of the carsharing service, we considered transit supply characteristics of the target area, public relations and marketing, user income, regional differences as the main variables. On the basis of the regression analysis result, the number of households was adopted as an effective variable.

Keyword: carsharing, big data, location allocation of public service

How Does IT(Information Technology) and ET(Environment Technology) Makes New Innovative Urban and Architecture Model

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SangHo Lee
(Hanbat National Univ., Korea)

Abstract

This study aims to analyze how to create the new urban and architectural space through mechanism between IT(Information Technology) and ET(Environment Technology). As a study process, the concepts, trends and situations urban and architectural space of IT·ET are figured out by lots of theoretical reviews and references analysis in chapter 2. Urban and architectural index, components and methods are classified through IT, ET technologies and Fused to IT·ET urban and architecture cases in chapter 3. The index and component were developed through in-depth analysis such as correlation analysis in chapter 4. The methodology, mechanism and road-map are built up by various index and components in terms of changing, fusing and dividing aspects in conclusion and the result are listed below. First, the macroscopic key trend of ET and IT embedded urban and architectural space are classified as 4 types, "Eco-Friendly Development", "Energy Production from Eco Development", "Energy Saving Technology Development", "Wide Area IT Network Development" are evolving consistently. Second, Sang-Am DMC(Digital Media Center) has been developed and evolved by environmental protective and eco-friendly aspect in ET from Korean War to 1970 via case studied. Wide area IT network development has carried out and evolved from 1990 to 2000 rapidly. But, after 2010 years, urban and architectural space are developed by fused ET and IT, which are classified "Energy Harvesting and Creating by Natural components(ex, solar, water and wind power)", "Environmental Quality Improvement of Natural Components(air, water and wind quality)", "Simplification Compactification(ex. Urban Skin Design) of Urban and Architectural Mass"and " Communication Space between Human and Nature by digital, Analog and Digilog Technology". Third, the mechanism of evolution about urban and architectural space is evolved vis creation, extinction and fusion process. Finally, the future of new innovative urban an architectural space will be made by rotational pattern mechanism of IT and ET.

Keywords: IT(Information Technology), ET(Environment Technology), IT and ET Embedded New Urban and Architectural Space

“Can CSR be a platform for open innovation to support a creative city development?”

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Abstract

Open innovation and creativity in an urban environment are known to contributeto economic development. In this context, one can propose an argument that the creation of conditions for people in cities to think and act to harness imagination (applied creativity) can lead to the provision of solutions to several urban problems and to regional development. In this era of neo liberalism where changes due to the shrinking role of the State in delivering certain functions and some limitations for providing the necessary solutions to urban problems, evoked varied responses from populations (Hall and Lamont, 2013).The State is seen also as promoting contributions from non-state actors in providing some of the services and amenities to the populations, which were hitherto the State’s responsibilities.This paper draws upon some of the CSR activity the south Indian city of Hyderabad. These cases show the contribution in offering space and certain solutions to the urban development which is increasingly getting excluded from the urban governance agenda. The paper tries to explore how these CSR programmes/activities and these models of CSR as partnership with other institutions are now gaining significance and popularity.

June 16 (Tuesday)

R# : 202 Conference Room

Special Session 7

"Smart Technology for Good Governance"

■ **Session Chair: KwangHo Jung** (Seoul National University)

- Paper 1: "Corporate and Public Policies for Open Innovation: Demand Articulation in the Open-Innovation Paradigm" by **Fumio Kodama (University of Tokyo)**
- Paper 2: "The Impact of 'Pay-As-You-Throw(PAYT)' on Waste Disposal" by **EunHyung Park(Seoul National University), Jonghwan Eun(Seoul National University), Kwangho Jung(Seoul National University)**
- Paper 3: "An Empirical Analysis of Food Waste Disposal Systems: RFID, Pay-as-throw system, and Block-Payment", by **Kwangho Jung(Seoul National University), EunHyung Park(Seoul National University), Jonghwan Eun(Seoul National University)**
- Paper 4: "The influence of need for touch and gender on Internet shopping attitudes" by **SeungHee Lee(Southern Illinois University), Jane Workman(Southern Illinois University), Kwangho Jung(Seoul National University)**
- Paper 5: "Factors influencing consumers' fashion M-Commerce" by **Marcella Smith(Southern Illinois University), SeungHee Lee(Southern Illinois University)**

Open Innovation, Knowledge City & Creative Economy
1st SOItmC (Society of Open innovation: Technology, Market, and Complexity)
8th Knowledge Cities World Summit
June 14 – 18, 2015, DGIST Daegue, Korea

Corporate and Public Policies for Open Innovation:

Demand Articulation in the Open-Innovation Paradigm

Fumio Kodama[1] and Tamotsu Shibata[2]

(Drafted on 5/29/2015)

Abstract

In the marketing literatures, "articulation of demand" is quoted as an important *competency* of market-driving firms. In this paper, therefore, I will demonstrate how the concept of "demand articulation" was effective in formulating corporate policies for technology and market development, and also in government policies for accelerating the commercialization process of emerging technologies, including. a historical case in the area of the U.S. defense policy that had induced the emergence of the Integrated Circuits technologies.

Secondly, in order to comprehend empirically what really means "demand articulation," i.e., how "market-driving" is different from "market-driven," we will go to a quantitative analysis of market growth paths in three different kinds of product categories. Finally, we will go to the arguments of "business model" creation, which will bring the concept of "demand articulation" into a reality under an emerging business environment of open innovation.

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2 Professor, Touhoku University.

1. Introduction

A number of frameworks have been developed by scholars in recent years in order to improve analysis and understanding of systems of innovation, with implications for individual firms, industries and nations. One area of interest is the concept of *national systems of innovation* (Freeman, 1987; Lundvall, 2014). Are systems of innovation sufficiently different from one country to another and internally coherent to justify the use of the term?

Another trend has been the increasing focus on the importance of *demand* aspect of R&D and technology in driving innovation forward. These efforts are aimed at understanding phenomena that are difficult to account for utilizing frameworks that emphasize the *supply* aspect of national R&D systems (National Research Council, 1999). Indeed, in the era of "open innovation," the key issue of technology policy is not how to make possible unprecedented technological capabilities, but how to put technology to the best possible use (Chesbrough, 2003). In the closed-innovation paradigm, technology policy has emphasized the supply side of development, but in the open-innovation paradigm, on the contrary, it must work on the demand side (Kodama, 1992).

Sheth and Sisodia (1999), meanwhile, acknowledge that the *marketing discipline*, has generated an impressive body of knowledge over the past 75 years. This knowledge base has been founded on the widely accepted concepts and thousands of empirical studies. In the 1960s, as is well known, most markets were relatively *homogeneous*, based on a mass-production and mass-consumption society. The marketing discipline responded to this situation by developing and refining theories that centered on *customers* and *markets*. They labeled these theories as *market-centric* concepts (market segmentation, customer satisfaction), and a *market-driven* orientation. In recent years, a significant contribution to the marketing literature, however, has come from researchers studying the concept of *market orientation*. It is defined as "the organization-wide generation of market *intelligence*, *dissemination* of the intelligence across departments. They summarized that the market orientation literature's core message as "be close to your customers—listen to your customers." One of the *innovation* literature's core messages, however, is "being *too close* to the customer can *stifle* innovation." This dichotomy needs to be resolved by studying the applicability of the *market-driven* and *market-driving* mind-sets.

Many scientists, on the other hand, have recently become aware that scientific leadership does not necessarily translate into industrial or product leadership. Therefore, they begin to consider the connection between science and product (Gomory and Schmitt, 1988). Usually, this connection is described as a type of *pipeline progression* in which a new technology emerges successively from basic research, applied research, exploratory development, engineering, and manufacturing (Alice et al., 1992). Gomory (1989) has called this progression the *ladder process*: the step-by-step reduction of new scientific knowledge into a radically new product. In the ladder process, a new technology dominates, and a product is created *around* it. The customers' needs are taken for granted.

Economists have also noted the intrinsic *dynamics* of technology development. Rosenberg (1976), for example, has concluded that *backward linkage* has been an enormously important *source* of technical change. He argues that the ordinary messages of the marketplace are not *specific* enough to indicate the *direction* in which technical change should be sought. Therefore, he concludes, there must be forces *outside* the marketplace that point in certain directions. Rosenberg suggests that *bottlenecks* in connected processes and obvious weak spots in products present clear targets for improvement. These become the *technological imperatives* that guide the evolution of certain technologies.

From the technologists' viewpoint, Kline (1986) argues that innovation can be interpreted as a *search* and *selection* process among technical *options*. The sample population from which technical options can be drawn, however, varies over a wide spectrum of sources of innovation. In this *intricate* process, Nelson’s "alternatives out there *waiting* to be found" is somewhat forced. The most important element in technology development, therefore, is the process in which the need for a specific technology *emerges* and R&D effort is targeted toward developing and *perfecting* it.

According to Sheth and Sisodia (1999), *market-driving* firms seek to *uncover* the latent *undiscovered* needs of current and potential customers, while market-driven firms reinforce existing frameworks. Hamel and Prahalad (1991) have offered the related concept of “*leading* the customer.” Indeed, it has been recently pointed out that the common view of the customer as offering marketers a *fixed* target is systematically *violated*. Rather, buyer perceptions, preferences, and decision making *evolve* over time, and competition is, in part, a battle over that evolution. Competitive advantage, therefore, results from the ability to *shape* buyer *perceptions*, preferences, and decision making.

This *market-driving* view, in addition, suggests an *iterative* process in which marketing strategy *shapes* as well as *responds* to buyer behavior. By doing so, the firm obtain a competitive advantage, which *in turn* shapes the *evolution* of the marketing strategy. Given this, we have to find a new and *accurate* way of describing the *dynamic* process of technology development. We have to give science policy administrators and research managers a *vocabulary* and a framework for talking *proactively* about the choices they must make in the high-tech environment. In this context, we have to conceptualize "a sophisticated translation skill that *converts* a vague set of *wants* into well-defined products." To do so, we will come to the concept of "demand articulation[3]."

Now, we can define demand articulation as a dynamic *interaction* of technological activities that involves *integrating* potential demands into a product concept and *decomposing* this product concept into development agendas for its individual component technologies. Articulating demand, therefore, is a *two-step* process: market data must be *integrated* into a product concept, the concept must be *broken* into development projects. Potential demands are often derived from *virtual* markets. The fact that the technology is still considered *exotic* should not be a deterrent in setting development agendas. Sheth and Sisodia (1999) summarize that "demand articulation" is an important *competency* of market-driving firms. Most firms are more comfortable in a world of *pre-articulated* demand, wherein customers know exactly what they want, and the firm's challenge is to *unearth* that information. Firms that are able to sustain success over a long period of time, therefore, need to be market driven and market driving *simultaneously*; most corporate cultures, however, are attuned to one or the other orientations.

In this paper, I will demonstrate how the concept of demand articulation was effective in formulating corporate policies for technology and market development, government policies for accelerating the commercialization process of emerging technologies. And I will also describe a historical case in the area of the U.S. defense policy, how the shift in strategic stance had induced the emergence of the IC (Integrated Circuits) technologies.

Secondly, in order to comprehend empirically what really means "demand articulation," i.e., how "market-driving" is different from "market-driven," we will go to a quantitative analysis of market growth paths in three different kinds of product categories. Finally, we will go to the arguments of "business model" creation, which will bring an idea of "demand creation" into a reality even under an emerging business environment of open innovation.

[3] According to Webster's dictionary, articulate comes from the Latin articulare. The word "articulate" has two conflicting meanings: (1) to divide into parts; and (2) to put together by joints. Thus, the word encompasses two opposite concepts: analysis (decomposition) and synthesis (integration). In fact, both are necessary in technology development, and the heart of the problem concerning technology development is how to manage these conflicting tasks.

2. Case Studies on LCD in Japan and United States

The importance of *demand articulation* in technology and market development of commercial products is best *illuminated* by investigating a half-century long history of Liquid Cristal Display (LCD) technology and its market development both in Japan and United States.

Although Europeans discovered liquid crystals phenomenon more than a century ago, the basic idea of using them in display devices came about only when RCA (Radio Cooperation of America) invented the dynamic scattering mode (DSM) in 1967. Thereafter, RCA demonstrated various prototype products.[4] All the products, however, were *premature* given the then-available technologies, and RCA gave up on the commercialization efforts. At the time RCA was trying to commercialize liquid crystals, the standard for display technology was the *cathode-ray tube* (CRT). A flat panel display was nothing more than a *dream*, and other technological alternatives to liquid crystals existed, including electroluminescence and plasma display. Manufacturers agonized over which to use. Since RCA developed liquid crystal technology as a display method for *general* purposes, it chose to stick with CRT technology, as did most manufacturers of CRT screens.

On the other hand, Sharp followed a *demand approach* when it translated the customer's *desire* for a more powerful and sleek electronic *calculator* into a set of specific R&D projects for a thinner, lower powered, easy-to-read display. These R&D projects included research in LCDs and in low-powered complementary metal oxide semiconductors (CMOS). Sharp was quick to identify the liquid crystal display as a *promising* technology, and the fact that the technology was still considered *exotic* was not a deterrent. Instead, Sharp saw LCDs as a way to solve *specific* technical problems and change the rules of competition in the marketplace.

Generally speaking, demand articulation flourishes when an industry is very competitive and technically sophisticated. Brisk competition, almost to the point of excess, motivates companies to keep their attention on the customer. And the more technically competent the industry is as a whole, the higher the *absorption* rate of technologies from other industries. In the case of Sharp, indeed, the competition included the likes of Hewlett-Packard and Texas

[4] Included are: a device displaying numerals and letters, a window curtain, still-picture display equipment, and a display panel for airplane pilots.

Instruments, both pioneers in electronics. Such a competitive environment spurred Sharp to *experiment* with alternatives that it probably would *not* have explored had the competition been less intense.

Ever since Sharp introduced an electronic calculator into market in 1964, the market for electronic calculators flourished and many companies entered in this growing market (Numagami, 1999). Around 1971, however, when Texas Instruments started supplying the standard chips for calculators in open market, many small-sized manufactures that have assembling capacities only but have no design abilities, suddenly appeared in the Japanese market. This market entrance had reduced the market price of calculators suddenly and drastically. Existing larger manufacturers of calculators were involved into the price-cutting competition, and some of them had left the market. Sony and Uchida left in 1973, Bisicon and Sigma Electronics did in 1974, and so did Ricoh in 1975. Even the market share of Sharp decreased dramatically.

It was in this context that *LCD* was introduced into the electronic calculators for the first time, namely in circumstances of such a price-cutting competition. Responding to that situation, Sharp introduced the LCD-based calculators in 1973 in order to bring a *functional* differentiation, while other remaining competitors continued to introduce cheaper products. By making the product much thinner and reducing the cost by the mass production, Sharp succeeded in differentiating their products from those by small-sized manufactures. This change in Sharp's strategies can best demonstrated by the rapid decrease in thickness from 1973 to 1983, as shown in the **figure 1**. As shown in the figure, the thickness of 1976 Sharp product was more than 2 cm, four years later in 1979, however, it became less than 1.6 mm. As a new comer, Casio reduced the thickness of their product to 0.8 mm in 1983 from 1.5 cm in 1976. They named their products as "pocket calculator[5)]."

[5)] This combination of technology and market strategies was not unique in Japan. The differentiation strategies of US manufacturers were different. Since they went forward to "programmable calculators," a further thinning was not their major concerns. *Source*: Numagami (1999)

Figure: Changes in thickness of calculators (1973 – 1983)

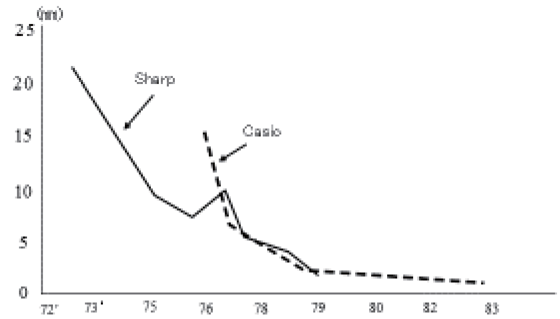

Figure 1. Changes in thickness of calculators (1973-1983)

Note: This graph was drawn by the author, based on numerical data provided by Numagami (1999).

Under the severe cost-cutting competition, indeed, Sharp chose to adopt a radical innovation in spite of letting their products higher priced. By these decisions, Sharp could overcome the difficulties, and keep a stable market position. We can summarize that Sharp was successful in *articulating* the demand for the *pocket* calculators, by developing and bringing the LCD technology into market in a right timing. In adopting LCDs in its calculators, Sharp not only achieved effective demand articulation for the technology, but subsequently became the technology and market leader in LCDs. During the 1970s and 1980s, Sharp and other Japanese companies made a number of improvements in LCDs, and they are now a widely used high value added component of portable electronic products such as laptop computers.

When we entered into 2000s, however, the process of demand articulation is getting a little more *subtle*. For the Apple Co. and its founder, Steve Jobs, in particular, the *practice* of demand articulation was taken for granted (Cupertino Silicon Valley Press, 2011). However, it seems me that they went far beyond the demand articulation practice. Jobs is quoted to have thought: first was the *mouse*. The second was the click *wheel*. And now, we're going to bring *multi-touch* to the market in each of these revolutionary products (the Mac, the iPod and now the iPhone). I actually started on the tablet first. I had this idea of being able to get rid of the keyboard, type on a multi-touch glass display. This is in the early 2000s. In the moment of multi-touch technology, he is quoted as saying:

> So let's not use a stylus. We're going to use the best *pointing device* in the world. We're going to use our *fingers*. We're going to touch this with our fingers. And we have invented a new technology called *multi-touch*, which is phenomenal. It works like magic.

A good evidence for demand articulation can be summarized by the following quotation. Some people say, "Give the customers what they want." But that is not only my approach. Our job is to figure out what they're going to want before they do. I think Henry Ford once said, "If I'd asked customers what they wanted, they would have told me, "A faster horse!" People don't know what they want *until* you show it to them. That's why I never rely on *market research*. Our task is to read things that are not *yet* on the page.

3. National Demand Articulation for VLSI in Japan and United States

The concept of demand articulation becomes even more powerful when a national technology policy is analyzed. The government-sponsored research consortia both in Japan and the United States, best illustrate demand articulation at the *national level*. This suggests that national policy can be discussed better using the concept of a "national system of demand articulation" rather than the oft-cited concept of a national system of innovation (Nelson, 1993).

As a technology shifts from the defense sector to the civilian sector,[6] particularly the development of manufacturing technology becomes more important because cost is a critical factor in the civilian sector. Furthermore, as the shift to civilian sector occurs, many companies in different industries become involved in bringing the new technology into the consumer-products market, while only a few selected, technological elite companies are involved in the defense sector. In other words, the policy agenda shifts to building a national manufacturing infrastructure. Many companies, in different industries, indeed, were involved in bringing the integrated circuit (IC) technology from the defense sector into consumer-products market. In Japan, the government played a significant role in this transition by organizing a research association for very large scale integration (VLSI) development. When first formed, the association included all of Japan's major IC chip manufacturers, who then *articulated* their demand for manufacturing equipment for chip-making. In this way, an internationally competitive infrastructure was established (Oshima and Kodama, 1988).

In the case of IC technology, the Japanese government, particularly MITI played a significant role in the creation of this infrastructure. In 1976, MITI orchestrated the establishment of the ERA (Engineering Research Association) for VLSI development. The association existed from 1976 to 1979 and spent a total of 73.7 billion Japanese yen, of which 29.1 billion yen was paid by the government on a project funding basis. Members of the association were Fujitsu, Hitachi, Mitsubishi, NEC, and Toshiba. Although we originally developed the concept of demand articulation to analyze the development processes conducted by a single firm, the dynamic process of collective action by rival firms creates the functional equivalent of demand articulation in a single firm. We can call this *collective articulation of demand*.

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[6] Although the U.S. government was the primary customer for the semiconductor industry in the early stage of IC technology, its influence on the market decreased significantly in the years that followed. In 1963, the share of the federal government was 35.5 percent, in 1970, 20.6 percent, in 1972, 11.9 percent, and in 1973, 5.8 percent.

The collective articulation of demand, therefore, should be viewed in and can be explained by the overall framework of industrial technological linkages. It can assist in creating a national technological infrastructure. Sometimes it results in establishing upstream technological linkages. Indeed, the association for VLSI development made possible *demand articulation* for manufacturing equipment for chip making. The five member companies established a joint research laboratory within the association. The laboratory had about 100 researchers who were drawn from the companies and from Electro-Technical Laboratory (ETL), one of Japan's national research institutes. Approximately 20 percent of the research was carried out in this joint research laboratory; the remaining 80 percent was done by the individual companies in their own laboratories with an association steering committee as a coordinating body.

A great deal of the research and development carried out in the joint laboratory, was also *subcontracted* to supplier companies that were not members of the association, e.g., camera manufacturers, silicon crystal suppliers, and printing companies. Although cooperative research sounds good in theory, it is often difficult in practice. In joint research by rival firms in the same industry, in particular, success hinges on ensuring that the research is *basic* and of *common* interest to all the participants. Therefore, rather than focusing on the method of producing chips, the association centered its research efforts around developing a *prototype* for IC manufacturing equipment and analyzing a process for the crystallization of silicon, a basic material in chip production[7]. No manufacturers of production equipment or chip materials were among the participants. **Figure 2** depicts the major actors involved in the Japanese development of VLSI and the technical linkages between them (Sigurdson, 1986).

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[7] This assertion is based on the author's interview (in 1986) with Dr. Yoshiyuki Takeishi of Toshiba Corporation, who led this association on behalf of the industry. He was a vice director of the association.

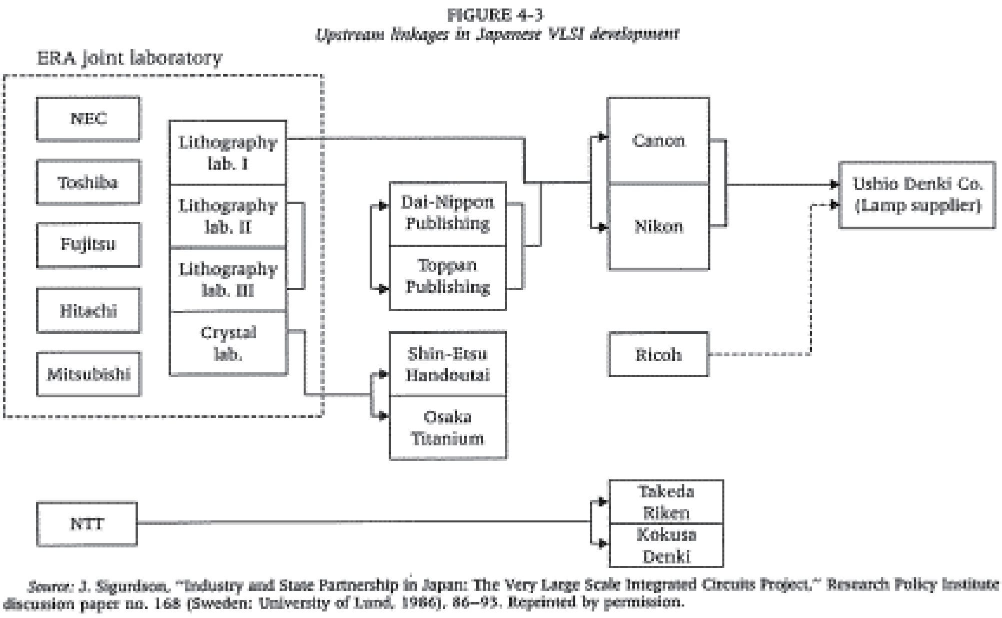

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Figure 2. Upstream Technical Linkages in Japanese VLSI Development

A pervasive *uncertainty* not only characterizes basic research, where it is generally acknowledged, but also the realm of government-sponsored development projects. Consequently, as Rosenberg (1994) asserted, the pervasiveness of uncertainty suggests that the government should ordinarily *resist* the temptation to play the role of *champion* of any one technological alternative. He argues, therefore, it would seem to make a great deal of sense to manage a *deliberately diversified* research portfolio, a portfolio that is likely to illuminate range of alternatives in the event of a reordering of social and economic priorities.

In this context, the power of demand articulation in research consortia had been manifested most vividly in *exploring* all the spectrum of possible equipment technologies.[8] It used to be a mainstream method to let the mask of circuit-diagram

[8] In the face of huge ex ante uncertainties concerning the uses of new technological capabilities, Rosenberg points out that private firms can depend upon the market mechanism, and that it encourages exploration along a wide variety of alternative paths. He also asserted: In the early stages when uncertainties are particularly high, individuals with differences of opinion need to be encouraged to pursue their own hunches or intuitions. Indeed, the achievement of technological progress, in the face of numerous uncertainties, requires such ex ante differences of opinion (Rosenberg, 1994).

contact directly the wafer and print on it. When the micro-manufacturing progressed further, a new idea emerged. The original circuit-diagram is projected through the *lens* on the wafer by reduction *ratios* of one-tenth or one-fifth. In actuality, the wafer moves *stepwise* in four directions, while the mask stays in a fixed position. This equipment has become called as "stepper."

In the beginning of the ERA for VLSI development, the other two methods than the stepper, i.e., direct printing by electron beam, and X-ray lithography, had already been much advanced and their prototype had been existent. Therefore, the stepper was assumed as the *third* candidate for safety reasons after these two methods. None could deny this *priority*, because no one did expect the lens technology that print *40* lines on the *width* of a hair. What makes steppers into multi-million-dollar pieces of sensitive equipment is the need to maintain focus within a fraction of a micron and to control the wafer's position with similar accuracy. Therefore, steppers use the sophisticated optical feedback mechanisms and the stringent control to keep the conditions across the surface of the wafer as uniform as possible.

Meanwhile, Mr. Syouichirou Yoshida (2000), who later became the CEO of Nikon Co., had been confident on *three* kinds of critical technologies which made the "stepper" competitive: ultra-high resolution lens; the staging technologies moving the wafer; and, the censor of photo-electric tube. As to the high resolution lens, Nikon had developed a commercial hit product, which was about to be procured for lens of photo-mask manufacturing, specified both by domestic and overseas producers. As to the staging technology, Nikon had an experience to provide Tokyo University's astronomical observatory with the staging mechanism for precise positioning of the telescope.

Indeed, the specific activities of the association included the development of the lithography. One of the association's lithography laboratories contracted the research necessary for the development of the lithography to camera manufacturers that owned the lens technology. Thus, companies such as Nikon and Canon succeeded in the development. Before Nikon produced the first prototype of stepper, a U.S. precision machinery giant, GCA Corporation, had already succeeded in commercializing the stepper. Through the development process described above, the "stepper" has become a mainstream in the equipment for semiconductor manufacturing. After ten years of demand articulation efforts, which were initiated by the VLSI association, Japanese companies in the upstream sector of chip manufacturing are beginning to emerge as dominant players in world production. Because we have said that collective demand articulation can create a national engineering infrastructure, we need to consider *second-tier* suppliers (Kodama, 1995). The suppliers of steppers, first-tier suppliers, were not the only beneficiaries of the joint effort. The real beneficiary was a second-tier supplier. Ushio Denki, the supplier of the lamp used for the optical stepper (see **Figure 2**), ended up dominating the world market for lamps. In 1983, Ushio had a market share of 100 percent for aligner lamps in Japan and 50 percent for the global market.

We will demonstrate that the concept of demand articulation was evident and visible beyond the national border in organizing the research consortia, by investigating the brief history of SEMATECH (Semiconductor Manufacturing Technology) consortia which was established in 1987. During the early and mid-1980s, the U.S. semiconductor industry lost about half of its global market share—particularly in memory chips—to Japanese integrated-circuit producers. The decline in semiconductor manufacturing equipment by domestic makers was equally drastic. That was the background against which the principal American chip manufacturers organized the SEMATECH consortium to foster research and development on advanced semiconductor technology. SEMATECH is one of hundreds of consortia that have been ever organized since the 1984 passage of the National Cooperative Research Act, which gives companies engaged in cooperative research and development partial *exemption* from *antitrust* laws. Fearing that the integrity of the U.S. defense apparatus was threatened by a growing dependence on foreign semiconductors, the federal government agreed to contribute $100 million annually to SEMATECH's operations.

After struggling unsuccessfully for more than a year to organize a research program suitable to its diverse membership, the consortium decided that the best opportunity it had to aid the U.S. semiconductor industry was *not* to emphasize *direct* cooperation between its members but rather to concentrate on improving the *position* of the domestic companies that make semiconductor manufacturing *equipment*. The consortium focused in particular on *lithography* technology (Randazzese, 1996). The U.S. share of the lithography market had slid from 71 percent in 1983 to just 29 percent by 1988. Most of the dramatic decline was accounted for by GCA Corporation. In the late 1970s GCA had invented the step-and-repeat (or stepper) technology that soon became the workhorse of the semiconductor manufacturing industry. A global downturn in the semiconductor manufacturing equipment industry and the rapid emergence of Japanese competition brought GCA to the brink of bankruptcy. In March 1988 GCA was bought by the General Signal conglomerate. Despite the highly visible failure of GCA[9], the years since SEMATECH was founded have seen an improvement in the competitive position

[9] As part of its exit from the semiconductor manufacturing equipment industry, General Signal put GCA up for sale in January 1993 and, unable to find a buyer, shut it down by the summer of that year.

of the U.S. semiconductor industry. In 1993 American companies captured 43.4 percent of the global semiconductor market, *surpassing* the Japanese share for the first time in eight years, and U.S. semiconductor manufacturing equipment companies once again held 50 percent of the global market, compared with Japan's 42.9 percent. Something of a consensus has emerged that SEMATECH deserves much of the credit for these gains, even though a number of other factors contributed to the recovery.[10]

According to Randazze (1996), SEMATECH's greatest accomplishment was probably not its technical achievements by themselves but rather its role in improving *relations* between chipmakers and their suppliers. Once almost *antagonistic*, these companies are now *cooperating* closely. Observers have universally considered these accomplishments, along with the consortium's ostensible contribution to the fortunes of the U.S. semiconductor industry, as the gauge to measure SEMATECH's success as a model for public policy[11]. I would argue, the demand articulation had directly or indirectly made these changes possible in the relations between chipmakers and suppliers of the United States.

[10] These include an extended recession in Japan, the rising value of the yen, trade agreements in which Japan conceded that imports should account for 20 percent of its domestic semiconductor market, competition from low-cost Korean makers of memory chips, and the continued dominance of U.S. semiconductor companies in the microprocessor market.

[11] In October 1994, SEMATECH invested about $8 million in Silicon Valley Group Lithography Systems (SVGL). In 2001, however, ASML (being independent from Philipps of Netherland in 1984), had acquired SVG. By acquiring several important technologies from SVGL, ASML has now become the world-largest lithography manufacturer. Source: Takahashi, T. (2006): *The History of Lithography*, National Science Museum, Tokyo.

4. Demand articulation in the US defense sector

In the defense sector, the concept of demand articulation is effective for describing how product development challenges at the component and systems levels are addressed in the integrated manner. One important historical case is the impact that shifts in U.S. strategic defense policies had on technology development in the 1950s and 1960s. The shift from a strategic stance emphasizing "massive retaliation" in the Eisenhower Administration to the Kennedy Administration's goal of achieving capabilities for "flexible response" put a *premium* on precision *delivery* of nuclear weapons, and highly survivable systems, including missiles and command and control systems (National Research Council, 1999).

According to a study carried out by the OECD (Organization for Economic Cooperation and Development), prior to the development of integrated circuits (IC), program sponsored by the US Department of Defense were driven by technology rather than by the *need* for a technology. In the case of the IC, however, the US Government *articulated* and *shaped* the problem which the innovative candidate technology was required to address. The resulting "articulated demand" for miniaturization and reliability in missile control systems went beyond what was possible using *vacuum tubes* or *transistors*, the available technologies at the time. Although they did not receive direct government funding for their work, Texas Instruments and Fairchild *responded* to this military demand in developing the first IC (OECD, 1977).

The dynamic and interactive relationship between defense strategic changes and technology developments have been studied by the author of this paper, by comparing the strategic changes around the concept of "containment" with the chronologies of IC related innovations. Gaddis (2005) summarizes his study of changes in "containment strategies," as follows: It would not be until the Kennedy administration that awareness would begin to develop of "the basic *unsoundness* of a defense posture based primarily on weapons *accidentally* destructive and *suicidal*[12)] in their implication." The chronological details of the relationships studied by the author follow.

- Immediately after the WW. II, *Truman's strategy* would have required *readiness* to fight everywhere, with old weapons and with new weapons.

[12)] Although he described explicitly, Gaddis did not have a chance to document how the nuclear weapons had been *accidentally* destructive and *suicidal* in their implications. Meanwhile, Graham Allison documented how we have become aware of these implications by the experiences at Cuban missile crisis, which occurred in the time period from October 16th to 28th in 1962. *Source*: Allison, G. and Zelikow (1999): *Essence of Decision: Explaining the Cuban Missile Crisis*, Second Edition, Longman, New York.

- In 1951, the military services sponsored an effort to *improve vacuum tube* circuitry. The *reliability* argument was even more persuasive for *missiles.* The *first* major effort specifically in the *miniaturization* mode was "Project Tinkertoy," to miniaturize and *completely automate* the manufacture of selected electronic components.

- Texas Instruments (TI) initiated an *in-house* program to seek basic *new* directions. By mid-1953, the first IC, i.e., electronic components indivisibly *embodied within a semiconductor-material*, was demonstrated by TI.

- The Secretary of State in the Eisenhower Administration, John Foster Dulles, explained how *strategic initiative* could be combined with *budgetary restraint*. It could be done by relying on the deterrent of "massive *retaliatory power*." We would be willing and able to *respond vigorously* at *places* and with *means* of its own *choosing*.

- In 1958, the Air Force suggested a concept dubbed "molecular electronics." With much fanfare the Air Force awarded a contract to *Westinghouse.* The molecular electronics concept *per se* proved quite controversial and *did not achieve* its goals. However, it did *sensitize* the U. S. semiconductor components industry towards *new directions*.

- Kennedy, possessed of an economic rationale for disregarding costs, placed his emphasis on minimizing *risks* by giving the United States sufficient *flexibility to respond* without either escalation or humiliation. He declared, "we believe in maintaining effective *deterrent strength*, but we also believe in making it do *what we wish*, neither *more nor less*."

- Texas Instruments was awarded an Air Force contract. It built a *computer using* IC components. It offered *impressive advantages* and, served as a *showcase* vehicle to illustrate the IC's potential utility. TI's contract called for the construction of an *IC pilot line* of turning out *500* integrated circuits per day for ten days. It was a *reinforcement* of the IC *idea*, moving it one more step towards *reality.*

- The *Minuteman* contract to *utilize ICs* was announced, publicly stating that the advanced version of the ICBM (Inter-continental ballistic missile) would use these new components. Its orders were the largest IC *purchases*.

- NASA (National Aeronautics and Space Administration) announced that it intended to use *IC devices* for its *Apollo* mission. NASA would *test the IC components* to ensure the fulfillments within the very rigid constraints of the Apollo program.

The OECD study concludes: Although the two basic patents and key technological contributions that underlie IC technology in the United States were made by private companies *without* government support, these fundamental innovations were achieved because both companies sensed the needs of their various customers, present and hoped-for. These customers, however, were drawn mainly from the government via its military interests. Thus, although government influence helped create the landscape these companies viewed, it did not *dictate* the nature of the technological *route* to be taken. The need was *articulated*, the *means* to satisfy it was *not*. In short, breakthroughs were brought about by the in-house R&D efforts of those companies that responded to the *articulated* demand of the military (OECD, 1977).

5. Empirical Evidences of Market-driving Growth Path

In her book on the history of Internet, Abbate (1999) summarizes its history as follows: Computing technology underwent a dramatic transformation. The computer, originally conceived as an *isolated* calculating device, was *reborn* as a means of communication. When computers were scarce, expensive, and cumbersome, using a computer for communication was almost *unthinkable*.

Innovations that occurred in the PC, therefore, created new ways of using one after another. In other words, the PC (Personal Computer) technology created new *systems-of-use* (Christensen and Rosenbloom, 1995). The drastic innovations that had occurred in *printer* technologies, meanwhile, seems to have produced the implications slightly different from the innovations occurred in PCs. The printer was used only as a machine for outputting character-based information on the paper during the 1960-1970s. It was also mainly used for business purposes. When *laser* and *inkjet* printers entered the market in the mid-1980s, the printer market expanded drastically as personal use began. There were two reasons for the expansion of the market for personal use. One was the ability to deal with high-resolution images and the other was the introduction of color printing.

In this context, we can interpret that new technologies related to the printer greatly widened the *scope of usage*. However, the commercialization of new technologies was conducted within an *existing* framework, i.e. printing on the paper. I would argue, therefore, that the printer did not necessarily create new system-of-use as had happened in PC case, although the nature of innovation in these products can be best described as "radical breakthrough," in terms of a drastic widening scope of usage. It is now clear, however, that both printer and PC technologies did produce the "market-driving" pattern instead of that of "market-driven," if we use the taxonomy proposed by Sheth and Sisodia (1999).

Now we will move to how different those two patterns of market-driving growth are empirically and quantitatively. Foster (1986) had once formulated the difficulty in managing technological discontinuities as the movements from one technology to another with *inherently* higher upper limits. When it comes to the market-driving growth of products, such as printers and PCs, therefore, it is reasonable to think that the product's potential market size could be increased by new value being added by technological innovation of the product during the period of diffusion. Now, we are interested in *visualizing* the differences in growth pattern between printers and PC technologies as well as the difference between market-driven and market-driving growths (Osaki and Kodama (2001); Kodama (2004)). Sharif and Ramanathan (1981) proposed a market-growth model in which the potential adopter (upper limit) increases over time in the following three different models:

Model A: Potential market size does not change (simple logistic model)
Model B: Potential market size increases stepwise (N-step logistic model)
Model C: Potential market size increases continuously (binomial logistic model)

The market growth data had been collected for Televisions (yearly production data: 1956--1980) as the example of the ordinary market-driven growth pattern (model A) for the reference case of our market growth study. As far as the case of market-driving growth (model B and C) is concerned, those market growth data were collected for Printers (monthly production data: 1983.01--1998.08) and PCs (monthly production data; 1987.01--2001.06). To identify the market growth patterns for these three product categories, we conducted the statistical fitting of these three kinds of growth models described above.[13)]

We confirmed that the growth trajectories of three different products followed the three different paths: Televisions identified best as following the simple logistic curve, where the upper limit does not change, as seen in **Figure 3**. In retrospect, this result is a good quantitative evidence that the demand for televisions had been *pre-articulated* from the beginning and the essence of this demand did not change all through the time period studies.

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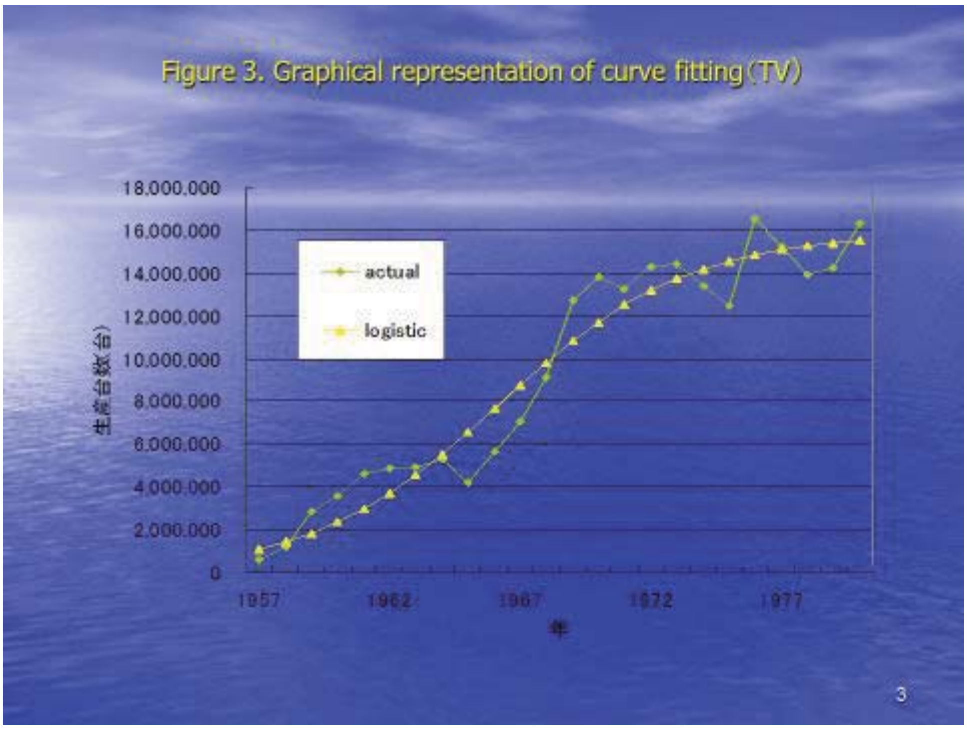
13) For identification of a most appropriate model, we will use the criterion developed by Akaike [9]. The AIC (Akaike information criterion) is developed for measuring the degree of fitness of nonlinear regression analysis. The smaller AIC value means a better fitness.



The growth pattern of market-driving products, as we can reasonably imagine, are found to follow the S-shaped curves where the upper limits also increase. The market growth for printers, turns out to be identified best as following the two-step logistic model (model B), as shown in **Figure 4**. As seen in the figure, a *stepwise* expansion of the potential market size is estimated to have occurred in 1987. Indeed, laser and inkjet printers entered the market in the mid-1980s. Based on these facts, we can generalize that "breakthrough" innovations such as laser and inkjet printers, might be measured by a *stepwise increase* in potential market size.

Our findings concerning *printer* innovations described above, indeed, coincide with the following assertions by Anderson and Tushman (1991): the notion of a series of S-curves suggests, an industry evolves through a succession of *technology cycles*. Each cycle begins with a *technological discontinuity*. Discontinuities are based on new technologies whose technical *limits* are *inherently greater* than those of the *previous* dominant technology.

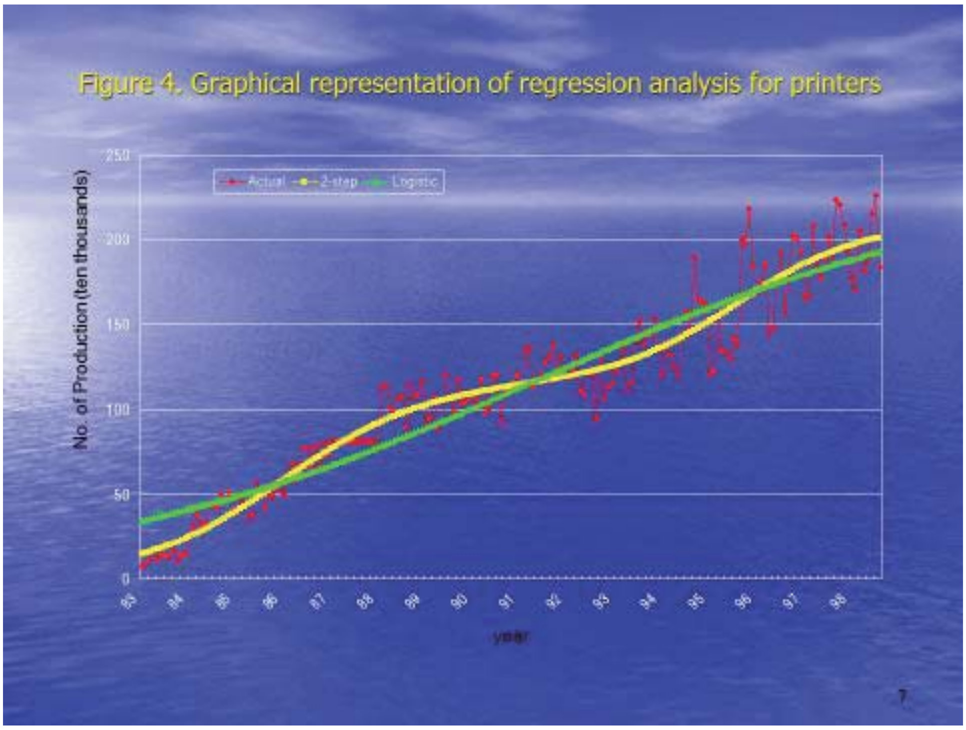


Figure 4. Graphical representation of regression analysis for printers

Apart from the results on printer innovation, the market growth path of PCs, we find, is identified best as following the *binomial* logistic model (model C), where the upper limit of the potential adopters *continuously* increases, by following also a logistic curve (we might call it "*double*-logistic" curve), as seen in **Figure 5**. This is very different from the patterns of discontinuous innovations. Indeed, a kind of consensus has recently arrived among several recent empirical studies on what is a real implication about the creation of "business model." (Ritala & Sainio, 2014; Tongur & Engwall, 2014; Mason & Lee, 2008), They describe: dynamic business models represent *continuous* change and therefore make firms learn *constantly* new and better ways of doing things.

In commercializing new technologies, moreover, Chesbrough and Rosenbloom (2001) argued that a new *business model* is required to commercialize a *disruptive* technology. They also argued that *new* technology creates only a little *disruption* if the business model of the related industry has not changed much. The printer technology is one such example that comes to mind immediately.

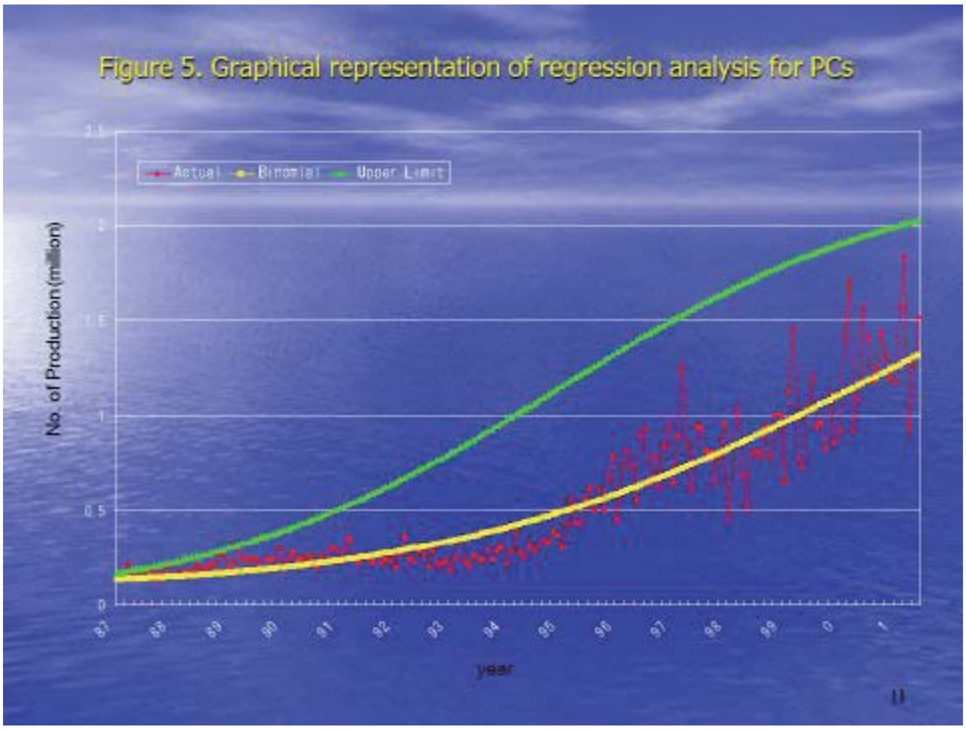


Figure 5. Graphical representation of regression analysis for PCs

To summarize, we discovered the PC did continuously create new systems-of-use one after another. In other words, technical progresses in the PCs created new *business models* in terms of utilization of these innovations (Kodama, 2004). This is equivalent to description by Abbate quoted in the first paragraph of this section: the computer, originally conceived as an isolated calculating device, was *reborn* as a means of communication.

6. Innovation Spiral and Business Model

It is widely held that a “new economy” is emerging, one in which conventional wisdom about the innovation process becomes obsolete. Since “new economy” can be easily translated into "digital economy,” we have to think about what is new about the “digital economy. In the analogue world, things cannot be easily combined. However, with digitalization, all sorts of combinations are possible and we can end up with something greater than the *sum* of the merger (Newsweek, 1999). In the age of digital economy, therefore, I would argue that the emergence of a new *business model* can be a source of discontinuity and disruption as well as that of technical breakthrough innovations.

In inventing iPod, for example, Steve Jobs (Cupertino Silicon Valley Press, 2011) is quoted as saying: What’s really interesting is if you look at the reason that the iPod exists and that Apple’s in that marketplace, it’s because these really great *Japanese consumer electronics companies* who kind of own the *portable music* market, invented it and owned it, couldn’t do the appropriate *software*. According to Anderson and Tushman (1991), an industry evolves through a succession of *technology cycles*. Each cycle begins with a discontinuity based on new technologies, along economically relevant dimensions of merit. In each case, a process with inherently higher limits *redefined* the state of the art, increasing machine capacity by an order of magnitude while lowering costs and improving quality. To sum up, each discontinuity *inaugurates* a new cycle.

In the revolution of portable music, therefore, I would argue, the Sony’s *Walkman* was obviously a technical innovation derived by the notion of demand articulation. It was based on Sony’s sophisticated translation skill to convert a vague sets of distant human wants into well-defined product concept, i.e., “portable music.” And it is also based on Sony’s product development skills to decompose the concept into a set of development projects. This decomposition was feasible by mobilizing all of the Sony’s competencies: recording and delivery of music, owned by Sony Music Co.; and, the various audio technologies owned by Sony Corporation, like regenerating the recorded music by tapes or CDs, good earphone technologies, and etc. In any way, Sony completed the *first* cycle of portable music.

And the iPod innovation by the Apple inaugurated the *second* cycle of portable music. Steve Jobs is again quoted as saying: Our idea was to come up with a music *service* where you don’t have to subscribe to it. You can just buy music at 99 cents a song, and you have great digital – you have great rights to use it. As is clear in this quotation, it is based on a breakthrough in *system-of use*, i.e., creation of new business model. This is easy to understand if we give some thoughts on what kind of core competencies are owned by Apple, compared with Sony, in terms of physical technologies related to the portable music. Therefore, we might generalize: while a breakthrough in technology starts the *first* cycle, a breakthrough in business model will inaugurate the *second* cycle.

We can further generalize this satement. Although the iPod example is characterized as B2C and IT innovation, however, we are now interested in a case characterized as B2B and IoT (Internet of Things). A Japanese construction machinery supplier, Komatsu Co. Ltd., turned out to be the first company which introduced disruptive technologies such as RFID (Radio Frequency Identification) and GPS (Global Positioning System) for development of building lots, and now is a market leader in construction businesses (Nikkei Business, 2007). In this system, RFID sensors are inserted inside their machines that are operating all over the world and all the data about their operating conditions are sent to Komatsu headquarters in Tokyo via *satellite* communication. The system Komatsu developed is called “KOMTRAX” system. They started its operation in 2001.

The development of KOMTRAX, however, was not as straightforward as we can imagine. In the mid-1990s, the country’s investment in construction business fell down significantly. Facing this reduced investment, companies had to revise the ways in which machinery was procured. This meant a shift away from ownership to *leasing* and *rental* (21% of machinery was either leased or rented by 1993, 30% by 1997, and 40% by 2006). In 1997, Mr. Masahiro Sakane (later became CEO of Komatsu Co. in 2001) was appointed as director of the business planning and administration office. At the time, this office was staffed by people dispatched from various divisions. At the end of 1997, the office had received a business plan of 10 pages long, from engineers dispatched from the development department. This plan was for a *business model* for remotely monitoring machinery, which was in effect the prototype of KOMTRAX system.

Having spent a long time in the service department, Mr. Sakane had a deep appreciation of the *intricacies* of managing construction machinery maintenance, and hence understood well the value and potential of the KOMTRAX system (Nihon Keizai Newspaper, 2014/11/24), and thus this idea proceeded into the development stage. In this regard, the KOMTRAX development was initiated as a kind of local project using the funds provided by the business planning and administration office. The company completed 5 prototypes by 1998, and asked Mr. Chikashi Shike of the "Big Rental" (a rental company at Koriyama in Fukushima prefecture), which had only started up in 1997, to test the 5 prototypes. At that time, Mr. Shike had been also thinking about a brand-new rental business model that entailed using IT for centralized management to raise the utilization rates of rental construction machinery, and because this remote construction machinery monitoring system fit well with his idea, Shike agreed to take on the prototypes for testing. Being engaged in a rental business, Mr. Shike had no difficulties in understanding the *inherent* value of KOMTRAX system[14).

At the end of 1998, it was suggested at Komatsu that *fifty* pieces of equipment should be subsequently tested. However at a development meeting, supervising executives took a negative view regarding continued testing. At that meeting, meanwhile, Mr. Shike was asked for his opinions about the commercial advantages of developing the remote monitoring system. Shike explained that the system was a piece of remote communications infrastructure, and thus it is not appropriate timing to discuss in details what sorts of businesses would be enabled by it.[15) Unfortunately though, it was decided that the remote monitoring system development should be cancelled. The Komatsu development team had not been able to *paint* a picture of a business model using KOMTRAX, because they did not have an understanding of its *inherent* value.

Nevertheless soon after that Mr. Shike, who had understood the value of KOMTRAX, wrote an order for 1,000 units and paid Komatsu 150 million Japanese yen (JPY) – an order made despite of Big Rental's having only 500 pieces of rental construction machinery at the time. In those days, KOMTRAX units were externally attached and cost 150, 000 JPY per unit. Thus, such a large order made KOMTRAX a viable business, and so development was continued within Komatsu. In the beginning of 2000, the Big Rental grew rapidly and within 3 years became the *top* rental company in Fukushima prefecture. Shike quickly *refitted* all the Big Rental's construction machinery with KOMTRAX units as soon as the units arrived from Komatsu. The product originally consisted of a communications terminal and modem, GPS and a simple CPU etc.

The capabilities and advantages of KOMTRAX in remote management of machinery and in work on construction sites, became widely known gradually. Komatsu Co., meanwhile, filed the *business model patent* for rental businesses so that that ways KOMTRAX could be used in a rental business. At that time, KOMTRAX was known as a business model for rental businesses, and was only available as a user option. In June 2001, Mr. Sakane has become the CEO of Komatsu company. He had aggressively pursued the possibility of utilizing KOMTRAX, not only as a tool for customer service, but also as a tool for *visualizing* the corporate management (Sakane, 2006).

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14) It is based on the interview with Mr. Shike, conducted by the coauthor of this paper, Shibata, T. in December 2014.

15) We are told that Mr. Shike responded by saying that Alexander Graham Bell had not clearly understood what kinds of businesses would be brought about with the development of the telephone.

By establishing the KOMTRAX system, Komatsu headquarters has obtained and access to all the data about operation conditions of all the Komatsu machines installed all over the world. In fact, these collected data are effectively utilized for discussion on *demand forecasting* being conducted at the headquarters. Based on this demand estimate, headquarters formulates production *schedules* and equipment *investment plans* at each factory. In 2004, for example, the Chinese economy was in *downturn*, due to the financial policies then implemented by the government. The collected data by KOMTRAX system showed clearly that the operating ratios of their machines were abnormally low in China. Komatsu halted production three months before the demand reduction was officially announced by a Chinese government agency. This gave Komatsu an enormous advantage.[16)]

A cyclical process of research, development, production, and distribution is called an *innovation cycle* (National Research Council, 1983). Now, we have learned that the *second* cycle of innovation related to B2B and to IoT, is triggered by the new *business model* creation rather than by technological discontinuity. On the basis of this experiences both in B2C (iPod innovation) and B2B (KOMTRAX invention), I would suggest that the innovation cycle in the open innovation paradigm, becomes a *spiral innovation model* with three-dimensional cycles[17)]. Our review of the history of the second cycles of B2C and B2B case studies, I would argue, revealed that the trigger at each stage came from different fields of knowledge areas. Furthermore, each time a change in sources of innovation occurred, dramatic upgrading in the inherent value (higher upper limit) of

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[16)] Indeed, Mr. Shike was recruited to Komatsu Co. as an executive officer in 2014.

[17)] In page 109 of the author's book, "Emerging Patterns of Innovation," (Harvard Business school Press, 1995): a cyclical process of research, development, production, and distribution is called an *innovation cycle*. Our review of the history of optical fiber development in Japan revealed that the leading innovators at each stage came from different industrial sectors while collaborating in joint research across industry boundaries. Furthermore, each time a change in leaders occurred, dramatic improvements in technological development were made. Therefore, the innovation cycle should be thought of as multilayered, because high-tech R&D is carried out simultaneously in a wide variety of industries.

In this multilayered structure, changes in leaders could be taken to mean that leaders move from an innovation cycle in one industry to a new innovation cycle in a different industry, solving technological problems as they go. The innovation cycle, then, becomes a *spiral innovation model* with three-dimensional cycles. The essential feature of this innovation model is the one-to-one correspondence between technological approach and industrial sector. Each industry tries to solve a problem using specific technological competencies accumulated in its industrial sector. Therefore, the high-tech R&D process is interindustry competition, instead of interfirm competition within a given industry.

innovation was accomplished.

In a spiral model of innovation, therefore, “demand articulation” is effective in starting the *first* innovation spiral. When it comes to the *second* innovation spiral, meanwhile, this wording had better be replaced by a term which is more *proactive* than the demand articulation by itself (Kodama, 2000). Having described so far new phenomenon and new research findings, I would suggest that “articulation of demand" should be replaced by “creation of a new business model,” in the second innovation spiral, i.e., in particular, in the process of “open innovation.”

7. Concluding Remarks

Chesbrough (2003) once concluded that technology by itself has no single objective value. The economic value of a technology remains *latent* until it is commercialized in some way. The value of an idea or a technology depends on its *business model*. There is no inherent value in a technology *per se*. The value is determined instead by the *business model* used to bring it to market. An inferior technology with a better business model will often defeat a better technology commercialized through an inferior business model.

Is this statement valid without any reservation? Let us review again what had happened to emergence of KOMTRAX system, from different standpoint than the simple creation of a business model. In the case of the Komtrax system in construction industry, the introduction of ICTs (Information and Communication Technologies) provides the machinery suppliers with drastic widening in the range of service activities and also enhances service quality. When it comes to innovation in corporate decision-making, a quantum leap in business activities was attained by utilization of *big-data* provided by the Komtrax system. This had not been originally intended nor planned since it is obvious that the Komtrax system was developed mainly for the improvement of after-sales activities by construction machinery providers as well as a rental company of this machinery. This prototypical case of the enhanced use of big-data available through the one-line and world-wide aggregation of operation data of their machinery being used, however, might trigger improvements in the quality of corporate decision-making countrywide. Indeed, the potential demand for this type of utilization of big operation data of construction machinery does exist in any company in any industrial sector.

In order for the concept of “open innovation” to be effective, the accumulation and advanced utilization of big-data is an absolute necessity. In other words, the combination of business model creation, accompanied by the accumulation of big data and its advanced utilization, can make the arguments of *market-driving* more plausible, and make the *accuracy* of demand articulation more enhanced. As far as business model itself is concerned, the *experimentation* and *simulation* of alternative business models becomes possible with the sheer existence of *big-data*. These are necessary conditions for IoT to be brought into a reality.

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The Impact of 'Pay-As-You-Throw(PAYT)' on Food Waste Disposal in South Korea

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Abstract

This study examines whether or not the Pay-As-You Throw(PAYT) waste management reduces food waste amount. Relying on 48 monthly food waste data at 31 municipalities(Cities:Si, Counties:Gun, Districts:Gu in Gyeonggi Province, Republic of Korea, we compare the amount of food waste disposal before and after the PAYT system. The impact of the PAYT system is analyzed between apartment areas and house areas. We find that the PAYT system significantly reduces food waste disposal, even after controlling the number of cars per capita, fiscal capacity(independence), and population. This suggests that market based instruments such as PAYT induce citizens to concerning their waste disposal behaviors through charging price for their actual food waste generation. Further study is required to explore how the PAYT system varies from municipalities and how they influence food waste generation.

Keywords: Food waste, Pay-As-You-Throw, Market incentives, Policy Instruments

An Empirical Analysis of Food Waste Disposal Systems: RFID, Pay-as-throw system, and Block-Payment in South Korea

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Abstract

Municipalities introduce different types of the Pay-As-You Throw(PAYT) system. Three types of the PAYT system are common in South Korea: Block-Payment(BP), Pre-paid authorized plastic bag(PPB), and RFID. Relying on food waste disposal data from 31 municipalities (Cities:Si, Counties:Gun, Districts:Gu) between 2010 January and 2014 December in Gyeonggi Province, we examine how these three PAYT systems differ from reducing food waste amount. We test the impact of three types of the PAYT system between apartment areas and house areas. We find significant effects of PPB and RFID on reducing food waste, but no effect of BP. The BP system does not provide any incentives to reduce food waste due to no link between the actual costs for food waste disposal and individual food waste disposal. These findings suggest the importance of designing an effective food waste system. Further research is required to examine how PPB and RFID influence food waste reduction behaviors and whether or not they are different.

Keywords: Food waste, Pay-As-You-Throw, RFID, Block-Payment, Pre-paid authorized plastic bag

The influence of need for touch and gender on Internet shopping attitudes

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Abstract

Recent research has indicated that touch plays an important role in consumers' product evaluation or decision making. Need for touch research has increased in marketing literature. Especially, a two-dimensional Need-For-Touch(autotelic and instrumental NFT) scale developed by Peck and Childers (2003) has been increasingly used in previous studies. However, there is little research which has examined NFT in other cultures or has adopted this NFT scale to Asian cultures such as Korea. Thus, it would be meaningful to check if the scale can be applied to Asian cultures such as Korea. Therefore, the purposes of this study were to investigate how need for touch is associated with gender and Internet shopping attitudes among a sample of adult Korean consumers, and to test if the Peck and Childers' NFT scale can be applied to Korean consumers. Based on literature review, nine hypotheses were proposed in this study. Three hundred twenty adults (160 women, 160 men) in South Korea were recruited from a Korean on-line survey company and participated in the study, using survey questionnaire. For data analysis, descriptive statistics, paired t-tests and MANOVA/ANOVA were used. Reliability of the scales was acceptable and ranged from .836 to .943. Results revealed that women differed from men in NFT, respectively the total level, autotelic NFT, and instrumental NFT. Also, women and men both had a higher instrumental NFT than autotelic NFT. There was no significant difference between women and men on Internet shopping attitudes. Individuals higher (vs. lower) in total NFT, autotelic NFT, and instrumental NFT differed in Internet shopping attitudes. Based on these results, retailing or marketing strategies would be provided for international companies and retailers as well as for Korean companies/retailers.

Keywords: Shopping attitudes, Need for touch, gender difference

Factors influencing consumers' fashion M-Commerce

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Abstract

Retail shopping websites have been reported to make up the largest part of online shopping revenue. Nowadays, with the growth of online shopping, mobile retail shopping has grown simultaneously and tremendously as a new retail service. Mobile Commerce (M-Commerce) can be explained as any transaction with a monetary value, employed by the development of wireless communication technology accompanied with the constant high penetration rate of the Internet. Although fashion mobile shopping has become very important when it comes to mobile commerce, there is little research that has examined the factors influencing consumers' fashion mobile shopping attitude. Therefore, the purpose of this study is to investigate what factors can promote fashion M-Commerce. Based on previous studies, four factors such as customer involvement, compatibility, perceived risk, and innovativeness were chosen for this study as antecedents of fashion M-Commerce attitude. Five hypotheses were proposed in the study. Two hundred and twenty-one college students in the Midwestern part of the U.S. participated in the survey, using a self-administrated questionnaire. For data analysis, descriptive statistics and simple or multiple regressions were performed. As a result, almost half of the respondents have purchased fashion products through M-Commerce. Also, out of four factors, three factors including perceived risk, customer involvement and compatibility were positively related to fashion M-Commerce attitudes. Perceived risk was negatively associated to fashion M-Commerce attitudes. These three variables explained 50.3 percent of the variances in fashion M-Commerce attitude. Consumer involvement showed the largest standardized regression coefficient, followed by compatibility, and perceived risk. However, innovativeness showed that it was not significantly related to fashion M-Commerce attitude. The result also revealed that fashion M-Commerce attitude was positively related to purchase intention of fashion M-Commerce. These results would provide fashion markers or retailers some M-Commerce strategies.

Keywords: Mobile Commerce, Shopping websites, Fashion mobile

June 16 (Tuesday)

R# : 203 International Conference Hall

Special Session 8

"Technology Policy for Open Innovation & Knowledge City"

■ **Session Chair: SangOk Choi** (Korea University)

- Paper 1: "On the Way Towards a Knowledge City" by **Katri-Liis Lepik(Tallinn University, Estonia), Merle Krigul(Brainport Living Lab, Estonia)**
- Paper 2: "How to interact within science parks in order to improve industrial performance? - comparing research park and industrial park through social network analysis" by **Injeong Lee(KAIST), Wonjoon Kim(KAIST)**
- Paper 3: "The Factors affecting to 'Basic Research' Performance Funded by Government: 'Creative Research Program' Case in South Korea" by **Youngsoo Ryu(KISTEP), Kwangseon Hwang(KISTEP), Sangok Choi(Korea University)**
- Paper 4: "The Effect of Product Innovation on R&D Activities and Government Support Systems: the Moderating Role of Government Support Systems" by **Si-jeoung Kim(KOFST), Eun-mi Kim(GSTEP), Yoon-kyo Suh(Korea University), ZeKun Zheng(Korea University)**
- Paper 5: "Perceived innovation barriers, open innovation and its performance" by **Daehan Jung(Korea University), Youngmi Kim(Korea University), Yoonjung Kim(Korea University), Yoonkyo Suh(Korea University)**
- Paper 6: "Affecting Structure on the Performances of University-Industry Cooperation: Mediating Effects of the Government & Enterprise Supported R&D Projects" by **Hue-kyung Lee(National Research Foundation), Hyun-duk Youm(Korea University), Si-jeoung Kim(KOFST), Yoon-kyo Suh(Korea University)**
- Paper 7 "An Empirical Study on the Determinants of Innovative Activity in Korean Manufacturing Firms: Focusing on the Firms' Perception of Innovation " by **SungChan Yeom(Korea University)**

On the Way Towards a Knowledge City

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Structured Abstract

Purpose –
The purpose of this article is to analyse the knowledge-based urban development (KBUD) policy approach for the purpose of profiling Tallinn city as a knowledge city in the KBUD context.

Design/methodology/approach –
We propose desk research methods as well as expert interviews. Knowledge-based urban development (KBUD) policy approach has four broad policy domains—i.e., economic, societal, spatial, and institutional development-and KBUD is described as the new urban development policy of the knowledge era that aims to bring economic prosperity, environmental sustainability, a just socio-spatial order and good governance to cities. KBUD is used as a framework for benchmarking knowledge cities. For specific purposes of analysing the capital city of Estonia, Tallinn, as a potential knowledge city, theoretical model of the generic knowledge capitals system is used. Tallinn is analysed according to the knowledge capital system theory.

Originality/value – Knowledge-based development performance analysis of knowledge cities is still an understudied area.
Profiling of a city as a knowledge city and benchmarking it according to the knowledge cities' criteria is still a novel concept in order to assist policy makers in assessing, compiling and implementing strategies that would aim at balancing the city's economic prosperity and citizens' wellbeing.

Practical implications – The outcomes of the analyses assist the city planners, developers, policy makers and strategist in assessing the weaknesses and strengths of the city in its pursuit towards a knowledge city and provide insights of which aspects need to be improved and which strategies require reformulation. The policy makers and practitioners tend not to be fully aware

of the possibilities of how the methods and theories of knowledge city could be utilized for the development of the city. It includes awareness raising on the knowledge city concept and its practical implications for citizens.

Keywords – knowledge city, knowledge-based urban development

Paper type – Academic Research Paper

Bibliographical Notes

Katri-Liis Lepik has Ph.D. in Management Science from Estonian Business School. She has experience from cross-border cooperation and international project management for the last 17 years having worked for public and private sector and non-profit organisations. She has been 8 years a manager of a non-profit organisation Helsinki-Tallinn Euregio focusing on cross-border regional development and strategies. She has lectured on EU and regional development topics in universities for last 10 years. Presently she is an associate professor of public management at Tallinn University. Her current research and business interests include knowledge management, strategic management, social innovation and innovation in the public sector.

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Her current research interests include inter-sectorial and cross-border co-operation and communication, knowledge regions, knowledge creation, management and sharing, intellectual capital.

How to interact within science parks in order to improve industrial performance? - comparing research park and industrial park through social network analysis

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Abstract

Korea has been shifting its paradigm of growth from a fast follower to a science park in various industries. Correspondingly, the role of a science park is becoming increasingly important and Korea's major science park, i.e. Daedeok Innopolis, has been consistently requested to transform its characteristics from Research Park to Industrial Park with expectations of more economic value creation rather than knowledge creation. However, with the limited number of studies on Korean science parks, our understanding and policy establishment has also been limited. Therefore, this study examines the network structural characteristics of Daedeok Innopolis through comparing them with a representative science park in Germany, i.e. Silicon Saxony, which has similar characteristics to Daedeok Innopolis, except its visible industrial performances. We find that the interactions among organizations regarding technological knowledge creation within clusters are much more active and diverse in Daedeok Innopolis, while they are more intense in Silicon Saxony. In addition, while the roles of universities in Daedeok Innopolis are diverse, in Silicon Saxony, the university functions primarily as a liaison facilitating information exchanges among industries and other organizations. However, in Silicon Saxony, companies more actively participate in mutual interactions with various entities of clusters, while those of Daedeok Innopolis remain limited. In particular, we find that that the networking within Daedeok Innopolis is more overlapped and constrained than that within Silicon Saxony, which indicates that Daedeok Innopolis is somehow less efficiently structured from the perspective of social capital theory. We also discuss some important policy implications based on our results.

Keywords: Science Park, Daedeok Innopolis, Silicon Saxony, Social Network Analysis

The Factors affecting to 'Basic Research' Performance Funded by Government: 'Creative Research Program' Case in South Korea

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Abstract

This study examines factors affecting to the performance of basic research in South Korea. "Creative research program", which is one of major basic research program, is a study target. The survey of N=120 researchers from universities and research institute was conducted in 2010. Basic research performance which is the dependent variable was measured by subjective survey questions. The data were analyzed using factor analysis and multiple regression. The result shows that leadership is the most important factor affecting the basic research performance based on the regression coefficient (Beta). Knowledge sharing, autonomy, collaboration, and creativity in sequence were also statistically valuable factors that impact on the performance of basic research in South Korea. Implications are discussed.

Keywords: R&D performance, Basic research, Efficiency, South Korea

The Effect of Service Innovation on R&D Activities and Government Support Systems: the Moderating Role of Government Support Systems

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Abstract

This study analyzes the effects of R&D activities and government support programs for the product innovation of service industry. With the advent of the knowledge based society, the technology innovation of the service industry has become an important source of national competitiveness. However, the studies on technology innovation have focused on manufacturing industry not the service industry. This study analyzes how differently R&D activities and the government support programs have influence on product innovation by the size of companies and how the government support programs have a moderate effect in the relationship between the R&D activities and the innovation.

The results of the study are as follows; first, in case of large enterprises, both the internal and external R&D activities were proven to be the important elements for product innovation. In case of SMEs, it was analyzed that only the internal R&D activities are

significant. In other words, it was found that internal R&D activities are the important factors of product innovation for both big companies and SMEs. Second, only the direct financial support for SMEs had a positive effect on product innovation. This can be understood as a result relative to the effectiveness and necessity of direct financial support to SMEs' product innovation. Third, in the case of the moderating effect of the government support programs, the programs that provide indirect opportunity for innovation had the positive moderating effects only for SMEs. In conclusion, internal R&D activities were proved to be an important factor of product innovation for both large enterprises and SMEs. And government support programs have had a significant effect only in the case of SMEs. To have an impact on the moderated effect of the government support programs for SMEs, the internal R&D activities were confirmed. This study supports the direction of establishing SMEs support policies in the prospect of service sector innovation.

Keywords: service sector innovation, service product innovation, government support programs on innovation, logistic regression analysis

1. Introduction

The role of the service industry in national economies is increasing globally. Following the era of the Industrial Revolution, service industries have been transformed into industrial structures that create high added value. In major overseas economies, such as the United States, France, and Japan, the proportion of GDP associated with the service industry is growing. In Korea, the importance of the service industry is also growing, as the share of value-added services has reached up to 58.1%. Due to this trend, there is increasing social demand and interest in innovation. Indeed, innovation capacity is determining competitive advantage and the survival of companies in the market(Cainelli, Evangelista, and Savona,2004; Elche and González, 2008; van Riel, Lemmink, and Ouwersloot, 2004; Kang, 2014).

However, research on innovation has been focused on manufacturing (Brown and Eisenhardt, 1995;Drejer, 2004).This lack of studies on innovation in the service sector is said to be due to endogenous limitations on measuring the quality and performance of services and, in particular, the Korean industrial ecosystem of to accumulate experience of economic growth led by manufacturing.

The impact factor for a company's innovation can be divided into significant internal and external factors. Typical internal factors may be the company's resources and capabilities related to R&D activities as well as the size of the company. Government support schemes would be an external factor. The role of government in supporting business innovation is very important because technology innovation is one of the significant factors contributing to an increase in national competitiveness.

The purpose of this study is to examine how business R&D activities and government support programs influence the effects of product innovation, and whether government support programs have a moderating effect on product innovation. This study is meaningful in the following ways. First, it provides a significant contribution to the research on innovation in the service sector, for which there are relatively few studies. Second, it considers how business R&D activities and government support programs influence product innovation performance. Third, this study analyzes the moderating effect of the government support scheme, which provides implications on how to establish policy geared toward innovation.

2. Theoretical Review and Hypothesis

1) Characteristics of Services Innovation

Innovation-related studies have focused mainly on manufacturing rather than services. A service has characteristics such as aplasia, concurrency, and decaying; thus, it is difficult to distinguish factors affecting service innovation. Considering the limits of the growth of the manufacturing industry and the advent of the knowledge-based service society, this study is focused on service innovation, as industrial and national interest in technology innovation for the service sector has been increasing. Service innovation-related research is approached from two perspectives. First is the demarcation approach, which emphasizes differentiation based on heterogeneous factors. Second is the assimilation approach, which is based on the premise that there is no difference between the innovation system of the manufacturing and service industries. Recently, a comprehensive integrated approach has arisen, but is still in its rudimentary stage. Moreover, the issue of heterogeneity and similarities between technology innovation in the manufacturing and service industries needs to be demonstrated consistently(Kim, 2010).

An assimilation approach is based on the perspective that the service industry achieves innovation by introducing new technologies and new processes from other industries because technology innovation and productivity improvements are minimal in the service sector itself. Further, this approach has a profound relationship with the subordinate survey, one of the approaches used to investigate innovation in the service sector(DjellalandGallouj, 1999, 2001; Seo et al., 2011).The subordinate survey means that the same method used to research innovation in the manufacturing industry is applicable to the service sector. This approach is used in the Community Innovation Survey(CIS) and the Korean Innovation Survey(KIS), for example. Many innovation-related studies have been carried out based on the data of the KIS using assimilation approaches. Based on the discussion so far, innovation performance in the service sector can be divided into product innovation and process innovation, as has been done for manufacturing innovation studies (OECD, 2005). There is no definite conclusion on which is reflected more heavily in the results regarding service sector innovation. Numerous the oretical reviews, including Hipp and Grupp(2005),showed prominent performance for product innovation in both the service and manufacturing sectors, but the results for process innovation are relatively few. Therefore, this study sets product innovation as the dependent variable, as it has a more noticeable result than process innovation does.

2) The Relationship between R&D and Innovation Performance

Traditionally, research and development(R&D) activities have been considered as important inputs for innovation(Romer, 1990; Geroski, 1994; Dinopoulos and Thompson, 1998). Manufacturers have focused on new technologies and new product development through technology innovation and services have enhanced the innovation capacity of companies through innovation in management(Howells, 2001). However, recently, there has been increasing awareness of the potential for 'non-technical' innovation in the manufacturing sector to strengthen manufacturing competitiveness. Moreover, technical innovation is highly valued for the promotion of services. R&D expenditures in the service sector are constantly increasing, and the service enterprise is aiming to improve product development and the production process by increasing both internal and external R&D activities(Edwards and Croker, 2001). In particular, the R&D activities of service companies are more relevant to product innovation than to process innovation, and process innovation has been closely related to external factors(Rouvinene, 2002).

3) The Relationship between Firm Size and Innovation Performance

The representative study for the relationship between firm scale and technical innovation is that of Schumpeter(1942). It hypothesizes that the larger an enterprises is, the more lively its innovation activities. According to economy of scale, larger companies are more active in innovation activities and more likely to commercialize new technology. Since Schumpeter's hypothesis was raised, various empirical analyses about the relationship between firm size and R&D have been carried out, and a wide range of results are still being discussed today. According to Schere and Ross(1990), R&D efficiency can drop as a company's scale increases, as large enterprises have lax management and scientists' and engineers' motives to invent can be lost to bureaucracy. On the other hand, Cohen(1995), Cohen and Klepper(1996), and others showed that there is a positive relationship between firm size and technology innovation. Scherer(1965) demonstrated that there is an inverted U-shaped relationship between firm size in certain industries and technology innovation. These studies indicate that in all industrial areas, a firm's size must be at a particular threshold in order to be effective in carrying out innovation activities. Thus, it seems that firm size has a significant impact on innovation performance(Cohen, 1995; Rogers, 2004). Company size should be considered in light of the present domestic business ecosystem, as empirical research on Korea provides similar results (Kim, 1992; Sung, 2003). As stated above, R&D activities are seen as an important input factor for service innovation performance. Hypothesis 1 verifies the relationship between R&D activities, as independent variables, and technological innovation. It reaffirms previous research results showing that R&D activities in the service sector have a close relationship with product innovation performance based on empirical analysis.

<Hypothesis 1>The type of R&D activities affecting product innovation in the service sector will vary depending on firm size.

<1-1>The R&D activities of large-sized companies affect product innovation in the service sector.

<1-2>The R&D activities of SMEs affect product innovation in the service sector.

4) The Relationship between Government Support Programs and Innovation Performance

Previous studies mainly considered the various government support programs as external factors of enterprise technology innovation. Government support schemes are classified by researchers using a variety of criteria, such as in<Table 1>. In particular, Lee's(2011) study on the Korean Innovation Support System showed that innovation support programs can be classified as supports for tax incentives, finance, technology development, human resources, purchasing, law and institutional infrastructure, or other indirect supports based on the expenditure approach. In Korea, government innovation support systems are considered an important factor in innovation performance. Indeed, the Korea business ecosystem offers many successful examples of government-led industrial development.

<Table 1 Government Support Program>

Persons	Types and Tools
Hood(1986)	Authority, Nodality, Treasure, Formal Organization
McDonnell and Elmore(1987)	Mandates, Inducements, Capacity Building, System Changing
Schneider and Ingram(1990)	Authority tool, Capacity tool, Symbolic tool, Learning tool
Keizer et al(2002), Shefer and Frenkel(2005), Lin et al(2006), Hall and Bagchi-sen(2002)	Finance, Human Resources
Vedung(2005)	Sticks, Carrots, Sermon
KIM&DO(2004)	direct support and indirect support, financial benefit and non financial benefit
KIM(2014)	Financial support, direct support, indirect support

When classifying the innovation support programs of a government, a subsequent commercialization stage should be considered as well as the promotion of technology innovation. This perspective applies equally to the case of Korean innovation support programs. Kim(2004) classified the Korean government's innovation support programs into direct and direct supports and financial benefits and non-financial benefits. Kim(2014) classified direct support as financial supports, R&D, and R&D education supports; and indirect support as technology information, human resources supports, and public procurement.

Based on the discussion above, this study divided various government support programs affecting service innovation into three types. First, financial support, such as tax reduction and commercialization funding is a major factor that influences the introduction of technologies and R&D. It has characteristics as a tool to induce technology innovation and subsidize companies' technology innovation activities. Second, programs to support innovation opportunities include support for R&D, technology information, human resources, and education. Third, programs to diffuse the results of innovation include programs for marketing and public procurement.

Hypothesis 2 of this study analyzes the relationship between government support programs, as independent variables, and product innovation in the service sector, as dependent variables.

<Hypothesis 2>The type of government support programs affecting product innovation in the service sector will vary based on firm size.

<2-1> Large-sized companies that have gained a benefit from government support will affect product innovation in the service sector.

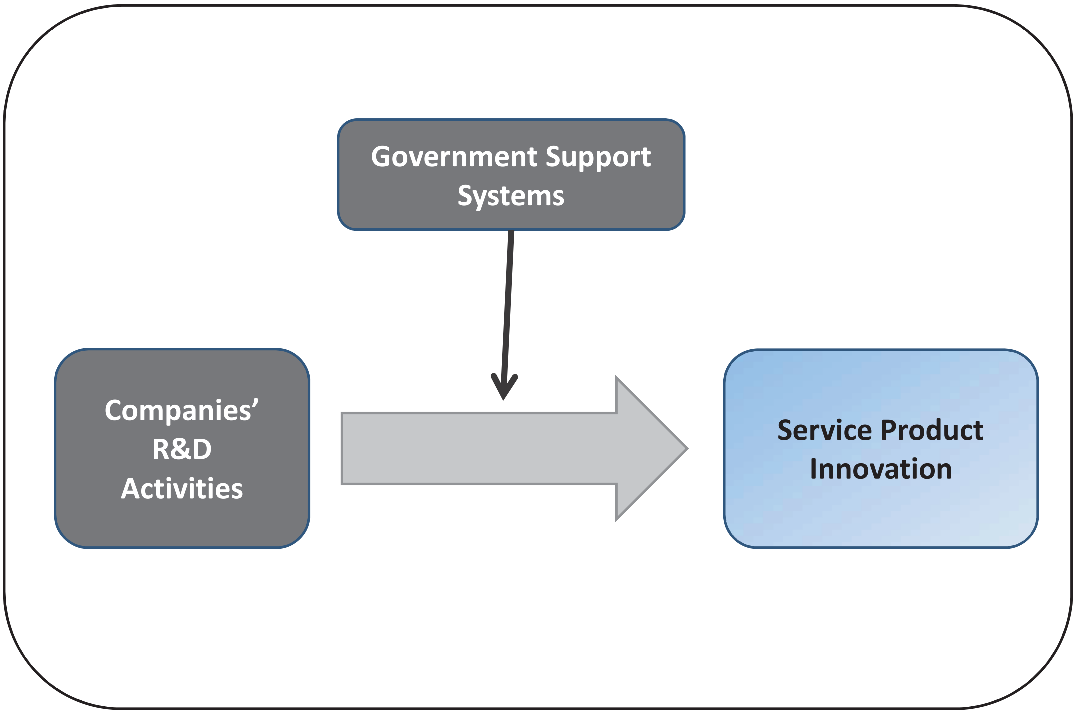
<2-2> SMEs that have gained a benefit from government support will affect product innovation in the service sector.

In relation to the factors affecting technical innovation, R&D activities are considered an internal impact factor, and government support programs are considered an external impact factor. Some preceding research has presented results of the moderating effect of government support programs on the relationship between enterprises' R&D activities and product innovation performance(Seo, 2007; Kang, 2013). However, such studies have typically targeted the manufacturing industry, not the services sector. Given that the government has recently expanded its support for SMEs in the service sector, this study empirically analyzes the moderating effect of government support programs on the relationship between companies' R&D activities and product innovation performance in the service sector. The effect of firm size is also investigated. The results are expected to offer meaningful implications on the establishment of policy to support service sector innovation.

<Hypothesis 3> When enterprises take advantage of the government’s innovation support system, the effect of product innovation will be strengthened.

<3-1>When large-sized companies take advantage of the government’s innovation support system, the effect of product innovation will be strengthened.

<3-2> When SMEs take advantage of the government’s innovation support system, the effect of product innovation will be strengthened.



3. Survey Design

1) Data and Research Method

This study utilizes data from the Korea Innovation Survey(KIS) 2012: Service Sector. The population includes service providers with more than 10 regular employees that were active from 2009 to 2011(service companies less than 45-96 by Korean Standard Industrial Classification(KSIC)). This survey targeted a total of 54,831 companies. The responses of 4,063 companies were made available by multistage stratified and systematic sampling. For the present study,615 samples were extracted by eliminating missing values(null) of major variables.

2) Variables

a. Dependent Variables

Product innovation in the service sector, the dependent variable, consisted of two items: to release new items completely different from existing products and to significantly enhance products. If at least one of the dichotomous outcomes was yes, it was regarded as valid innovation (Y=1); if both responses were no, it was regarded as invalid innovation (Y=0).

b. Independent Variables

The R&D activities of companies, the independent variable, were classified into three items: internal R&D activities(X1), joint R&D activities(X2), and external R&D activities(X3).The responses were checked for these three items.

c. Moderator Variable

Government support programs, the moderator variable, are composed of three items: 1) direct financial supports(M1), 2) indirect support to provide opportunity for innovation(M2), and 3) indirect support to diffuse the result of innovation(M3). Nine interaction terms related to R&D activities and government support system(X1*M1, X2*M1, X3*M1 / X1*M2, X2*M2, X3*M2 / X1*M3, X2*M3, X3*M3) were created to analyze the moderating effects. The result of the variance inflation factor(VIF) among independent variables used as an interaction predictor was less than 10, which means that multi collinearity did not arise(Neter, Wasserman, &Kutner, 1985). Thus, the process of mean-centering was omitted.

d. Control Variable

Workforce size dedicated to R&D was adopted as a control variable. Major preceding research utilized workforce size dedicated to R&D for an indicator showing companies' activity.

<Table 2 Definition of Variables>

Variables				**Variable Measurement**
Dependent variables	R&D activity	Internal R&D	**X1**	Whether companies have carried out R&D activities from 2009 to 2011.
		Cooperate R&D	**X2**	
		External R&D	**X3**	
Indepen-dent variables	Product innovation performance	Achieving product innovation performance	**Y**	Whether companies have achieved product innovation performance from 2009 to 2011.

Moderator variable	Government Support Program	Direct Financial Support	**M1**	Whether companies have received government's finance supports including tax reduction from 2009 to 2011.
		Indirectly providing innovation opportunity	**M2**	Whether companies have received government's indirect support to provide opportunity innovation from 2009 to 2011.
		Indirectly support for diffusing the results of innovation	**M3**	Whether companies have received government's support programs for marketing and public procurement from 2009 to 2011.
Control variable	R&D workforce size		**C**	Size of R&D workforce in 2011

2) Research Model

The study was carried out using binary logistic regression. This statistical analysis technique can be used when the dependent variable is binary and nominal (Aldrich, 1984; Hur). If observations are independent, a nonlinear regression model can be employed, which is relatively easy to use compared to linear regression analysis. Moderated regression analysis(MRA) was used to verify the effect of the control variables. Each logistic regression equation is as follows:

$$\ln\left(\frac{P(Y1)}{1-P(Y1)}\right) = \beta_0 + \beta_1 X_n + \beta_2 M_n + \beta_3 C$$

$$\ln\left(\frac{P(Y1)}{1-P(Y1)}\right) = \beta_0 + \beta_1 X_n + \beta_2 M_n + \beta_3 X_n M_n + \beta_4 C$$

Y= Product innovation performance, P(Y) = Probability of product innovation

X1= Internal R&D, X2= Co R&D, X3= External R&D

M1= Direct financial support, M2= Indirectly providing opportunities for innovation, M3= Indirectly diffusing of innovation performances

C= R&D workforce size

4. Results

1) Descriptive Statistics

<Table 3>represents a descriptive statistical analysis. The sample was classified into large-scale companies and SMEs according to legal standards. There were a total of 74

large-sized companies(12%) and 541 SMEs(88%).

<Table3Descriptive Statistics>

Variables	Large Firm(observations=74)				SEM((observations=541)			
	Min.	Max	mean	SE	Min.	Max	mean	SE
X1	0	1	.65	.481	0	1	.42	.495
X2	0	1	.36	.485	0	1	.15	.355
X3	0	1	.20	.405	0	1	.11	.307
M1	0	1	.2838	.45391	0	1	.3530	.47836
M2	0	1	.2703	.44713	0	1	.2015	.40148
M3	0	1	.1622	.37112	0	1	.0739	.26191
Y1	0	1	.5811	.49675	0	1	.5342	.49929
C	0	99999	1385.54	11620.9	0	273	5.28	21.643

2) Hypothesis Testing Results

a. Model compliance verification

The significance of the model was verified through the likelihood ratio test. This allowed consideration of the conformity of the research model, which analyzes R&D activities affecting service product innovation. First, the chi-squared statistic for the large firms is 26.973, and is valid at the level of $p<.01$ As a result of Hosmer-Lemeshow verification, the valid probability is found to be 0.539.Thus, the model is deemed suitable, with 74.3% prediction accuracy based on the criteria table. Second, the chi-squared statistic for the SMEs is 28.594, and is valid at the level of $p<.01$ The result of the Hosmer-Lemeshow verification is 0.936 of valid probability. Therefore, the model is confirmed to be suitable, with 60.8% prediction accuracy.

b. Hypothesis Testing

<Table 4>presents the analysis of the results regarding the impacts on service-product innovation performance when large firms and SMEs conduct R&D using government support programs. And<Table 4> also includes the results of the analysis of the moderating variable on the impact of companies' R&D activities for product innovation

performance.

<Table 4 Logistic Regression Analysis>

Variables	Model 1		Model2(M1)		Model3(M2)		Model4(M3)	
	Large Firm	SME	Large Firm	SME	Large Firm	SME	Large Firm	SME
X1	**2.093*** (8.106)**	**.667*** (1.948)**	**2.398*** (10.997)**	**.459** (1.582)**	**2.327***** (10.245)	**.375*** (1.455)	**1.797***** (6.030)	**.409**** (1.506)
X2	-.439 (.645)	.357 (1.429)	.239 (1.270)	.153 (1.165)	-.011 (.989	-.038 (.962	-.292 (.747)	.229 (1.257)
X3	**2.643** (14.052)**	-.085 (.918)	1.983 (7.262)	-.054 (.948)	1.823 (6.189)	.053 (.898)	**2.159*** (8.662)	-.365 (.694)
M1	-.179 (.836)	**.657***** (1.930)	.900 (2.460)	**.469**** (1.598)				
M2	-.911 (.402)	**-.807***** (.446)			.781 (2.184)	**-1.516**** (.220		
M3	.274 (1315)	.419 (1.520)					-19.131 (.000)	-.485 (.411)
C	.004 (1.004)	.002 (1.002)	.003 (1.003)	.001 (1.001)	.005 (1.005)	.002 (.1.002)	.002 (1.002)	.000 (.936)
X1*M1			-1.386 (.250)	.234 (1.264)				
X2*M1			-1.771 (.170)	.215 (1.24)				
X3*M1			19.829 (409037997)	-.271 (.762)				
X1*M2					-2.167 (.115)	**1.207**** (3.342		
X2*M2					-.740 (.477	.992 (2.696		
X3*M2					20.100 (5361.95041)	−.54 (.583)		
X1*M3							39.928 (8.056E+16)	.448 (.641)
X2*M3							-21.075 (.000)	.463 (.641)
X3*M3							19.695 (357697811)	1.186 (.231)
-2LL	**73.657***	**718.859***	**70.790***	**727.93**	**70.389***	**723.109**	**71.440***	**733.2***
NR^2	.411	.069	.446	.047	.451	.059	.439	.035
HL	.539	.936	.701	.334	.508	.483	.530	.517

(1) R&D Activities and Government Support Programs' Impact on Service-Product Innovation Performance (Hypothesis1, Hypothesis2)

First, in the case of large firms, internal R&D activities are valid at the level of $p<.01$, and external R&D activities are valid at the level of $p<.05$ based on the result of Wald test. An increase of one unit (X1, $\beta=2.093$) in the internal R&D activities is linked to an 8.106-fold increase in the odds ratio, which refers to the probability of product innovation versus no product innovation(1-p(Y)). A one-unit increase in external R&D activities(X3, $\beta=2.643$) leads to a 14.052-fold increase in the odds ratio. Thus, it is found that a one-unit increase in external R&D has a more significant effect on product innovation than does a one-unit increment in internal R&D.

Second, in the case of SMEs, internal R&D activities(X1), direct financial support(M1), and indirect support to provide innovation opportunity(M2) are valid at the level of $P<.01$. The odds ratio of internal R&D activities of SMEs (X1, $\beta = 0.667$) is 1.948. For SMEs, a one-unit increase in direct financial support(M1, $\beta=0.657$) from the government led to a 1.93-fold increase in the odds ratio of product innovation performance. The odds ratio of government support programs that indirectly provide innovation opportunity(M2, $\beta = -0.807$) is 0.446. Thus, it seems that the probability of product innovation compared to no product innovation decreases 55.4%. Proceeding from this fact, financial support from government support programs has a positive impact on service-product innovation performance, whereas support to provide innovation opportunity does not.

The findings are summarized as follows: First, <Hypothesis 1> can be adopted. <Hypothesis 1-1> is partially adopted because internal R&D activities and external R&D activities have a significant impact on service-product innovation performance in the case of large firms. Also, the internal R&D activities of SMEs were confirmed to have an impact on product innovation performance, so <Hypothesis 2> can be adopted. When large firms received government support, the effect seems to be not valid, and so <Hypothesis 2-1> is not adopted. However, when the government provides financial support and innovation opportunities to SMEs, it has an impact on product innovation, so <Hypothesis 2-2> is partially adopted.

(2) Moderating Effect of Government Support Programs on the Relationship between R&D Activities and Service-Product Innovation Performance(Hypothesis3)

The model is found to be persuasive because the value of -2LL was smaller in the second, third, and fourth stages, including the moderating effects, than in the first stage, excluding the moderating effects.

The regression coefficients value of interaction term, an important factor used to analyze the moderating effects of government support programs, is not valid. Only the interaction predictor between internal R&D of SMEs and indirect support to provide innovation opportunity is deemed valid(β=1.207, $p<.05$). This means 3.342-fold increase in the odds ratio of the probability of service-product innovation performance results from aone-unit increase in the interaction predictor between internal R&D activities(X1) and indirect support providing innovation opportunity(M2). In other words, indirect government support providing innovation opportunity strengthens the positive effects of the impact of internal R&D activities(X1, β=.375, $p<.1$) on service-product innovation performance.

All this considered, <Hypothesis3> is partially adopted, and <Hypothesis3-2> is partially adopted as well because it was confirmed that when SMEs use government support programs that indirectly provide innovation opportunities, the impact of their R&D activities on service product innovation performance is strengthened.

5. Conclusion

This study analyzed the impact of companies' R&D activities and government support program on service-product innovation performance as well as the moderating effects of government support program. The following conclusions are drawn. First, R&D activities are needed for service innovation. Generally, the service industry, a non-technical industry, has been focused on developing new service products and processes that combine the technologies and products developed in other industries. However, according to the results of the analysis, internal and external R&D activities were a major factor in releasing and improving new service products in the case of both large firms and SMEs. In particular, large corporations had a greater influence from external R&D than did SMEs. This can be seen as a reflection of the flow of innovation development, whereby certain environments are considered worthy of such leverage of external resources and cooperation including open innovation.

External R&D activities of SMEs did not affect service-product innovation. The result maybe caused by the fact that the proportion of external R&D activities for SMEs is very low, and thus it was difficult to predict its effect. It can be assumed in advance that the R&D capability of SMEs is also low compared to that of large enterprises. For SMEs, it is necessary to make voluntary efforts to enhance the external R&D activities beyond the internal R&D activities, and the government's policy support is required as well. The effects of government innovation support programs are constantly verified. Therefore, it is necessary to provide different government support programs based on company size. In Korea, there are various institutions related to the innovation support system. However, as is shown in the above results, there seems to have never been in-depth discussion about policy improvements geared toward operating system-specific status and situation.

There are different types of government support schemes affecting service production innovation that have varying effects. The effects of direct financial support can be expected to address the innovation-related difficulties of SMEs. Likewise, it is not expected to be effective to consider institutions uniformly, without respect to industry characteristics, legal standards, and innovation capability. If the development of technology innovation support programs and evaluation and feedback on that form a virtuous cycle, a synergistic effect would be expected between corporation R&D activities and government support programs.

Despite the aforementioned implications, this study has the following limitations. First, even though service innovation performance can be classified into different types, this study analyzed it in terms of product innovation, just as has been done for the manufacturing industry, in order to obtain survey data on innovation performance. The reliability of this approach is high because the innovative performance measures are borrowed; however, this study may be limited in that it does not reflect a new perspective on the scope and type of services. Second, there are limits to the type of government support schemes. This study classified government support programs into direct financial support, indirect support that provides innovation opportunity, and indirect support to diffuse the results of innovation, based on the standard questionnaire for the KIS data. This cannot cover all of the various support programs. More specific policy-related implications can be derived in future studies of innovation performance that explore more detailed characteristics of the service industry.

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Perceived innovation barriers, open innovation and its performance

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Abstract

Technological innovation is recognized as a critical factor that determines a nation's and a company's growth potential. The innovation system is failing because of its structural problems, blocking the creation and spread of innovation. In order to overcome such systemic failures it is imperative that the existing system's shortcomings be analyzed and solved all the while creating new system and structure in which innovation actors can expedite innovation. Therefore this study aims to identify the factors that promote and inhibit innovation performance in Korean companies and suggest amendments to the existing policy and regulations. This study investigated the effect that awareness of factors that hamper innovation and innovation activities themselves have on the technological innovation performance of companies. This study calls for an environment and system where Korean companies can continuously grow its global business value by open innovation activities, creating a virtuous cycle. In conclusion, the result of this study should be taken into account for revising and ameliorating the existing environment. We suggests that the policy and law be amended as to allow support based on the size of business and create new infrastructure, policy institutions and structure that reduces the possibility of systemic failures in innovation.

Keywords: Open innovation, awareness of factors that hamper innovation, innovation activities, technological innovation performance

Affecting Factors on Performances of University-Industry Cooperation

: Mediating Effects of the Government Support & University-Industry Cooperation

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Abstract

This study is designed to find out the mediating effects on government-funded R&D projects in relationship between competence factors of universities and performances of university-industry cooperation. The majority of former researches on university-industry cooperation and its performances are focusing on research capacity of the university, competence of the TLO and traits of the university. Researches on the role of government and industrial supports in R&D projects for university-industry cooperation are relatively rare. This study is conducted to analyze mediating effects of government and enterprise funded R&D projects in consideration of performances from university-industry cooperative projects.

In this study, 3-step analysis of mediating effects (Baron and Kenny, 1986) and Sobel Test is taken for the empirical analysis. In result, R&D funding from the central government partially mediates performances of university-industry cooperation when the research capacity of full-time faculty and the size of TLO are taken as independent variables. The R&D funding from central government does not mediate the university-industry cooperation when the size of the center for university-industry cooperation is an independent variable. On the other hand, the R&D funding from the local government does not mediate the performance of university-industry cooperative projects in any chosen independent variables.

Based on the results from this study, it suggests the direction of governmental funding in R&D projects to promote performances from university-industry cooperation. It is also required for universities to expand its research capacity and operation of TLO.

Key words: University-Industry Cooperation Performances, R&D Capacity of Universities, Mediating Effects, Sobel Test

1. Introduction

R&D in universities takes an important role for technological innovation and economic growth of private enterprises. (Mansfield, 1991) The U.S. and major European countries support policy to promote university-industry cooperation. It is to create new industrial field and employment by encouraging commercialization of creative knowledge produced in the university. Also in Korea, supports on university-industry cooperation have been reinforced at government level and universities take the major role since it has been one of the largest institutions of R&D. In Korea, 23% of total R&D budget is invested to universities and 67% of doctoral level researchers are engaged with R&D at the university.

Supporting policy on university-industry cooperation makes universities to pursue expansion of research capacity and transformation of its institutional role to enhance practical application research outcomes (Yim, 2013). However, strong support from the government to promote university-industry cooperation was evaluated to have less impact on the outcomes, and observed to be insignificant so far (Sung, 2011).

In Korea, researches on the affecting factors of university-industry cooperation and its performances fledged after 2000s. The performance of University-industry cooperation has been understood in various senses. In a broad, qualitative sense, it includes mutual transfer of tacit knowledge and vitalization of local economy. In a narrow, quantitative sense, university-industry cooperation performances are measured with number of patents (both local and international), number of technology transfer contracts and its income (royalty), number of spin-offs, etc. Research and management competence of the university and other several traits are considered to be influential on the performance of these cooperative works.

In many researches, competency factors of the university were investigated to draw its relevance to the outcomes from the university-industry cooperation under the premise of the importance of cooperation between the university and the industry. However, R&D funding from government to promote university-industry cooperation is facing rather skeptical evaluation, and it becomes necessary to analyze the role and its effectiveness of government in funding R&D projects.

This study focuses on universities operating the Center for University-Industry Cooperation. It shows competence factors and organizational traits of universities affects performances of university-industry cooperation, and in this affecting structure the mediating effects of government-funded R&D projects are empirically analyzed. Based on the results, this study suggests the direction of governmental funding in R&D projects to promote performances from university-industry cooperation. It is also required for universities to expand research capacity and operation of TLO[1].

2. Literature Review

1) Performances of University-Industry Cooperation

In early 80s, with an emerging concept of 'academic capitalism[2]', researches on the role of researches conducted in universities increased in discussion of university-industry cooperation and technology innovation. (Slaughter and Rhoades, 2004) With legislation of Bayh-Dole Act in 1980, the U.S. systematized the rights on intellectual properties and created cooperative environment at

[1] TLO (Technology Licensing Office) is widely used in Korea instead of TTO (Office of Technology Transfer) as in the U.S.

[2] Academic capitalism: Decreased tax revenue and intervention of neo-liberalistic ideology has driven universities to pursue new source of income. Universities promote research funding from enterprises, secured rights of intellectual properties and foundation of spin-offs to create new profit centers. (Slaughter and Rhoades, 2004)

university level by promoting Office of Technology Transfer (TTO or TLO, Technology Licensing Office), University Research Park (URP) and venture start-ups.

University-industry cooperation in Korea started with the legislation of Vocational Education Promotion Act in 1963. At this early stage, it focused on training of manpower for the industrial needs. In 1990s, the Act reformed and expanded to provide institutional background for university-industry cooperation. In 2000s, the importance of university-industry cooperation stressed out with catchphrases ‘Balanced National Development’ and ‘Construction of National Innovation System’. In 2003, the Act expanded to‘Industrial Education Enhancement and Industry-Academia-Research Cooperation Promotion Act’ and became legal foundation for university-industry cooperative programs. In Korea, ‘Industrial Education Enhancement and Industry-Academia-Research Cooperation Promotion Act’ defines university-industry cooperation as mutual cooperation with industrial education institutes, central government, local government, the research institutes and enterprises in pursuit of manpower training for industrial needs, R&D for technology development, technology transfer and consulting to enterprises. Universities are expected to lead cooperative role and to produce practical outcomes from cooperative works with its industrial counterparts, to promote national economic growth and technological innovation. (Yim, 2013)

2) University competence and performances on industrial cooperative works

Early researches on the university-industry cooperation stressed out the importance of universities as research institutes. Mansfield (1991, 1992, 1995, and 1998) surveyed enterprises in the U.S. to discover the contribution of universities to the development of new product reached to 13% and of new process reached to 10% during 1975-1985. Mansfield(1995) studied how technological innovation in several industrial fields are relying on R&D conducted in universities and found that academic research provided new theory and empirical development for manufacturing process and product. In short, it describes performances of university-industry cooperation are directly affected by research capacity of the faculty, scale of R&D, geographical adjacency in positive direction. As in <Table 1>, affecting factors on performances of university-industry cooperation have been conducted in 4 categories; research competency of the university, TLO, sources of funding in R&D projects and traits of the university.

<Table 1> Major Affecting Factors on Performances of university-industry cooperation

	Affecting Factors & Existing Researchers
Research competency of the University	· Number of Papers (Hicks & Hamilton, 1999) · Number of Well-known Professors of Department of Engineering (Powers, 2003) · Number of SCIE Papers (Kim & Lee, 2007)
Technology Licensing Office (TLO)	· Old Technology Transfer Office(Powers, 2003) · Number of Employees of University-Industry Cooperation Foundation & TLO (Ok & Kim, 2007)

Government & Enterprise Funded R&D Projects	· Government-supported R&D funds, Enterprise-supported R&D funds (Di Gregorio et al., 2003) · R&D funds per faculties (Gulbrandsen et al., 2005) · Type & Scale of R&D Funding, Enterprise-supported R&D Ratio (O'Shea et al., 2005)
Number of students and faculties & Location of Universities	· Number of Faculties and students (O'Shea et al., 2005) · Gap of R&D Fund between Universities located in Metropolitan and Non-Metropolitan Area (Han, 2009)

Reviews on former researches on university-industry cooperation and the performances draw a few features in common. First, there are many researches finding relationship between research capacity of universities and university-industry cooperation performances. Hicks & Hamilton (1999) discussed the positive influence of the number of produced papers on university-industry cooperation performances. Kim & Lee (2007) explained a significant relationship between the number of SCIE papers and technology transfer.

Second, in organizational capacity of universities, Powers (2003) argued a university with time-honored TLO, R&D funding from federal government and enterprises and celebrated professors in Engineering school tends to produce more patents and to have more income from technology transfer based on the Resource-Dependency theory. In Korea, Ok & Kim discussed the size of TLO has positive influence on the number of technology transfer contracts and income. Academic background of human resources in universities is also considered to have significant influence on technology transfer and commercialization of technology. (Kim, 2005)

Third, there are researches focusing on the traits of universities. O'Shea et al. (2005) suggested the size of a university, counted with the number of faculty members and the number of post-doctoral researchers is significantly related to the number of spin-offs. Jaffe (2003) described the correlation between the research funding from the federal government and the production of patents at state level. Friedman & Silberman (2003) explains if a university's geographical location is close to a high-technology enterprises concentrated area, it enhances the technology transfer. In Korea, researches suggested the gap of research capacity between universities in metropolitan area and others. (Han, 2009) The size of a university and its location also differentiate R&D funding from the government (Kwon, 2013), it is expected to create significant influence on performances of university-industry cooperation.

At last, in consideration of R&D funding from the outside, Di Gregorio et al. (2003) discussed universities with larger R&D funding from the industry showed higher level of performance in foundation of spin-offs. Gulbrandsen et al. (2005) argued performances were affected by R&D funding on the individual researchers. The scale of individual funding from the industry shows significant relationship in positive direction with patents, consulting and start-ups. O'Shea et al. (2005) argued the traits and the scale of individual funding have significant influence on the performance of university-industry cooperation. Especially, the more funding a university receives, the higher research applicability is shown. Foltz et. al. (2000) argued the R&D funded by federal and state government shows positive influence on the performance while the R&D funded by industry or by the university itself did not have significant relationship. Martino (1992) stressed out the importance of local governments' efforts to vitalize local economy. Also in Korea, Baik (2009) argued local government should perform supplementary role in support of central government in funding R&D projects.

The majority of proceeding researches described linear relationship of research capacity of universities and its performance in university-industry cooperation to highlight the importance of the research capacity (Yim, 2013). In extension from this viewpoint, Trostel & Ronca (2007), Weerts & Ronca (2008) studied other determinants related to financial supports on universities. Senter (1993) investigated the determinants of state government budget in the R&D institutes including universities in the U.S. Based on these proceeding researches, the mediating structure of R&D funding from the government and the industry can be assumed. However, there are few researches have been conducted to analyze the supporting structure and effectiveness of R&D funding from various sources into universities.

There are many supports on policy to promote university-industry cooperation in Korea. However, despite the governmental supports to promote university-industry cooperation, the employees of the Center for University-Industry Cooperation are experiencing difficulties to produce significant outcomes from the university-industry cooperation due to heavy workload from R&D project management (National Research Foundation, 2010). However, strong supports from government to promote university-industry cooperation are evaluated to have less impact on the outcomes so far (Sung, 2011). Under this circumstance, this study is to suggest efforts of university to expand its research capacity and direction of R&D funding from the government.

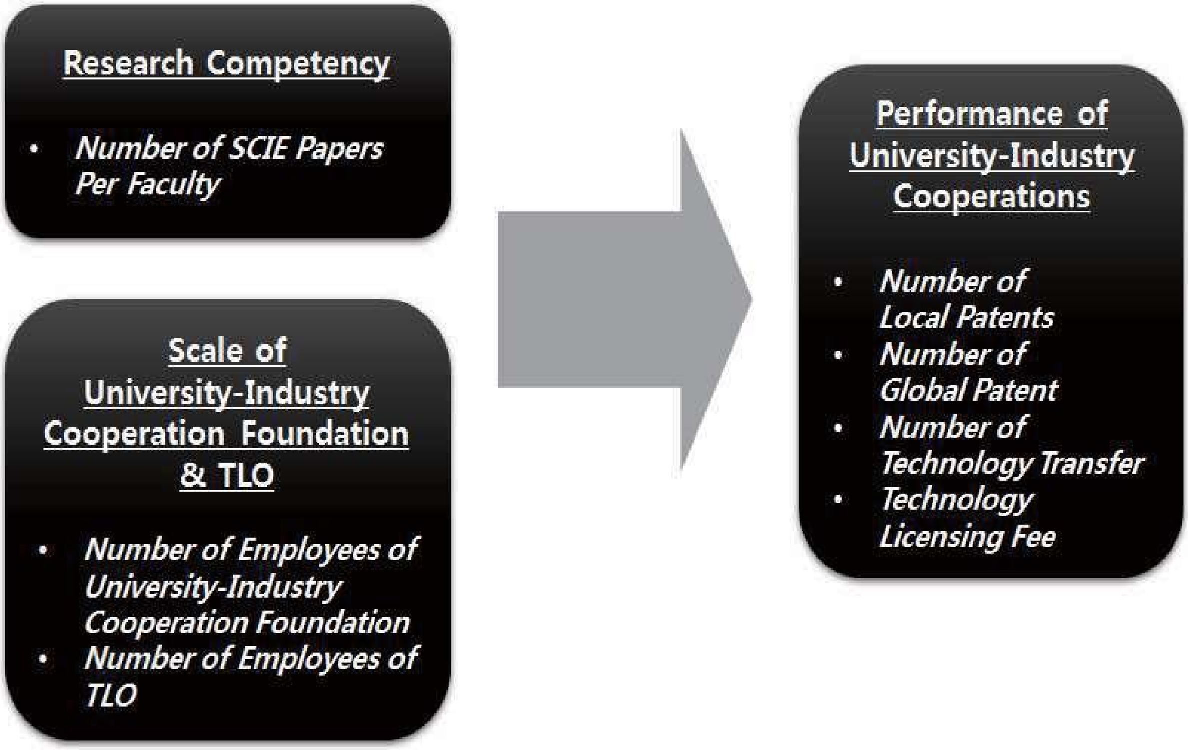
3. Hypothesis and Research Models

1) Affecting factors on performances of university-industry cooperation

As in proceeding researches, the major description factors of the performance of university-industry cooperation are related to the research capacity, size of the organization and traits of universities. The research capacity, especially, considers research capacity of full-time faculty in perspective of human resources as well as research facilities (Hicks & Hamilton, 1999). In this study, the number of SCIE papers produced by full-time faculty as the key factor for research capacity of universities, as in other former studies. The environmental aspects such as location, whether a university is located in the metropolitan area or not, and the type of foundation, whether it is a national university or a private university, are treated as control variables. In organization management standpoint, closeness of relationship, quality of patents, excellence of human resources involved in the university-industry cooperation would be counted as explanatory variables. However, these variables can hardly be measured to be used in quantitative analysis, and therefore excluded in this analysis. Instead, the size of the Center for University-Industry Cooperation and the size of TLO are considered as independent variables.

In former researches, number of national-international patents, number of technology transfer contracts, income from the technology transfer and number of spin-offs were treated as dependent variable in analysis of performances of university-industry cooperation. In this study, the number of spin-offs is excluded in analysis since the target university with any records on spin-offs only reaches to 40% of the entire target universities to show limitation of overall comparison. To validate major affecting factors in the performance of university-industry cooperation considered in former researches, research model (A) is designed to test <Hypothesis 1> as in <Figure 1>.

<Figure 1> Research Model (A)
- Affecting Structure to performances of university-industry cooperation



- *H1: Research capacity of full-time faculty, size of the Center for University-Industry Cooperation and size of TLO promotes the performance of university-industry cooperation.*

  H1-2) Research capacity of full-time faculty, size of the Center for University-Industry Cooperation and the size of TLO promotes the number of international patents.

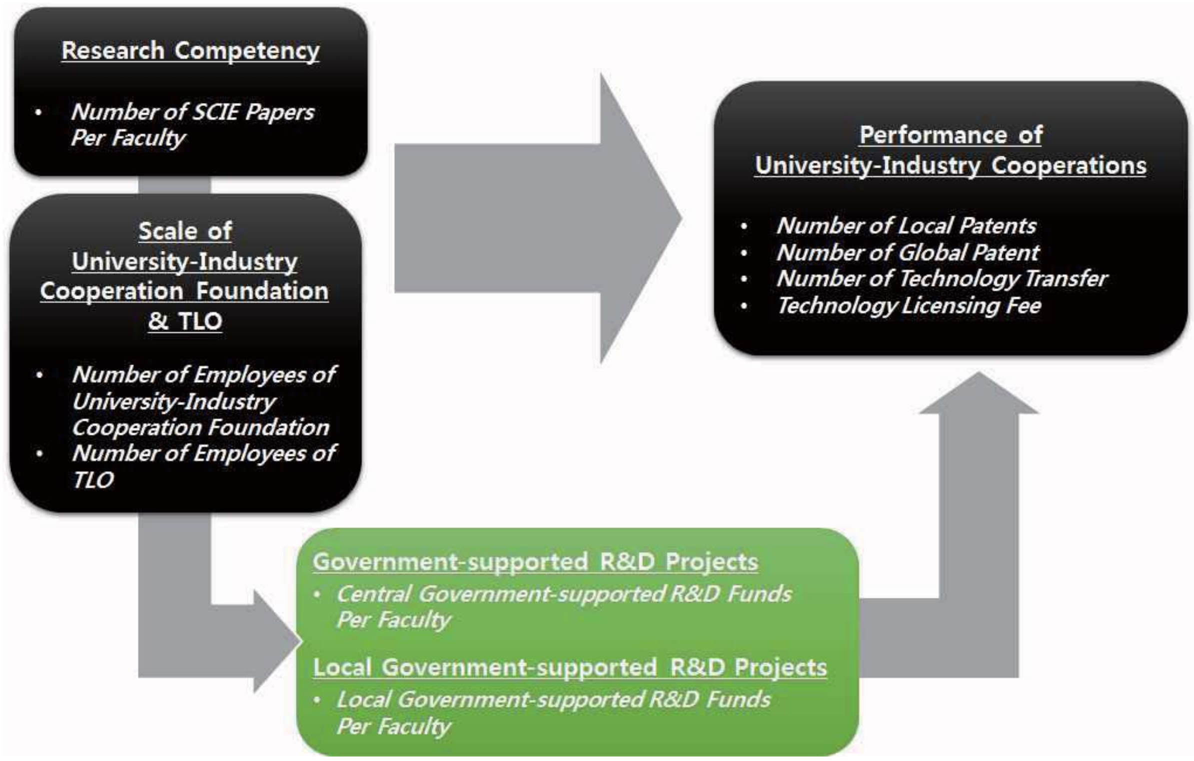
  H1-3) Research capacity of full-time faculty, size of the Center for University-Industry Cooperation and the size of TLO promotes the number of technology transfer contracts.

  H1-4) Research capacity of full-time faculty, size of the Center for University-Industry Cooperation and the size of TLO promotes the income of technology transfer.

2) Mediating effects of Government-funded R&D projects

The scale of R&D funding from the government is influenced by research capacity of the university and the size of TLO (Powers, 2003), Trostel & Ronca (2007), Weerts & Ronca (2008)). Foltz et al. (2000) suggested R&D projects funded by central and local government are positively related to the performance of university-industry relationship. In short, R&D projects funded by central and local government mediate the performance of university-industry cooperation from the research capacity of the university and the size of TLO in positive (+) direction. To observe the mediating effect of R&D funding from central and local government on the performances of university-industry cooperation based on the research capacity and the size of TLO, research model(B) is designed to test <Hypothesis2> as in <Figure 2>.

<Figure 2> Research Model (B)
- mediating effect of central·local government R&D projects



- *H2: R&D projects funded by central/local government would positively mediate the performance increase of university-industry cooperation.*

  H2-1) R&D projects funded by central government would positively mediates the performance increase of university-industry cooperation.
  a) number of national patents b) number of international patents
  c) number of technology transfer contracts d) incomes from technology transfer

  H2-2) R&D projects funded by local government would positively mediates the performance increase of university-industry cooperation.
  a) number of national patents b) number of international patents
  c) number of technology transfer contracts d) incomes from technology transfer

3) Mediating effects on university-industry cooperative R&D projects

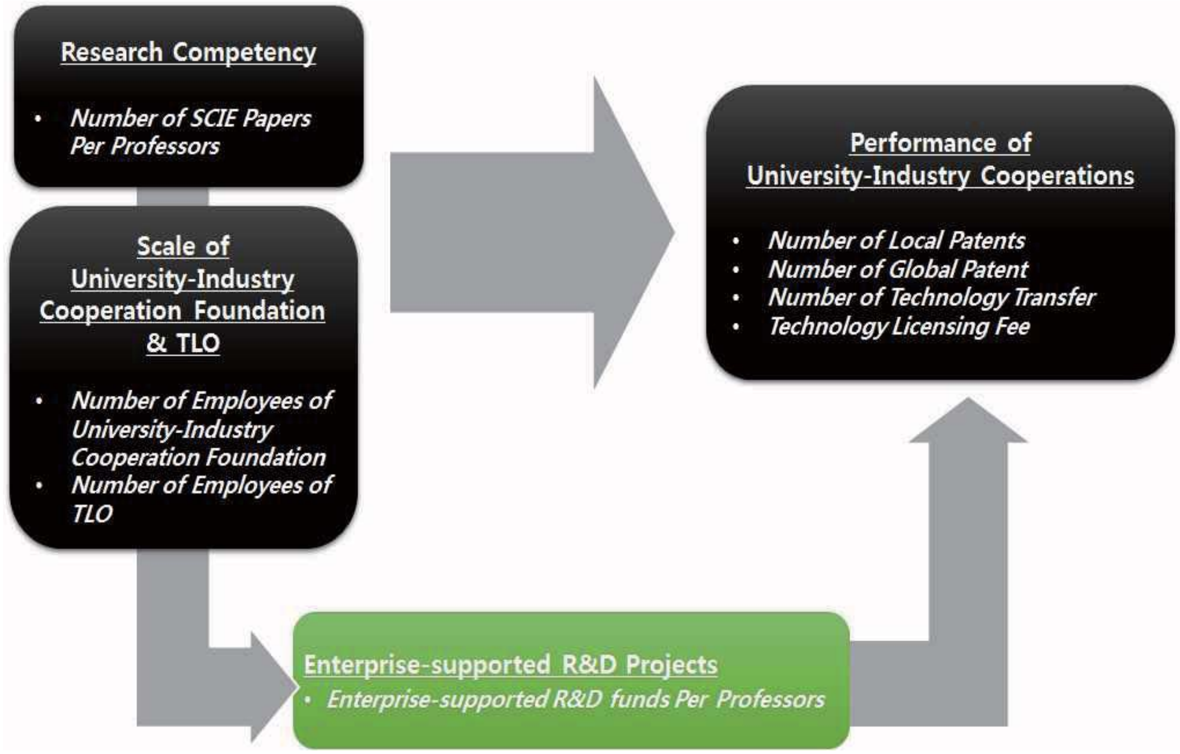
Many universities are operating the Center for University-Industry Cooperation and the office of Technology Transfer to promote cooperative works. The importance of university-industry cooperation is highlighted in terms of independence in financial management of each university and vitalization of local economy (Yim, 2013). In evaluation of the results from the university-industry cooperative R&D projects, factors such as patents, technology support and transfer and education programs take major consideration. As in Powers (2003), research capacity, size of the Center for University-Industry Cooperation and the size of TLO affects the execution of university-industry cooperative R&D projects. In short, execution of university-industry cooperative R&D projects positively mediates the performance of university-industry cooperation based on research capacity of the university and the size of TLO and contributes to the outcome of the cooperation. To observe the mediating effect of university-industry cooperative R&D funding on the performances of university-industry cooperation based on the research capacity and the size of TLO, research model(C) is designed to test <Hypothesis 3> as in <Figure 3>.

- H3: R&D projects funded by enterprises (university-industry cooperative projects) would positively mediate performance increase of university-industry cooperation.

H3-1) R&D projects funded by enterprise would positively mediate performance increase of university-industry cooperation.
a) number of national patents b) number of international patents
c) number of technology transfer contracts d) incomes from technology transfer

<Figure 3> research model(C)

- mediating effects on university-industry cooperative R&D projects



4. Research Design

1) Methods and data

The data is collected from "The Information Service of Higher Education in Korea" website[3]. In Korea, an obligatory survey is conducted by the National Research Foundation, in cooperation with the Ministry of Education, every year according to the provisions of "Act on Information Disclosure of Educational Institutions" and the collected information is provided online. In this study, 3-year data from 2011 to 2013 is collected from the website. The target is limited to 139 universities offering 4-year coursework and a bachelor's degree and excludes technical colleges focusing on vocational training. In consideration of time lag in production of outcomes from university-industry cooperation, an average of 3-year data is used in the analysis.

<Table2> describes the dummy variables in this analysis, categorization of universities based on its location and the type of foundation. In the category of location, the national university includes the

[3] www.academyinfo.go.kr

national, public universities and universities endowed with special Acts. The dummies, location and the type of foundation, are considered as major independent variables as in other related researches in a discussion of affecting structure of the performance of university-industry cooperation from research capacity of full-time faculty.

<Table 2> Categorization of the university

	National/Public Universities	Private Universities	Sub Total
Non-metropolitan Area	28	67	**95**
Metropolitan area	4	40	**44**
Sub Total	**32**	**107**	

A multiple regression analysis is performed to investigate the effects of the number of SCIE papers produced by full-time faculty, the size of the Center for University-Industry cooperation and the size of TLO in consideration of the outcomes from university-industry cooperation as in <Hypothesis 1>. <Hypothesis 2> and <Hypothesis 3> assume mediating effects of R&D projects funded by central·local government and the enterprises. To test these hypotheses, 3-step analysis on mediating effects suggested by Baron and Kenny (1986) was carried out in this study. In addition to this point estimation based analysis, interval estimation based Sobel Test is conducted to improve the statistical significance of the mediating effects analysis.

2) Variables description

The dependent variables in this analysis are the number of patents (both national and international), the number of technology transfer contracts and income from the technology transfer. Since the frequency distribution of registered patents is inconsistent, the variable is defined as a sum of applied and registered patents. Also, to control the difference from the size of full-time faculty in performances of university-industry cooperation, the research capacity per faculty is taken in this analysis.

For the independent variables, the number of SCIE papers per faculty is used to see the research capacity of the university, and the number of employees in the Center for University-Industry cooperation and TLO is counted to measure its size. The number of registered students is used as the control variable since it is one of the major indicators representing the size of a university (O'Shea et al., 2005). In consideration of influences on university-industry cooperation from its location and the type of foundation, as discussed in several former studies, those variables are treated as dummy variables. Operational definition of each variable is described in <Table 3>.

<Table 3> Definition of the Variables

	Variables	Variable measurement
Dependent Variables	**Number of Local Patents**	3-year average of national patents, both applied and registered
	Number of Global Patents	3-year average of international patents, both applied and registered
	Number of Technology Transfer Contracts	3-year average of the number of technology transfer contracts.

	Income from Technology Transfer(Licensing)	3-year average of income of technology transfer(licensing)
Indepen-dent Variables	**Number of SCIE Papers Per Faculty**	3-year average of the number of SCIE papers produced by full-time faculty per faculty
	Number of Employees of University-Industry Cooperation Foundation	3-year average of employees in the Center for University-Industry Cooperation
	Number of Employees of TLO	3-year average of employees in TLO
Mediating Variables	**Central Government-supported R&D Funds Per Faculty**	3-year average of R&D funding from central government per faculty
	Local Government-supported R&D Funds Per Faculty	3-year average of R&D funding from local government per faculty
	Enterprise-supported R&D Funds Per Faculty	3-year average of R&D funding from enterprise per faculty
Control Variable	Number of students	3-year average of registered students
(Dummy)	Metropolitan area or Non-metropolitan area	Location of the university, either metropolitan or other location
	National/Public or Private University	Type of foundation, either national or private

5. Analysis Result

1) Basic Statistics

A few variables representing the performance of university-industry cooperation in this analysis is positively skewed and fails to satisfy the assumption of normal distribution. To solve this problem, unitary transformation of the data suggested by Tukey (1977) is taken to reduce the skewness of normality-violating variables and to have consistent dispersion of the data. For income of technology transfer and R&D funding from local government per faculty, the value is square rooted. For the number of international patents and R&D funding from central government and the enterprises, natural logarithm is taken on the value[4]. Basic descriptive statistics of the variables are shown in <Table 4>.

The Durbin-Watson index is close to 2 in regression analysis and in every mediating effects test of dependent variables, therefore indicates its independency without autocorrelation. In multicollinearity test, the value of variance inflation coefficiency (VIF) appears between 1.278 to 2.975 to indicate no multicollinearity problem in the analysis.

<Table 4> Descriptive Statistics

Category	Variables	Mean	S.D	Min.	Max	skew-ness	kur-tosis

[4] In SPSS, normality assumption is satisfied if skewness is not exceeding the absolute value of 2 and if kurtosis is not exceeding the absolute value of 4. (Hong, 2007)

Dependent Variables	**Y1**	**Number of Local Patents** (Square root)	9.86	7.98	0.82	43.30	1.46	2.50
	Y2	**Number of Global Patents** (ln)	1.01	2.30	-2.30	5.79	0.19	-1.03
	Y3	**Number of Technology Transfer**	14.164	86.70	0.00	86.7	1.70	2.98
	Y4	**Technology Licensing Fee** (Square root)	379.63	444.98	0.00	1887.90	1.66	2.41
Indepen-dent Variables	**X1**	**Number of SCIE Papers Per Faculty**	0.3712	0.16	0.10	0.90	0.72	0.300
	X2	**Number of Employees of University-Industry Cooperation Foundation**	28.52	20.99	3.33	107.00	1.29	1.94
	X3	**Number of Employees of TLO**	5.94	7.26	0.00	39.00	1.94	3.81
Mediating Variables	**M1**	**Central Government-supported R&D Funds Per Faculty** (ln)	9.99	1.24	5.65	13.06	-0.29	0.36
	M2	**Local Government-supported R&D Funds Per Faculty** (Square root)	42.75	21.95	0.00	130.30	0.69	1.26
	M3	**Enterprise-supported R&D Funds Per Faculty** (ln)	7.95	1.39	3.69	12.00	-0.26	0.55
Control Variable	C1	Number of students	9801.82	5957.80	364	25076.00	0.70	-0.33
(Dummy)	D1	Location(Metropolitan / Non-metropolitan)	0.32	0.47	0.00	1.00	0.80	-1.38
	D2	National/Public or Private University	0.22	0.42	0.00	1.00	1.35	-0.193

※ N=139

2) Results from Statistics analysis

ⅰ) Regression Analysis on <Hypothesis 1>

<Table 5> shows the result of multiple regression analysis of <Hypothesis 1>. The analysis is conducted to find out the influences on the performance of university-industry cooperation from the number of SCIE papers of faculty(X1), the size of the Center for University-Industry Cooperation(X2), and the size of TLO(X3). The value of R^2, the explanation power of the variables, is high in the national patents (Y1), the international patents (Y2), technology transfer contracts (Y3) and income from the technology transfer (Y4). The t-value, an indication for statistical significance of the regression equation, of this analysis shows 99% significance level except in the relationship between the size of the Center for University-Industry Cooperation(X2) and the international patents (Y2). This validates <Hypothesis 1>, except for <X2> in <Hypothesis 1-2>.

<Table 5> Regression Analysis Result

	<H1-1> **Y1**		<H1-2> **Y2**		<H1-3> **Y3**		<H1-4> **Y4**	
	β	t-value	β	t-value	β	t-value	β	t-value
X1	**0.261*** **	5.563	**0.391*** **	5.653	**0.170*** **	0.006	**0.328*** **	6.037
X2	**0.094* **	1.660	0.092	1.108	**0.242*** **	0.001	**0.185*** **	2.840
X3	**0.591*** **	10.292	**0.348*** **	4.112	**0.390*** **	0.000	**0.501*** **	7.544
C1	0.056	1.224	0.125*	1.869	0.160***	2.725	-.231	0.818
D1	0.034	0.898	0.044	0.791	0.037	0.767	1.669*	0.097
D2	0.079*	1.968	0.002	0.036	0.114**	2.197	-.557	0.578
R^2		**0.853**		**0.681**		**0.755**		**0.804**
F-value		**128.152*** **		**47.058*** **		**67.691*** **		**90.210*** **

*** p<0.1, ** p<0.05, *** p<0.01**

With variable <X1>, the number of SCIE papers per full-time faculty, the performance of university-industry cooperation influenced by variables <Y1>, <Y2>, <Y3> and <Y4> is statistically significant(p<0.01) with positive(+) estimated coefficient. With variable <X2>, the size of the Center for University-Industry Cooperation, the performance of university-industry cooperation influenced by variables <Y1>, <Y3> and <Y4> is statistically significant(p<0.1) with positive(+) estimated coefficient. <Y2>, the number of international patents, does not have statistically significant influence in this analysis. With variable <X3>, the size of TLO, the performance of university-industry cooperation influenced by variables <Y1>, <Y2>, <Y3> and <Y4> is statistically significant (p<0.01) with positive (+) estimated coefficient.

The control variable, the number of registered students (C1), is not having significant influence on national patents (Y1) and income from technology transfer (Y4). However, it has significance on the international patents (Y2, t=1.869, p<0.1) and technology transfer contracts (Y3, t=0.160, p<0.01).

In consideration of the dummy variables, the location (D1)[5] has significant influence on income from technology transfer. Universities in the metropolitan area with higher industrial concentration is tends to have higher performance of technology transferal innovation. The type of foundation (D2)[6] has significant influence on national patents (Y1, t=1.968, p<0.1) and technology transfer contracts (Y3, t=2.197, p<0.5). It shows the lowest level of influence in comparison with other significant independent variables.

ii) Mediating Effects Analysis – <Hypothesis 2>, <Hypothesis 3>

As in <Table 6>, the R&D funding from central government per faculty(M1) shows mediating effect on relationship of the performance of university-industry cooperation(Y1, Y3 and Y4) with the number of SCIE paper(X1) and the size of TLO(X3). The independent variable <X2> promoted the performance of university-industry cooperation (Y1, Y3 and Y4), except for the international patents (Y2), however, no mediating effect of R&D funding from central government (M1) is observed. In

[5] Reference: the non-metropolitan area coded in ‘0’
Event: metropolitan area coded in ‘1’

[6] Reference: private universities coded in ‘0’
Event: national or public universities coded in ‘1’

result, <Hypothesis2-1-c> is rejected, and <Hypothesis 2-1-a>, <Hypothesis 2-1-b> and <Hypothesis 2-1-d> is confirmed in exception of <X2>, the size of the Center for University-Industry Cooperation.

In discussion of the result, first, in <Hypothesis2-1-a>, the R&D projects funded by central government (M1) mediate the relationship between independent variables and the national patents (Y1). In the third step of the 3-step analysis of Baron & Kenny (1986)[7], the relationship of <X1>, <X3> and <Y1> is statistically significant and the value of correlation coefficient is reduced to indicate partial mediating effect. However, in the relationship of <X2> and <Y1> at the first step of the analysis, <M1> is not statistically significant. Therefore, <M1> is considered to have no mediating effect, even without the second and the third step of the analysis. In short, <Hypothesis2-1-a> is confirmed with the exception of <X2>.

Second, in <Hypothesis2-1-b>, as in <Hypothesis2-1-a>, <M1> partially mediates in relationship of (Y2) and related independent variables. As in <Hypothesis2-1-a>, <M1> is considered to have no significant mediating effect. In short, <Hypothesis2-1-b> is confirmed with the exception of <X2>.

Third, in <Hypothesis 2-1-c>, there was no mediating effect of R&D projects funded by central government<M1> in relationship with technology transfer contracts(Y3) and independent variables. Therefore, <Hypothesis2-1-c> rejected since the regression coefficient of the mediating variable is not statistically significant in the third step of the analysis.

Forth, in <Hypothesis2-1-d>, <M1> partially mediates in relationship of <Y4> and related independent variables, and only <X2> has no significant regression coefficient. Therefore, <Hypothesis2-1-d> is confirmed with the exception of <X2>.

<Table 6> Analysis Result on <Hypothesis 2-1>

Dependent Variables	Step	Unstd. Coef.(B)								R^2	F -value
		Dependent variables							Mediating Variable		
		X1	X2	**X3**	C1	D1	D2	Constant	**M1**		
<H2-1-a> Y1	**Step1**	**3231*** **	.005	**.03** **	-8994E-7	369**	656**	8179***	-	589	31545***
	Step2	**13156*** **	-	**.650*** **	-	579	1.508*	-1.153	-	853	128152***
	Step3	**6787** **	-	**577*** **	-	213	7637E-5**	-17277***	**1.972*** **	892	154345***
<H2-1-b> Y2	**Step1**	**3231*** **	.005	**.037** **	-8994E-7	369**	656**	8179***	-	589	31545***
	Step2	**5685*** **	-	**.110*** **	-	217	.012	-2588***	-	.681	47.058***
	Step3	**2752*** **	-	**.077*** **	-	-118	-584**	-10012***	**.908*** **	.779	66.070***
<H2-1-c> Y3	Step1	3231***	.005	.037**	-8994E-7	369**	656**	8179***	-	589	31545***
	Step2	18831***	-	940***	-	1402	4778**	-10305***	-	755	67691***
	Step3	13904**	-	884***	-	840	3777**	-22778***	1.525	759	59095***
<H2-1-d> Y4	**Step1**	**3231*** **	.005	**.037** **	-8994E-7	369**	656**	8179***	-	589	31545***
	Step2	**920739*** **	-	**30736*** **	-	69335**	-27513	-263561***	-	804	90210***
	Step3	**691538*** **	-	**28117*** **	-	43188	-74086	-843764***	**70.942*** **	820	85214***

* p<0.1, ** p<0.05, *** p<0.01

As in <Table 7>, R&D projects funded by local government<M2> do not indicate any

[7] In the first step of the mediating effect analysis, the regression of the independent variables and mediating variables should indicate statistical significance. In the second step of the analysis, the regression of the independent variables and dependent variables should indicate statistical significance. In the third step, the regression analysis is taken to see the relationship both of the independent variables and the mediating variables to the dependent variables and this should indicate statistical significance. In the third step, it is a “full mediation variable” if the relationship of independent variables and the dependent variables become in significant. If the value of regression coefficient is reduced while the relationship is still statistically significant, it is counted as a “partial mediation variable.”(Baron & Kenny, 1986)

mediating effects on every relationship between <X1-3> and <Y1-4>. Therefore, <Hypothesis 2-2> is rejected since the mediating variables are not statistically significant in relationship with the independent variables in the first step of the analysis, and <M2> does not have mediating effect.

<Table 7> Analysis Result on <Hypothesis 2-2>

Dependent Variables	Step	Unstd. Coef.(B)								R^2	F -value
		Dependent variables							Mediating Variable		
		X1	X2	X3	C1	D1	D2	Constant	M2		
<H2-2-a> <H2-2-b> <H2-2-c> <H2-2-d>	Step1	2.018	-.005	-.324	.001**	6.463	16.693***	29.918***	-	.130	3.296***
	Step2	-	-	-	-	-	-	-	-	-	-
	Step3	-	-	-	-	-	-	-	-	-	-

<Table 8> shows the mediating effect of the R&D funded by the enterprise, the university-industry cooperative R&D, in relationship of <X1>, <X3> and <Y1>, <Y2> and <Y4>. As in <Hypothesis2-1>, <X2> is the sole variable with no significant mediating effect of M3 on every performance factors of university-industry cooperation. In short, <Hypothesis 3-1-c> is rejected, and <Hypothesis 3-1-a, hypothesis 3-1-b and Hypothesis 3-1-d> are confirmed in exception of <X2>.

<Table 8> Analysis Result on <Hypothesis 3>

Dependent Variables	Step	Unstd. Coef.(B)								R^2	F -value
		Dependent variables							Mediating Variable		
		X1	X2	**X3**	C1	D1	D2	Constant	**M3**		
<H3-1-a> Y1	Step1	**3.447*****	.004	**.051*****	-7.953E-6	.465**	.608**	6.032***	-	.553	26.991***
	Step2	**13.156*****	-	**.650*****	-	.579	1.508*	-1.153	-	.853	128.152***
	Step3	**8.919*****	-	**.585*****	-	.007	.752	-8.699***	**1.245*****	.873	128.081***
<H3-1-b> Y2	Step1	**3.447*****	.004	**.051*****	-7.953E-6	.465**	.608**	6.032***	-	.553	26.991***
	Step2	**5.685*****	-	**.110*****	-	.217	.012	-2.588***	-	.681	47.058***
	Step3	**3.741*****	-	**.083*****	-	-.045	-.325	-5.903***	**.553*****	.727	49.512***
<H3-1-c> Y3	Step1	3.447***	.004	.051***	-7.953E-6	.465**	.608**	6.032***	-	.553	26.991***
	Step2	18.831***	-	.940***	-	1.402	4.778**	-10.305***	-	.755	67.691***
	Step3	17.164**	-	.897***	-	1.173	4.399*	-14.502***	.641	.756	57.453***
<H3-1-d> Y4	Step1	**3.447*****	.004	**.051*****	-7.953E-6	.465**	.608**	6.032***	-	.553	26.991***
	Step2	**920.739*****	-	**30.736*****	-	69.335**	-27.513	-263.561***	-	.804	90.210***
	Step3	**807.771*****	-	**28.615*****	-	53.989	-49.462	-491.755***	**36.526****	.810	78.978***

* p<0.1, ** p<0.05, *** p<0.01

iii) Complementary Sobel Test: Statistical significance of mediating effect

The analysis results from 3-step mediating effect test suggested by Baron & Kenny (1986) is based on point estimation. To test its statistical significance, complementary Sobel Test based on interval estimation is recommended (Baron & Kenny, 1986). <Table 9> shows the result from Sobel Test. In Sobel Test, in general, a null hypothesis is rejected and mediating effect is statistically significant if Z-value is larger than 1.96 or smaller than –1.96.

<Table 9> Sobel Test Result

Mediating variables	Independent variables	Path	Std. Coef. (β)	Z	Adoption
R&D projects funded by central government (Amount of Funding per faculty) (M1)	<2-1-a> Y1	‣ X1 → M1 M1 → Y1	0.614 0.289	4.17***	adopted
		‣ X3 → M1 M1 → Y1	0.016 0.289	2.19**	adopted
	<2-1-b> Y2	‣ X1 → M1 M1 → Y2	0.614 0.119	4.33***	adopted
		‣ X3 → M1 M1 → Y2	0.016 0.119	2021**	adopted
	<2-1-d> Y4	‣ X1 → M1 M1 → Y4	0.614 20.800	2.86***	adopted
		‣ X3 → M1 M1 → Y4	0.016 20.800	1.91**	adopted
R&D projects funded by enterprises – the cooperative projects (Amount of Funding per faculty) (M3)	<3-1-a> Y1	‣ X1 → M3 M3 → Y1	0.725 0.268	3.32***	adopted
		‣ X3 → M3 M3 → Y1	0.019 0.268	2.32**	adopted
	<3-2-b> Y2	‣ X1 → M3 M3 → Y2	0.725 0.113	3.41***	adopted
		‣ X3 → M3 M3 → Y2	0.016 0.113	2.35**	adopted
	<3-3-d> Y4	‣ X1 → M3 M3 → Y4	0.725 18.316	1.84***	adopted
		‣ X3 → M3 M3 → Y4	0.019 18.316	1.60	**rejected**

* p<0.1, ** p<0.05, *** p<0.01

As described in <Table 9>, all of the 3-step test result is adopted in Sobel Test, with an exception of <M3> in <X3>-<Y4> relationship. First, same result is drawn from Sobel Test and the 3-step mediating effect analysis when <M1> is projected on the relationship of independent variables <X1>, <X3> and dependent variables <Y1>, <Y2>, <Y4>, making <M4> a valid mediating variable. The independent variable <X2> has positive influence on university-industry cooperation performances, but the mediating effect of <M1> is not confirmed in Sobel Test as in the 3-step analysis. Second, <M3> is also validated its mediating effect in the relationship of independent variables <X1>, <X3> and dependent variables <Y1>, <Y2>, <Y4>. In case of <Y4>, however, it is not statistically significant in the Sobel Test, unlike to the result from 3-step mediating effect analysis.

4) Discussions on the results

ⅰ) Hypothesis 1

The number of SCIE papers, size of the Center for University-Industry Cooperation and the size of TLO affects the performance of university-industry cooperation in positive direction and reconfirm the discussions in proceeding researches. This indicates the recent efforts of the university to improve its own research capacity in qualitative perspectives and the direction of policy supports. Recently, university-industry cooperation performances affect performances of university-industry cooperation.

With the size of the Center for University-Industry Cooperation, however, it does not indicate statistical significance on the number of international patents. I corresponds to a few proceeding researches describing the professional human resources take more significant role in the performance than the simple size of the organization (Powers, 2003; Ok & Kim, 2007). In short, based on the analysis result on <Hypothesis1>, the number of SCIE papers per faculty, the size of the Center for University-Industry Cooperation and the size of TLO are the major factors for the performance of university-industry cooperation, and universities should make greater efforts to sharpen the competitiveness in qualitative level.

ii) Hypothesis 2

R&D projects funded by central government mediate the performance of university-industry cooperation, except for the number of technology transfer contracts. R&D projects funded by local government are invalid as a significant mediating factor. Then, what is the causation of this result? First, local governments tend to be underbudgeted. Second, the income from technology transfer is widely accepted in R&D evaluation rather than the number of technology transfer contracts. Third, the majority of workforce in the Center for University-Industry Cooperation is assigned to R&D management.

(iii) Hypothesis 3

As in the mediating effects of central government-funded R&D projects, university-industry cooperation R&D projects, funded by enterprises, mediates the performance of university-industry cooperation except for the technology transfer contracts. This result suggests the efforts to expand the Center for University-Industry Cooperation and TLO can be highlighted as in <Hypothesis 2>.

6. Conclusion

Based on statistical analysis results discussed so far, the hypothesis on the mediating effects of R&D funding from various sources is statistically tested. The result is summarized in <Table 10>, and all of the mediating variables are having partial mediating effects. The analysis result confirms the mediating effects of <M1>, <M3> in the relationship of <X1>, <X3> and <Y1>, <Y2>, <Y4>. On the other hand, <M2> does not indicate any mediating effect in all considered relationships. In consideration of <X2> and its influence on university-industry cooperation performance, <M1>, <M3> have insignificant mediating effects. The policy implication of the result is as follows.

<Table 10> Analysis result on mediating effects

Mediating Variables	Dependent Variables	Independent Variables		
		X1	X2	**X3**
Central Government-supported R&D Funds Per Faculty	**(H2-1-a) Y1**	**Partially Mediating**	Not Mediating	**Partially Mediating**
	(H2-1-b) Y2	**Partially Mediating**	Not Mediating	**Partially Mediating**

(M1)	(H2-1-c) Y3	Not Mediating	Not Mediating	Not Mediating
	(H2-1-d) Y3	Partially Mediating	Not Mediating	Partially Mediating
Local Government-supported R&D Funds Per Faculty (M2)	(H2-2-a) Y1	Not Mediating	Not Mediating	Not Mediating
	(H2-2-b) Y2	Not Mediating	Not Mediating	Not Mediating
	(H2-2-c) Y3	Not Mediating	Not Mediating	Not Mediating
	(H2-2-d) Y4	Not Mediating	Not Mediating	Not Mediating
Enterprise-supported R&D Funds Per Faculty (M3)	**(H3-1-a) Y1**	Partially Mediating	Not Mediating	Partially Mediating
	(H3-1-b) Y2	Partially Mediating	Not Mediating	Partially Mediating
	(H3-1-c) Y3	Not Mediating	Not Mediating	Not Mediating
	(H3-1-d) Y4	Partially Mediating	Not Mediating	No Mediating (Rejected by Sobel Test)

First, the mediating effect of central government funded R&D projects, the direction of government R&D funding and evaluation system at university level can be suggested. In evaluation of R&D projects, evaluation index of university-industry cooperation performance can be associated with national R&D program performances. In Korea, a standard set of evaluation index suggested by National Science and Technology Council is applied in evaluation of national R&D programs. To apply attribute of university-industry cooperation programs, the evaluation is supposed to give priority to factors like research capacity of full-time faculty and the size of TLO over the size of Center for University-Industry Cooperation,

Second, since R&D projects funded by local government do not mediate university-industry cooperation performances, additional discussion is required its causal relationship with shortfall of local government R&D budget. Unlike to proceeding researches highlighted the role of local government in funding R&D projects, the result from this study does not confirm the importance of R&D funding from local government. This might result from circumstantial difference of central and local government budget, and an additional empirical analysis is required to find out a significant mediating effect of R&D funding from local government.

Third, in expansion of research capacity in universities, qualitative growth of research capacity of faculty and manpower in TLO is recommended rather than quantitative growth of the size of Center for University-Industry Cooperation. In promotion of university-industry cooperation performances, secure cooperative R&D project support system from government and university is required.

This study is conducted to find out the mediating effect of central/local government-funded R&D projects in relationship between competence factors of universities and performances of university-industry cooperation.

This study has limitation of generalization since it only covers universities with 4-year coursework and excludes vocational colleges. Also, relatively high level of reliance on R&D projects supported by central government and shortage of R&D budget in local government are not considered into the analysis. In international comparison, differences caused by policy support from government in Korea and university-industry cooperation supporting system in each university can be discussed as influential factors.

Despite of the limitation, this study is meaningful in discussion of mediating effects of R&D projects funded by central government and cooperative R&D projects with empirical data. Further researches on international comparative researches to generalize mediating effects on university-industry cooperation performances and eventually to understand the efforts of universities and suggests ideal direction of R&D funding from government.

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An Empirical Study on the Determinants of Innovative Activity in Korean Manufacturing Firms: Focusing on the Firms' Perception of Innovation

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Abstract

In order to sustain the life of organization, it is important to answer the following questions: "why innovation is required in enterprise?" and "how innovation can be made?" Research of organization innovation has been carried out with three different topics, which are diffusion of innovation, process theory of innovation and organizational innovativeness, and these topics are applied for the innovation of company and government in Korea. Previous studies showed that leadership, R&D investment, and organizational and industrial structure were main factors affecting the change of organization not only in Korea but also in other countries. However, these studies were not fully taken into account the significance of employee's awareness about the necessity of organizational change because employees were considered not as a principal agent for innovation but as a passive actor. This study aims to identify the importance of the employee's awareness and its influence on innovation performance. In particular, the effect of the employee's awareness on product·process·organization innovation would be analysed from this study.

Keyword : Organization Change, Organization innovation, Product innovation, Process Innovation, Perception of innovation

June 16 (Tuesday)

R# : 203 International Conference Hall

General Session 3

"Open Innovation in Energy"

■ **Session Chair: Eunnyeong Heo**(Seoul National University)

- Paper 1: "Learning Networks for Energy Efficiency in Industry as Open Innovations" by **Wolfgang EICHHAMMER (Fraunhofer Institute, Germany)**
- Paper 2: "Smart Home and Smart Energy – potentials and limits for innovation" by **Christoph WEBER (Duisburg University, Germany)**
- Paper 3: "Global energy trend and KIER's R&D portfolio" by **Seongkon Lee(Korea Institute of Energy Research)**
- Paper 4: "A study on the Accountability of the Regional R&D Program: The Case of APCTP" by **Jinwon Kang(KISTEP), Seongsik Cho(KISTEP)**
- Paper 5: "A study on the R&D investment and financial performance: Focused on existing and potential competitors" by **Dongphil Chun(KRICT), Youngjoo Ko(KRICT), Yanghon Chung(KAIST)**

Learning Networks for Energy Efficiency in Industry as Open Innovations

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Abstract

Germany, as an important industrialized country, has set stringent targets in the frame of the „Energiewende" (transformation of the energy system). This requires reducing greenhouse gas emissions by 2050 by 80-95% as compared to 1990, halving primary energy consumption and reaching renewable shares of 80% and more. In order to reach these targets radical changes have to occur in the energy system, requiring important innovations in many fields such as technical innovations, innovations in electricity market organization, innovations in policy instruments, innovations in business models etc. These innovations will be the more important, the earlier they include the main actors and the more they are able to create open innovation networks that are able to embrace actors in different development stage and with different interests. Energy efficiency improvements do occur in companies every day; however, there is not enough progress to achieve the ambitious energy and climate targets. Therefore, mechanisms need to be developed which enhance the existing innovation mechanisms for energy efficiency in companies. In the past regulation has been experienced to spur innovation in companies. This has, however, limits and mechanisms must be developed which make use of the daily development processes in companies.

Based on previous experiences in Switzerland, Germany has set up open innovation networks in industry that shall spur the renewal of company development in the direction of increased energy efficiency. These so-called "Learning Networks for Energy Efficiency" consist in networks of 10-15 companies which set themselves energy efficiency targets for about 4 years. They meet regularly in structured and moderated processes in their different premises, discuss approaches, monitor achievements and learn mutually from their experience. These open learning processes induces organizational and technical innovations in the companies, lowering thus considerably transaction costs for energy efficiency improvement. The networks comprise network initiators, network moderators and other actors. During the last four years, Germany has introduced 30 pilot networks. Private actors, such as energy suppliers have initiated further networks with the intention to create new business models. The experience of the past four years from 600-700 companies has shown that the networks were able to double the path of energy efficiency in those companies. Given the success of this open innovation process, the German government has introduced in its recent National Action Plan for Energy Efficiency NAPE the idea to enhance the number of networks to 500 , comprising around 7000-10000 companies by 2020. This will spur substantial innovation processes in the German industry environment and anchor energy efficiency processes deeply into the companies.

Smart Home and Smart Energy – potentials and limits for innovation

Prof. **Christoph Weber**, University Duisburg-Essen

Abstract

The rapid developments in information and communication technologies together with the need of an in-depth transformation of the energy sector to cope with the global challenge of Climate Change are powerful drivers for innovations for a smart energy use in households. Yet the results of largescale demonstration projects in Germany ("E-Energy") have not met the initial high ambitions. The technical feasibility of smart energy solutions has been demonstrated, however the business cases are far from evident. The presentation therefore analyses systematically the key challenges to be addressed by successful smart energy and smart home innovations from an European perspective.

First a detailed look is taken at the relevant stakeholders for smart energy and smart home innovations. These include households, energy utilities, ICT companies, appliance manufacturers and the building sector. The broad range of potentially involved stakeholders constitutes a challenge in itself and gives rise to a number of questions surrounding integration and standardization of interfaces: To what extent will it be necessary? How will it be achieved? And who will be the driving forces behind? In order to explore potential answers to these questions, the variety of industry structures and standardization practices in the sectors involved have to be scrutinized.

The potential benefits of smart home and smart energy solutions for the core customer groups are a second key issue to be investigated. The methodology of the Business Model Canvas is useful here, even if in an open innovation context the focus is more on impact than on monetization of business models. The service promise to the customer is at the center of this methodology and therefore several potential key services are scrutinized: increased convenience through tele-control, improved security, improved possibilities for assisted living, monetary savings and energy consumption and emission reductions. The latter are at the core of the sustainability debate but might not be the key driving forces for smart home solutions.

Given their relevance for sustainability, the potential benefits of emerging smart home and smart energy solutions in an energy system and environmental perspective are investigated in a last step.

This requires an in-depth understanding of the key requirements in a future clean energy system. Flexibility of conventional producers, storages and consumers will be a core issue when it comes to integration of large amounts of intermittent generation from renewables like solar and wind. But

especially in the case of consumers, one has to consider in detail

Global energy trend and KIER's R&D portfolio

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We have been facing depletion of energy and natural resources and disruption of the energy demand-supply balance. Fossil fuels have faced the energy supply limits. Regarding to r/p(reserve/production) ratio of fossil fuels, Coal, oil, and gas are forecasted about 113 years, 53 years, 55 years respectively according to BP statistics in 2014. The advanced and advancing economies try to secure energy resources from around the world toward their sustainable development. The global energy demand will be increased around 40% in 2035 comparing with the 2009 level (Figure 1). The emerging developing economies including China, India, and Russia have led the increase on energy demand due to their rapid economic development. In case of China, oil consumption had more than doubled from 1997 to 2010. Energy consumption of fossil fuel-driven economies have accelerated depletion of global fossil fuels.

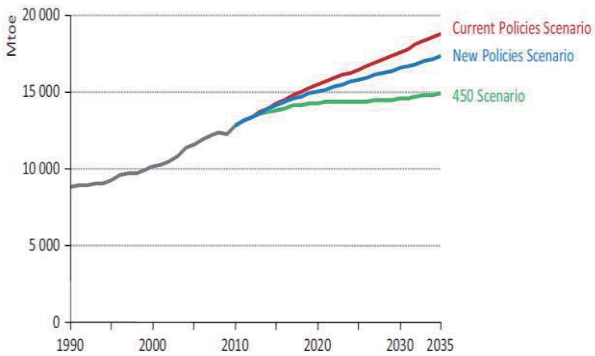

Fig.1 IEA World energy demand to 2035

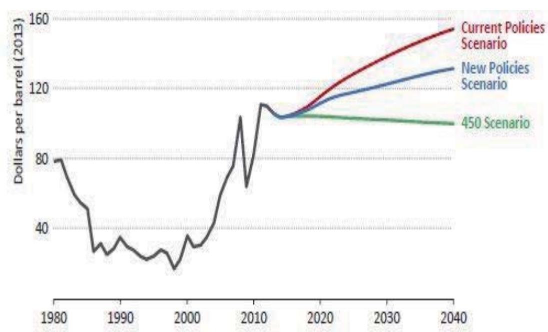

Fig.2 IEA WEO Oil prices forecast

The industrial development has also caused climate changes around the world. Energy crisis are getting worsen because of the growth of imbalance between supply and demand in the frame of energy system. In addition, increased and excessive use of fossil fuels is sharply increasing greenhouse gas emissions. The recent global average sea level rises 19cm for 110 years from 1901 to 2010. It will be 63cm until 2100 year. Average temperature was increased 0.85 ℃ from 1880 to 2012 and is forecasted to rise 3.7℃ to 2100 year. Obama administration changed its attitude for coping with the climate changes aggressively. The US announced the 2013 Climate Change Action Plan in this trend and is actively expressed willingness to set up such major response strategy accordingly. The US is expected to participate actively driving global climate change agreement negotiations

Concerning to nuclear power, which is the one of bridge and prominent energy technology in the transforming to the clean society based on new and renewables, advanced and advancing economies have the negative perception for developing and new construction of nuclear power plants after the Fukushima nuclear accident. Advanced economics including Korea have been focusing on strengthening nuclear security. On the other hand, the interest for developing and dissemination of new and renewables have increased. Energy resource from this current status is non-conventional oil such as oil shale. Specifically in recent years r/p ratio of shale gas are issued and it can be used around the world in 60 years (Figure 3).

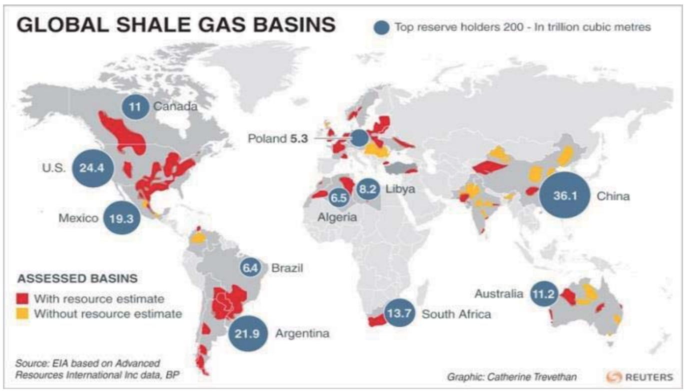

Fig.3 Global shale gas basin and forecasted reserve

The US tries to develop nonconventional oil including shale gas, oil sands. The US oil production has increased significantly and Obama administration plans to boost the US manufacturing industry by the nonconventional oil production. Although the current oil prices are lower but experts forecast these low prices are short-term phenomenon and eventually it will be increased.

Energy status is directly or indirectly influenced by growth of an economy and its efforts to achieve sustainable development. Energy technology is a crucial way for sustainable development and the new growth driving force. The advanced economies including the U.S.A, Japan, and Germany are taking the lead in the development of energy technology. Other high technologies such as IT, NT, and BT have matured. But Energy technology has emerged in the market and can accelerate economic growth of the developed and developing counties with conversion of other high technologies. McKinsey global institute analysis announced the estimated potential economic impact of technologies in industrial sector in 2025. 3 key technologies accounting for Internet of Things, Energy storage technology, and Renewable energy technology, out of 12 technologies are selected. In case of renewable energy technology, it will have 3.5 trillion dollars of potential economic impact substituting the present electric industry with the increase of renewables in electricity portion.

The interest in development of energy technology has been increasing. Developed and developing countries, led by their governments, have come up with strategic plans to develop energy technology aimed at helping economies cope with problems related with national energy security, sustainable development, and creative economy. In case of Korea, Innovative energy technology development equals to the second energy resources acquisition.

KIER, the government supported research institute covering energy efficiency, new and renewables, climate changes, innovative energy material, and sea energy technologies, has been developing strategic energy technologies coping with the rapid change of energy circumstance. KIER implemented four strategic targets and performance indexes in 2014. First strategy focuses on increasing energy efficiency related to energy demand management technologies. The second strategy is ensuring the competitive new and renewables comparing with the fossil fuel energy technologies with acquiring the grid parity in the short-term. The third strategy is to promote the commercialization of CCUS for coping with the climate changes and clean fuel technology. The last strategy is to develop lead energy future fusion technologies. KIER pursues to create new value and markets through creative convergence energy technology. Specifically, KIER focuses on developing the 8 world top class energy technologies as shown in the figure 4.

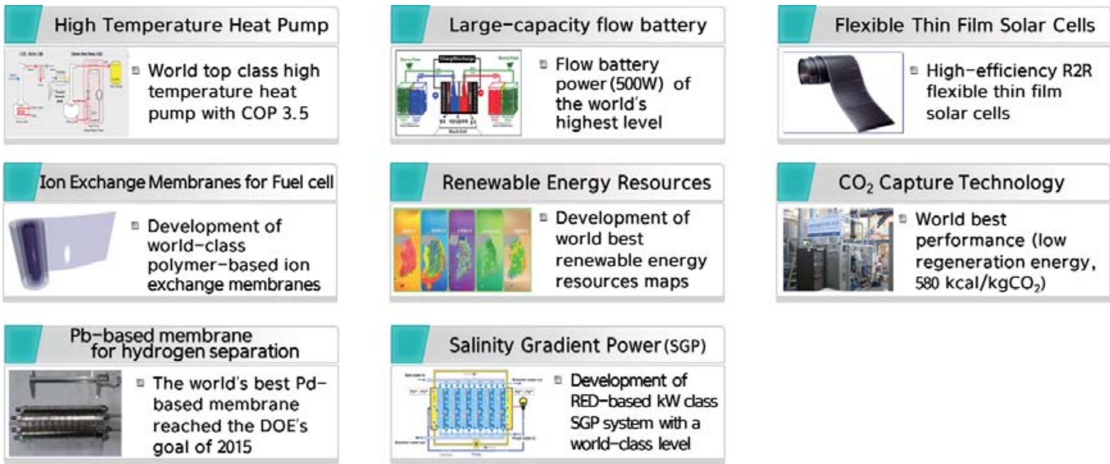

Fig.4 KIER's 8 world top class energy technologies within 3 years (2013-2016)

A study on the Accountability of the Regional R&D Program
: The Case of APCTP

Jinwon Kang, Seongsik Cho***

abstract

In order to develop Asia-Pacific Center for Theoretical Physics (APCTP), it is necessary to respond various kind of accountabilities around research environment as well as research capacity and international reputation. APCTP, the case of this research, has achieved its goal through proper handling of managerial and institutional problems. Simplifying complicated program structure and enhancing efficiency in the managerial level and the stable position of secretary being able to excise practical authority in the institutional level have been based for the sustainable development. While the lack of legal support limited to enhance international reputation, bottom-up building of APCTP and volunteer participations and efforts of researchers made good performance as a research platform considering its budget. The previous and present government's emphases on basic research and regional government's support took positive effects to the development of APCTP as international research institute and will provide real help for international reputation in the near future. This paper investigated difficulties around APCTP and their solutions for the sustainable development in terms of technical, managerial and institutional level.

Key word: regional R&D program, accountability, basic research, APCTP

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I. Introduction

After Korea experienced rapid growth through imitation, She is struggling to find the new creative development strategy for the new growth. The portion of applied research and development research has been high and Public Research Institutes and universities still have similar trends of research as well as firms. It is time for creative research based on basic research so as to get the new growth. The goal of theoretical physics is the understanding of natural law, which is a starting point of development of technology and this field has high efficient among basic science regarding research expenses.
Theoretical physicist, Maxwell's discovery of electric magnetic wave directly affected the invention of generators and motors. The research about wireless telegram in 1909 took a effect to radio, TV, smart-phone and wireless internet, so on. Quantum physics, aiming to understand 'atom' gave influences on the inventions of transistor, DVD player, laser and MRI so on. The research about gravity by Albert Einstein also affected the development of GPS.

In this circumstances, APCTP, built bottom up way and aiming for basic research and research network, introduced Max-plank's Junior Research Group into Asia Pacific area at first time and provided young scientists with ground for growing up to the next leaders. APCTP also supplied the latest research information and then the role and importance of APCTP is getting bigger. APCTP appointed Yang (Nobel Prize Winner) as the 1st president, Robert and Peter (Max Planck president) as presidents and currently Korean scientist as president for the first time. It has been 18 years since APCTP was hosted in Korea. It is also time for new jump for the another development. While Korea's economy and global role is getting more important in the world, Korea needs to increase basic research capacity, lead development of basic science in the Asia Pacific region and enhance international reputation in the basic science fields. These are goals of APCTP as international basic research institute. The regional location of APCTP (in Pohang) and its regional contribution can give a good regional case to check the performance of APCTP in the perspective of accountability and show the implication for the further development.

The theoretical background of accountability will be reviewed in section 2, the main issues of APCTP in section 3, the accountability about APCTP in Section 4 and the conclusion in section 5.

II. Theoretical background[1]

According to Behn (2000), since the meaning of “accountability” depends on its context, it is difficult to define, but it is an important concept. Mulgan (2000) says that since the concept of “accountability” is complicated and ambiguous, it is difficult to define accurately, and its concept is not only changeable like a chameleon, but also expanding. Generally, even though “accountability can be interpreted in various ways according to different aspects, it can be defined as social relations in which an actor is under obligation that he should explain and justify his action related to transfer of authority to another important object, based on a basic concept that various stakeholders’ expectations should be met. More simply, it can be defined as "response to demand of a person who assigns a mission".

1. Level of accountability

With respect to accountability, Thompson (1967) applies Parsons (1960)’s theory that accountability is classified as technical, managerial, and institutional level, arguing organization’s responsibility and control. Thompson’s summary is as follows. Also, he argues that each level has a mutually hierarchical structure and the upper level embraces the lower level. Table 1 shows the summary of his argument.

Table1. Level of accountability according to organization’s responsibility

Level	Focus	Remark
Technical level	Specialized functional result	-
Managerial level	Coordination with organization’s customers	-
Institutional level	Legal meaning and the implementation of organizational goals	Able to grasp underlying causes

First, the technical level is the lowest level of accountability among all of three accountabilities and focuses on effectively achieving results of organization-specialized detailed functions. The accountability in such a viewpoint can be applied to a cooperation process with other people because of the technical nature of the work. Based on these discussions, this paper analyzes the technical level, focusing on problems arising from the uniqueness of science and technology field.
Second, the managerial level includes technical sub-organization and procurement of resources for the implementation of technical functions and coordination among its customers, suppliers, and work environment. Thus, the managerial level includes technical work, scope of work, recruitment and procurement policies. This paper analyzes the managerial level, focusing on how organization, staffing, budget, resources, motivation, performance are managed.
Third, the institutional level refers to a broader concept which includes both technical and managerial level. The institutional level deals with high level of support realizing fundamental or organization’s goals regarding organization’s legal meaning and accountability partially

[1] *Note*: Cho, Seongsick & Kwon, Gihoon & Kim, Donghyun. (2012). Used with modifying and supplementing the part of theoretical background (pp. 166-169).

needed in the social system, in a broader sense. The institutional level can identify underlying causes unnoticed the managerial level.

2. Institutional accountability

Romzek & Dubnick (1987) put more emphases on the institutional level than the technological and managerial level, analyzing the cause of the Space Shuttle *Challenger* disaster in 1986. They categorize accountability as four different types, indicated in figure 1, including bureaucratic, legal, professional, and political accountability according to the source of control agency and the degree of control over agency actions. They also argue that the executive branch in the United States should be matched with not only the technological and managerial problems but also two or more institutional accountabilities because of the institutional conditions of the environment. They empirically suggest a decline of professional accountability resulting from an increase in political and bureaucratic accountability through the National Aeronautics and Space Administration (NASA)'s the Space Shuttle *Challenger* disaster.

Figure1. Types of accountability

		Source of control Agency	
		Internal	External
Degree of Control Over Agency Actions	High	1. Bureaucratic accountability	2. Legal accountability
	Low	3. Professional accountability	4. Political accountability

Source: Romzek, Barbara S. & Dubnick, Melvin J. (1987)

The contents and features of each type of accountabilities are as follows (Romzek & Dubnick, 1987; Eom, 2009; Gormely & Balla, 2013). First, bureaucratic accountability refers to abiding by supervision of superiors over subordinates, orders or instructions, and standard operating procedures and disciplines in an organization. It is the most widely used form for a control of accountability after priority is determined by hierarchy. Bureaucratic accountability occurs inside an organization and has a high degree of control. It is also expressed as obedience to supervisor's instructions or compliance with rules in an organization. Bureaucratic accountability has a low level of autonomy since a supervisor can impose penalties based on supervisor's rewards and punishments for a subordinate in hierarchical relationships. Second, legal accountability indicates one that appears in relationships between enacting legislators and officials implementing enacted laws and in the principal and agent relationship through contracts. It appears in obligatory relationships with an external individual or group legal sanctions and contractual liability. Legal accountability is distinguished from bureaucratic accountability in that legal accountability is based on official or implicit fiduciary relationships between autonomous both parties. Legal accountability has a wider area of administrative activities than bureaucratic accountability, is based on a relationship between external groups (legislators, policy coordinators, etc.) and members of a group, and is expressed as implantation of legislators' acts. Specifically, the mechanism of ensuring legal accountability is Constitutional and legislative structure, judicial judgement, an audit, control from Congress, and etc. Third, professional accountability reflects a circumstance in which a staff with relevant skills and expertise provides solutions to technical and complicated policy issues, having the discretion and autonomy in their work. According to profession accountability, a staff makes a decision, based on internalized norms. The internalized norms are based on socialization as a profession, personal beliefs, training and education, and work experience. Professional accountability has a characteristic that decisions are made on the inside and external opinions are passed indirectly and reflected only in a defensive form. Public administrators solely rely on the solutions provided by staffs with a high level of expertise, and professional accountability is expressed as a form that the staffs themselves have responsibility of performances. Respect for professionalism is the key of professional accountability and it is based on trust that professions will do their best as much as possible on the basis of their expertise. Fourth, political accountability means officials' response to the needs of external stakeholders such as elected politicians, customer groups, and the general public. Political accountability is a 'reactive' form which arises due to the pressure on the democratization of the public administrative area and expressed as a form that public administrators are responsive to groups (the general public, officials, representative of related institutions, and special interest groups) for which they should be responsible. A high level of control does not happen in political accountability since its sanctions are indirect. While emphasis on political accountability has a high possibility to promote favoritism and corruption, it can also contribute to establishment of open and strong representative government.

This study analyzes the relevant ministry, activities of a local government, and the internal structure of the center for bureaucratic accountability and examines national law, international agreements, and etc. for legal accountability. This study also analyzes autonomy of researchers, leadership, professionals, and etc. and examines relations with concerned countries, attention of the President and politicians, parliamentary support, and etc.

III. The case of APCTP

1. The characteristics of basic research institute

Similar institutes like APCTP with characteristics of international research institutes can be summarized as follows. First, they are operated by small group of best researchers not by large group of researchers. Second, they support young scientist's independent research with limitation of their research period and then intake new scientists continuously for the researchers circulation. Examples of these kind of institutes are MGP in German, IAS in US, PI in Canada, ECT in Europe. Third, the securement of visiting researchers through hosting of academic activities including diverse conferences enables scientists to be exposed to the latest research trends and information and to build up researchers' network. These kind of institutes contain ICTP in Italy, PI, in Canada, IAS and KITP in US and ECT in Europe. Fourth, they pursue international role in the theoretical physics fields through international cooperation and development cooperation with developing countries. This type research institutes are ICTP in Italy, PI in Canada, MPI-PKS in German, IAS in US. Last, they operate outreach program using research performance and human resources and pursue to harmonize and support regional societies. MPI-PKS in German and PI in US correspond to this type of institutes (Kang, 2014). APCTP does not have the only one type, but the diverse shapes as other institutes. Therefore, strategic consideration about the type to be focused and pursued is requested.

2. Outline of APCTP

APCTP is international institute aiming for performing leading edge research, training young scientists and enhancing international cooperation between physicists in Asia Pacific member countries and non-member countries as well.

The establishment of APCTP was firstly suggested on the February in 1989. For this IPC (international promotion committee) was made up on the February in 1993 and they decided Korea is hosting country in the first meeting of IPC on April in 1994. Korea was approved as hosting country in the13th conference of ASCA(Asia Science Cooperation Association) on November in 1994 and the 1st board meeting was held on April in 1995 in Seoul. President of Korea confirmed Korea hosted APCTP and announced government would support it in the APEC meeting on November in 1996. APCTP selected as a demonstration project in the APEC meeting was registered to ministry of science and technology as a foundation in Seoul.

APCTP was moved to Pohang on August in 2001 and strengthened basic science international cooperation through joint research with MP. APCTP has 14 member countries and 22 cooperation institutes on May in 2013 now and specific process was shown as table below.

Table 2 the main projects of APCTP in the stages

Stage	Year	Objective	Main projects
Establishment	1996. 6	Establishment of center	• hosting demonstration academic conference
Foundation furtherance	1997- 2004	Academic exchange International joint research Science communication Research infra building	• infrastructure building • theme research project • international joint research
	2005- 2006		• science communication project • science popularization system building • establishment of Asia Pacific national cooperation system • mid/long term research visiting and staying activities • sharing operating cost between member countries • research and visit infrastructure expansion - visiting research room, seminar room so on
Development	2007- 2012	Globalization of projects	• expansion of disciplinary and confusion research fields support • strengthening of basic science international cooperation through international joint research
Maturity	After 2013	International institute	• establishment of confusion international research institute status • Mecca of theoretical physics in Asia Pacific area

IV. Studying accountability

1. Technical level

APCTP is operating with characteristics of international basic research institute and the technical level of accountability about APCTP can be described as follows. First, APCTP was pivoted on internationally famous theoretical physicists including Nobel prize winner operated from the beginning. 1957 Nobel prize winner, Yang Chenning was appointed as the first present and was propagated the importance of theoretical physics and basic science into Korean society. The second president Robert Replein (Nobel prize winner in 1998), served as the president of KAIST, led globalization of domestic basic research and activated popularization of science. As a result of these efforts, APCTP hosted R&D investment for young scientist groups from MP and enhanced the Korea's level of basic science.

Second, Junior Research Groups (JRG), first adopted 'human centralized' residing research program, were made up for the excellence of joint research regarding characteristics of theoretical physics. APCTP has fully supported young scientists' independent research through JRG and limitation of support period for individual researchers made new researchers in-took and circulated continuously and now total 35 researchers (Korean 16, foreigner 19) have been participated until 2013 now. Providing the beneficial with research immersed environment and international research network led production of best research performance and through its support, giving independent role of their research to young and promising scientists in basic science fields led them to do creative research and become next generation leader. Excellent research papers are produced through international joint research group. Despite being young scientists under 40 year old, they produced excellent results which are better than national average and the main R&D program performance (MEST, 2012). On the base of these results, the leaders of these research group held good position such as tenured professors in Chinese Science Foundation Graduate School and in Germany Alexander Friedrich University, principal researchers in IBS and heavy ion accelerator research institute and so on. That means APCTP contributed to the raising the next generation researchers in the theoretical physics fields.

Third, APCTP contributed to training young scientists from South-east Asian developing countries and raising next generation basic science researchers in Asia pacific area and cooperating with South-east Asian countries through the Young Scientist Training Program. As a result of these efforts, continuously the member countries are getting increased and Kazakhstan currently jointed and many other countries expressed their intention of participation to APCTP.

Fourth, outreach program separated from academic activities enabled physicists to meet scientists and the public and performed scientific communication using physics. These activities of APCTP as the supreme Asia Pacific physicist network contributed to the expansion of ground of theoretical physics and disseminated the importance of basic science and secured communication channels with scientists, pre-scientists, youngsters and the public in cooperation with the regional governments and the public organizations.

2. Managerial level

The accountability of managerial level faced by APCTP is as follows. First, it related to identity and portfolio of programs. APCTP has characteristics as basic research institute and international cooperation agency supporting developing countries as well. This mixed characteristics caused the confusion in the identification of status and then the clearance of this confusion and expansion of international joint research were recommended in the external evaluation (MOSF, 2011). Along this, the legal status of APCTP has been unstable since it was established because of absence of the qualification process. Therefore, in the parallel with strengthening basic science supported by government policy, APCTP needs to identify himself as basic research institute and enhance its reputation in basic research area. Related to this problem, the mixture of research and cultural activity programs in the structure of programs is another problem. There are too many kind of programs in this center regarding the designated budget. Self evaluation indicated AP scholar and chair professor program need to be merged to the academic program in higher level (MEST, 2011b). APCTP defined its identity as a research oriented organization and restructured programs with putting an emphasis on research program rather than science culture activities.

Second, it is related to operation of program. This could be reviewed in terms of overlapping, efficiency and propriety, monitoring system and governance.
In regard to overlapping, JRG and YST as residence researcher program have differences between former focused on excellence and latter as young scientists training program involved by member countries. In the case of academic activities program, 'theme research', 'season school', 'international academic conference and workshop', 'focus program' have different objectives, objects, the beneficial, and contents each other. Web journal 'cross road' aims to communicate with the public and has a structured differentiation with other programs and tries to expand the base and popularize science through scientific writing with diverse genres.
Regarding to efficiency and propriety, YST of residence researcher program needs to be changed into ODA training program for the member countries to secure budget and enhancement of competitiveness. There are differences between 'AP scholar' and 'chair-professor' within visiting program of academic activities program in terms of visiting period, supporting contents, inviting level, and so on. Operation of visiting programs are fragmented, it is necessary to integrate them for enhancing its efficiency and flexibility in budget usage and operation.
In the case of Physics Outreach Program, sharing budget with government, regional government, education organization, science related institute/party, publisher and increase of program implementation efficiency in the operation through cross support of administrative staff, exchange of information about program operation, expansion of PR effect and participants are requested.
Residence researcher program was monitored through regular review and advice of science committee involved world level researchers and its result was reflected to operation of this program. Academic program and international cooperation program of academic activities are deliberated and reviewed by representative members of theoretical physics communities, who conduct survey for the beneficial of main academic program. Physics Outreach Program is planned through regular review and advice in the meeting by members of group for science culture activities about web journal, science communication and regional science culture festival. 'Crossroad' is regularly reviewed and advised by members of science culture group and then is upgraded effectively in the operation of program.
In the reflection of simplification of program and focus on research program, the governance of APCTP needs to be changed for the efficient support to research and the strengthening of status. The delegated mission to Korean secretary general from foreigner president needs to be restored because of the election of Korean president in 2013.

Third, it is related to management of performance. Even though it is not perfect to evaluate performance of the theoretical physics using the general indicators, APCTP produced superior performances to those of other national R&D programs. According to the performance evaluation of S&T promotion fund program in 2011, this pointed out that APCTP achieved the designated goal but its goal seemed to lack challenge (MEST, 2011). The evaluation in 2012 pointed out that the expansion of international joint research group for the jumping up to international research institute and the strengthening of academic program and cooperation in link with south east countries and under developed countries are requested and the approval method of objectivity for the measurement of satisfaction of its performance need to be established (MEST, 2012). Therefore the setting and operation of new indicators for the program performance are required.

Table 3 Result of evaluation of APCTP

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<tr><th></th><th>05</th><th>06</th><th>07</th><th>08</th><th>09</th><th>10</th><th>11</th><th>12</th></tr>
<tr><td>Academic research activities</td><td>A</td><td>A</td><td>Excel lent</td><td>Excel lent</td><td>Excel lent</td><td rowspan="3">Avg</td><td rowspan="3">Excel lent (90)</td><td rowspan="3">Excel lent (85)</td></tr>
<tr><td>International cooperation exchange and training</td><td>A</td><td>A</td><td>Excel lent</td><td>Excel lent</td><td>Good</td></tr>
<tr><td>Establishment of scientist network</td><td>B</td><td>B</td><td>Good</td><td>Avg</td><td>Avg</td></tr>
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Fourth, it is related to the budget. The implementation of budget was determined on the base of yearly plan and progressed under quarterly management. But the budget source change of APCTP program from S&T promotion fund to general budget account and securement of new budget with new growth strategy are needed.

" Regarding the shortage of budget, the performance is good. While the fund is getting shorter, the budget source change into general budget account is necessary very soon to keep the current program scale" (interview with budget deliberation expert, June.19.2014)

Government planned to enhance the effectiveness of S&T promotion fund source as focusing on the promotion of science culture and moved less relevant programs to the general budget account gradually. Ministry of Strategy and Finance (MOSF) also indicated it is necessary to classify the differences between the fund programs and general budget programs and move less relevant programs in the fund to the general budget account. APCTP was started in 1997 as a program in the general budget account and moved to that fund in 2003 for the flexibility of budget operation and the strengthening of science culture promotion. But it is a pressing situation to return to the general budget account for the shrinkage of the fund volume and strengthening of research program.

3. Institutional level

In the R&D program, institutional accountability appears as an institutional response embracing technical and managerial accountability, and has bigger causal effects on the performance of the program than accountabilities in other levels. The institutional accountability to the APCTP will be reviewed in terms of bureaucratic, legal, professional, and political accountability.

3.1 Bureaucratic accountability

First, the support of the relevant ministry in charge of the APCTP seemed to be negligible meanwhile. During last government, since Ministry of Science and Technology, which was dedicated to Science and Technology, was merged to Ministry of Education, Science and Technology (MEST) focused on the education, the APCTP like other S&T programs was not supported appropriately. Even though the change of APCTP's budget source was suggested in 2010 and 2013 by Parliament, The veto of MOSF made it failed. Thus, this case clearly shows a lack of support from the relevant ministry. However, since the role of Ministry of Science, ICT and Future Planning (MSIP), which focuses on Science and Technology, came to be highly conspicuous during the Park Geun-hye government and Fundamental Technology Division, which is in charge of this program, is working actively, it is expected that the support from MSIP will be done significantly contrary to a relatively lack of support.

Second, even though the APCTP is a kind of international organization, most funding came from MSIP except for contributions of developing countries and support from local governments. In addition, the budget for the APCTP is not an institutional base but as a program so that APCTP program has many projects and activities. Thus, the operation of the APCTP in project level is not influenced by government officials, but the key factor influencing its operation is the internal structure of the APCTP including the president of the center, the secretary general and the administration bureau, and so on. The reason why the APCTP was able to develop sustainably in this structure is that many roles of the center was entrusted to Korean secretary general during foreign President’s incumbency and long-term tenure of the secretary general enabled the center to be operated consistently without frequent replacement. In addition, appointing a person of high reputation such as a Nobel Prize laureate as president of APCTP facilitated the funding from the government and the direction of the program was evolved into strengthening not only regional cooperation but also research capacity. Moreover, its contribution to popularization of science in the local community led to funding[2] from related local governments, Gyeongsangbuk-do and Pohang-si.

Third, work to be endorsed by APEC is in progress. APEC’s endorsement is one of the

[2] The budget of the APCTP (₩3,864 million) in 2013 comprises central government budget (₩2,915 million), local government budget (Gyeongsangbuk-do &Pohang-si, ₩318 million), MPG (Germany, ₩175 million), other budget (₩456 million).

diplomatic activities so that the support of governments and public institutions is important. Consequently, cooperation among MSIP (Fundamental Technology Division and Multilateral Cooperation Division), Gyeongsangbuk-do, and Pohang-si is required. The APCTP needs to present national importance through the mid and long-term development plan and its specific effects.

3.2 Legal accountability

This section examines legal accountability as below. First, the APCTP was established as a private institution, a form of a member country centered foundation, under Civil Code Section 32. Then, private-governmental partnership was established as the government started to support the program. A private research center can be operated flexibly unlike government-affiliated research institutes. In addition, a private research institute has advantages in that it keeps a favorable position for benefits from international organization and international human resource network can be constituted freely from government's interference.

Second, it can be concerned with status as an international organization. Without any specific legal support to date, the APCTP has functioned as a research platform for theoretical physicists (approximately 3000 of total visiting researchers, etc.) and a great deal of achievement including cooperation in Asia-Pacific region seemed to be accomplished. Recent reinforcement of budget accountability and change of the division managing APCTP from cooperation division to a basic research division in ministry caused more difficulty in an increase of APCTP's budget. The strengthening of domestic legal footing can help to obtain more budget but be likely to hinder privately led development of APCTP. As a consequence, if the establishment of the APCTP is legally supported by an agreement with international organizations such as APEC rather than domestic laws, it will secure budget more easily and achieve private-led development sustainably.

Third, there are many difficulties in securing additional budget because the budget is funded from S&T Promotion fund. It is a recent trend that the government is transferring projects, which are less relevant to creation of scientific culture, into the general account to improve the effectiveness of limited fund resources, focusing on creation of scientific culture.

"It is a recent trend that the budget of Science and Technology Promotion Fund is reduced every year. Thus, it is virtually impossible secure additional budget since the APCTP compete with representative science and technology organization such as the Korean Federation of Science and Technology Societies and the Korean Academy of Science and Technology to secure more from limited budget."(Interview with the President of the APCTP, July 9, 2014)

However, the APCTP is the only major R&D program among programs that requested a change of a budget source in 2015. In addition, while 'Northeast Asia R&D hub establishment project' which aims at invitations of excellent international organizations such as Max Planck POSTECH/Korea Research Initiative and 'the establishment of global cooperation foundation' which aims at support for developing countries' science and technology are funded from the general account, the APCTP is the only program that is funded from S&T promotion Fund. It is expected that the completion of Max Planck project will cause pressure on budget. However, since the APCTP is funded from S&T Promotion Fund, it has difficulty with budget increase. In addition, its evaluation for the fund program does not match with APCTP characteristics so that it can act as impediments to strengthening research capabilities. The budget for creation of scientific culture accounts only for 17 percent for the APCTP so that it is required to be transferred into the general account and to secure a new budget source.

3.3 Professional accountability

First, the APCTP was established not in a top-down approach by APEC but in a bottom-up approach by leading participation of theoretical physicists. The field of theoretical physics requires a high level of expertise and its research is carried out by researchers' autonomy so that professional accountability is strongly realized in this field than any other fields., the APCTP, originated autonomously from this field, has been operated by professional accountability. The APCTP is not long-term resident cooperation research using research equipment, but rather it carries out cooperation research through constant meetings without requiring any specific equipment. Thus, the APCTP, a form of a platform, could achieve relatively great performance considering its budget by deriving voluntary cooperation among researchers.

Second, the APCTP has continuously grown through private leadership. Through scientists' autonomous activities and cooperation, a role of the APCTP as a platform has been maximized, so that many achievements have been accumulated. The first and second presidents of the APCTP as Nobel Prize laureates disseminated the importance theoretical physics and basic science to Korea and actively promoted globalization of Korea's basic science and popularization of science. The third president of the APCTP as the president of the Max Planck Institute strengthened research capabilities and enhanced the status of basic science including creation of emerging research groups through cooperation with Germany. The new president as the first Korean president (Term: from July, 2013 to July, 2016) served as a secretary general for many years and was elected as the president of the Association of Asia Pacific Physical Societies (AAPPS) so that a favorable environment for Asia-Pacific academic collaborative research and international cooperation projects was created.

"The APCTP seems to enter a adulthood period, passing through an adolescent period. The new president of the APCTP was elected in return for leadership and trust that Korea has showed the international society. However, we feel burdensome because it is very hard to build trust, but it can be gone like a flash. We are going to do our utmost to establish the foundation for the world-leading research institute in theoretical physics."(Interview with the President of the APCTP, July 9, 2014)

Since present member countries consist of not only Australia, China, and Japan but also developing countries such as Laos, Malaysia, the Philippines, Mongolia, Vietnam, and Thailand, the APCTP has grown sustainably, playing leading roles such as training emerging workforce based on Korea's expertise.

Third, in addition to scientists and engineers who were in charge of leading roles, professional accountability of secretary general and staffs of the administration bureau functioned as important roles in the development of the APCTP. The role of the APCTP includes a supporting activity with understanding research administration, school administration, and international cooperation. Both the secretary general, who manages APCTP's activities like a responsible prime minister, and staffs of the APCTP played the following important roles. Even though the APCTP is located within Pohang University of Science and Technology (POSTECH), it maintains independence and completes 'Pohang System' through cooperation with universities and nearby Pohang Accelerator Laboratory (PAL).

3.4 Political accountability

First, let's examine the hosting of the APCTP. The APCTP was established with the desire of counteracting absence of world-class theoretical physics research institute in Asia-Pacific region, conducting world-class research, and cultivating competent human resources through international cooperation among 10 countries including Korea, China, and Japan. In addition, it was established in Korea because China wanted to check Japan's sole lead, Australia has a geographical disadvantage, and Vietnam and the Philippines, which consider Korea as a role model, supported actively. The APCTP was located in Seoul when established, but the crisis of leadership caused it to move from Seoul to inside of POSTECH through open invitation for a new place. Compared to Seoul and Daejeon, Pohang is similar to the case of International Centre for Theoretical Physics (ICTP), which is located in Trieste, Italy. In addition, Gyeongsangbuk-do and Pohang-si's promise of active support caused favorable results.

Second, let's examine political support from a national ultimate decision maker. President Kim Young-sam' commitment caused the APCTP to secure official support when established. In the Lee Myung-bak government, one of the main science and technology policy was that basic research occupied 50 percent of R&D budget and establishment of Institute for Basic Science and installation of heavy ion accelerator were progressed. The Park Geun-hye government set up Basic Research Promotion Master Plan ('13~'17)' and made clear that they will strengthen support for promising new researchers of basic research and revitalize international cooperation. The APCTP will be able to exploit such will to promote basic research for strengthening its status.

Third, let's look at political accountability in the level of National Assembly. In National Assembly, Education and Science Technology Committee's review report on 'Agenda of 2010 Settlement of Accounts and Approval for Reserve Fund Expenditure' said that since the APCTP program is similar to another program transferred into the general accounts in 2010, it is necessary to examine whether to transfer the APCTP program into the general accounts('11. 8.). In 2013, through a relevant permanent committee, Science, ICT, Future Planning, Broadcasting, and Communications Committee's resolution('13.12.10.), the agenda was submitted to Special Committee on Budget and Accounts, but MOSF, a budget department, did not accept the transference. For the transference, there is a need to actively assert that they should screen programs and support intensively the program in accord with fund's purpose, highlighting that S&T promotion Fund is deteriorating, and transfer programs which do mainly aim science and technology promotion including the APCTP into the general budget account in cooperation with amicable politicians.

Forth, let's examine political accountability regarding local government or local politicians. The APCTP is funded directly from Pohang-si and Gyeongsangbuk-do and it does not seem to have any problem with increasing budget because of it regional characteristics as a political support base of both President Lee Myung-bak and Park Geun-hye. A wise role of local politicians is important to develop the APCTP since spread of awareness that the APCTP is a local program tends to make central government's interest distracted.
Finally, in the level of an international organization, for agenda-setting to be an APEC endorsed specialized institute, a process securing understanding and cooperation of other member countries is more important that an official procedure. Consequently, to draw support and

participation of APEC member countries and neighboring countries, it is necessary to make the best use of APEC's official project. In addition, MSIP's practical cooperation is required in this process.

V. Conclusion

As reviewed in this paper, diverse accountabilities around research environment as well as research capacity, enhancement of international status, contribution to regional society should be responded in order to develop the APCTP. A case in this research, the APCTP, has achieved the goal of the program, responding properly to many problems in a managerial and institutional level. In the managerial level, efficiency of the program was enhanced by simplifying the complicated program and in the institutional level, a long-term role of the secretary general, who exerts real authority, was foundations for a sustainable development. Even though enhancement of its status was limited by the lack of legal support, voluntary participation and endeavor, because the APCTP was established in a bottom-up approach, made good performance as a research platform considering its budget. In addition, the Lee Myung-bak government and the Park Geun-hye government's strong will for basic research and support from local government will play a positive role in development of the APCTP as an international research institute and it is expected to be real help for enhancement of international status for the future.

Specifically, we can make the following conclusion from summarizing institutional accountability of the APCTP. Active support and cooperation of local governments have a positive influence on lasting the program. However, because a relevant ministry of the APCTP, MOST's status was weakened during the last government, active support was not given. Moreover, a budget ministry's lack of understanding and interest about the program caused a lot of difficulties. In the field of theoretical physics, trust in professionals' capability, which is based on the high level of expertise, and professional vocation should be fully used, but minimum regulation should be applied so that efficiency of policies can be enhanced. Thus, legal accountability is crucial in this field. However, the APCTP has been operated by internationally prestige scientists and vocation of both secretary generals and staffs of administration bureau, but it lacked legal accountability backing them. Fortunately, the APCTP realized such circumstance and is actively promoting endorsement as an international specialized organization. It is required to draw relevant ministry's support in addition to restoration of relevant ministry's power in government. In addition to endorsement for international specialized organization, transference of its budget into the general account is preponderantly being carried. It seems to need endeavor to secure separate budget to support the APCTP rather than oscillating between fund and the general account. Regarding political accountability, political circles strongly support the APCTP on the surface, but practical achievements are not accomplished. It is necessary to draw practical effects from political support of central and local governments.

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A study on the R&D investment and financial performance : Focused on existing and potential competitors

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Abstract

The goal of this study is to examine the effects of capitalized and expensed R&D investment on the growth and productivity of the firms in competitive environment. Competitive environment is operationalized as the intensity of existing rivalry within an industry and barriers to market entry. Synthetically, the effect of R&D investment on firm performance is tested by considering competitive environment using a sample of KOSPI and KOSDAQ-listed firms. Binomial logistic regression was used for empirical analysis. The key findings of this study are as follows. Firstly, capitalized and expensed R&D investment have a mixed effect on firm's growth and profitability. R&D investment of the year 2012 has a negative effect on firm performance of the same year. After extending the time frame and considering odds ratio, both capitalized and expensed R&D investment have significantly positive effects on firm performance.
Secondly, R&D investment is found to be an important factor for the enhancement of profitability when the intensity of existing rivalry is low and barriers to market entry is high. In contrast, high intensity of existing rivalry and low barriers to market entry lead us to observe the

role of R&D investment in enhancing the growth of the firms. Our results may be applied to formulate R&D investment strategies contingent on firms' competitive environment.
This study investigated the impact of R&D investment on firms' profitability and growth which is contingent on competitive environment. The measurement of competitive environment may also be replicated in future studies.

Key words: Competitive environment, Capitalized R&D expenditures, Expensed R&D expenditures, Growth, Profitability

June 17 (Wednesday)

R# : 204 Auditorium

Keynote Speech

Fumio Kodama (University of Tokyo, Japan)
Presentation Theme: "Corporate and Public Policies for Open Innovation: Demand Articulation in the Open-Innovation Paradigm"

Blanca C. Garcia (Northern Borderlands Research College, Mexico)
Presentation Theme: "Knowledge Cities Benchmarking: The case of Daegu, Korea"

Venni V. Krishna (Jawaharlal Nehru University, India)
Presentation Theme: "Globalization of R&D and Open Innovation: Linkages of Foreign R&D centers in India

KongRae Lee (DGIST, Korea)
Presentation: "Sectoral differences in convergence innovation: implications for open innovation "

Corporate and Public Policies for Open Innovation: Demand Articulation in the Open-Innovation Paradigm

Fumio Kodama[1] **and Tamotsu Shibata**[2]

(Drafted on 5/29/2015)

Abstract

In the marketing literatures, “articulation of demand” is quoted as an important *competency* of market-driving firms. In this paper, therefore, I will demonstrate how the concept of “demand articulation” was effective in formulating corporate policies for technology and market development, and also in government policies for accelerating the commercialization process of emerging technologies, including. a historical case in the area of the U.S. defense policy that had induced the emergence of the Integrated Circuits technologies.

Secondly, in order to comprehend empirically what really means “demand articulation,” i.e., how “market-driving” is different from “market-driven,” we will go to a quantitative analysis of market growth paths in three different kinds of product categories. Finally, we will go to the arguments of “business model” creation, which will bring the concept of “demand articulation” into a reality under an emerging business environment of open innovation.

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Knowledge Cities Benchmarking: The case of Daegu , Korea

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Abstract

One of the difficulties in creating and sustaining knowledge cities is the lack of benchmarks to identify those cities and regions that are generating knowledge-driven initiatives, triggering development and collective value. One of such benchmarks is the value-based Generic Urban Capitals System (GUCS) taxonomy. The rigorous application of GUCS to cities in European, Asian, North and Latin American contexts has already yielded its initial fruits, providing a deeper perspective for different urban communities through the MAKCi (Most Admired Knowledge City) application of GUCS. In this paper, we are aiming to introduce the MAKCi Framework as an integrative system of capital analysis for the case of the Daegu city-region and its journey into developing its knowledge capitals. Depicted as the "Apple City" for its high quality apple production, Daegu is also known as a "Textile City" evoking its traditional core industry, and currently focusing on fostering its fashion and high-tech industries. Through Knowledge City capital system taxonomy (MAKCi), some of Daegu's intriguing systems of knowing are expected to emerge as a comprehensive regional meta-system articulated by the extensive knowledge-creating initiatives already in place in this Korean city, bearing the flag of knowledge-based development schemes.

Key words – Knowledge-City Capitals System, Social/Relational Capital, Social Norms, Borderland Knowledge Cities. Innovation Clusters, Networks, Creative Class, Brokers

Conference Theme – Open Innovation, Knowledge City & Creative Economy
Sub-themes – Knowledge-based Development

Globalization of R&D and Open Innovation: Linkages of Foreign R&D centers in India

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Abstract

In the new form of Globalization of R&D, Multinational (MNEs) firms have established their R&D units in emerging Asian countries, particularly in India and China. This trend causes a major concern for both home and host countries' perspectives. Generally firms choose to locate their R&D units in their country of origin and rarely go with their crucial R&D in the offshore location. However, in the recent years these trends of offshoring of R&D by MNEs are mainly because of emerging markets in developing countries. Beside this sourcing knowledge from globally dispersed knowledge hubs is also one of the major motives. In these foreign R&C centers, firms very occasionally work in isolation to build their assets, but they work association with the other actors of the host economy. This study has investigated the linkage patterns of foreign firms in India from an in-house developed database. The ICT sector has taken to investigate the linkages of foreign firms with the Indian entities. The study observed that most of the foreign firms are collaborating with the other foreign firms located in India. Firms are strongly attached with their parent unit or subsidiaries located in the other global locations. Indian firms are more preferable entity then the university or government research institutes. Foreign firms' embededness with the local innovation system is only by linking with the local firms. Also, most of the collaboration happens in peripheral (joint development) rather than core domain (joint R&D). Industry-academia linkages are weak in India. Many of the firms are going for 'Open Innovation' mode to build up their assets in India. Although, India has very strong government research laboratories, these are not playing important role in collaborating with the foreign entities. From the policy perspective, Industry academia linkages needs to be strengthen.

Keywords: Globalization of R&D, Linkages, Foreign R&D, Multinational, Open Innovation

Sectoral differences in convergence innovation: implications for open innovation

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Abstract

Convergence innovation becomes a prevailing phenomenon in the modern innovation of the manufacturing industry as IT technologies began to be applied to vast areas of conventional technologies. This paper aims to measure the degree of convergence innovation and their trends at the industry level. The data set used is composed of 12 years in longitude and five industry types with 39 sub-industry sectors and comparisons of four countries having patent applications in the US: Japan, Korea, Taiwan and China. This paper measured intra-industry convergence and inter-industry convergence in the case of the Korean industries and made a convergence innovation matrix based on the results of the analysis. We hope that this study will provide a clue to exploring further the structure of convergence innovation at the meso and macro level. Innovation studies that focused on convergence innovation need to deepen their framework toward various perspectives in the future. Research performances achieved by open innovation studies and their research framework might provide many insights into the exploration and exploitation of future convergence innovation studies.

Keywords: convergence innovation, open innovation, inter-industry convergence, intra-industry convergence, convergence innovation matrix

June 17 (Wednesday)

R# : 203 International Conference Hall

Special Session 9

"Open Innovation: Technology, Society & Dynamics"

■ **Session Chair: KyungBae Park** (Sangji University)

- Paper 1: "Globalization of R&D and Open Innovation: Linkages of Foreign R&D centers in India" by **Swapan Kumar Patra(Jawaharlal Nehru University, India), Venni V. Krishna(Jawaharlal Nehru University, India)**
- Paper 2: "Open Innovation Effort, Entrepreneurship Orientation and Their Synergies on Innovation" by **JinHyo Joseph Yun(DGIST), KyungBae Park(Sangji University), JangHyun Kim(Sungkyunkwan University)**
- Paper 3: "The Philosophy of Open Innovation: Historical Development of Philosophy of Open Innovation and Its Reflection from Taoism" by **JinHyo Joseph Yun(DGIST), KyungBae Park(Sangji University), JeongHo Yang(DGIST), WooYoung Jung(DGIST)**
- Paper 4: "How User Entrepreneurs Succeed: The Role of Entrepreneur's Caliber and Networking Ability in Korean User Entrepreneurship" by **JinHyo Joseph Yun(DGIST), KyungBae Park(Sangji University)**
- Paper 5: "A Study on the Dynamics of Platform Business Models" by **JinHyo Joseph Yun(DGIST), DongKyu Won(KISTI), KyungBae Park(Sangji University), JeongHo Yang(DGIST)**
- Paper 6: "Autonomous learning model in closed and open innovation condition" by **DooSeok Lee(DGIST), JinHyo Joseph Yun(DGIST), HeungJu Ahn(DGIST), KyungBae Park(Sangji University), JeongHo Yang(DGIST)**

6 June 2015 draft

Globalization of R&D and Open Innovation: Linkages of Foreign R&D centers in India

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Paper for SOItmC and KCWS 2015 conference 14-18 June 2015, Daegu, South Korea

Globalization of R&D and Open Innovation: Linkages of Foreign R&D centers in India

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Abstract

In the new form of Globalization of R&D, Multinational (MNEs) firms have established their R&D units in emerging Asian countries, particularly in India and China. This trend causes a major concern for both home and host countries' perspectives. Generally firms choose to locate their R&D units in their country of origin and rarely go with their crucial R&D in the offshore location. However, in the recent years these trends of offshoring of R&D by MNEs are mainly because of emerging markets in developing countries. Beside this sourcing knowledge from globally dispersed knowledge hubs is also one of the major motives. In these foreign R&C centers, firms very occasionally work in isolation to build their assets, but they work association with the other actors of the host economy. This study has investigated the linkage patterns of foreign firms in India from an in-house developed database. The ICT sector has taken to investigate the linkages of foreign firms with the Indian entities. The study observed that most of the foreign firms are collaborating with the other foreign firms located in India. Firms are strongly attached with their parent unit or subsidiaries located in the other global locations. Indian firms are more preferable entity then the university or government research institutes. Foreign firms' embededness with the local innovation system is only by linking with the local firms. Also, most of the collaboration happens in peripheral (joint development) rather than core domain (joint R&D). Industry-academia linkages are weak in India. Many of the firms are going for 'Open Innovation' mode to build up their assets in India. Although, India has very strong government research laboratories, these are not playing important role in collaborating with the foreign entities. From the policy perspective, Industry academia linkages needs to be strengthen.

Keywords: Globalization of R&D, Linkages, Foreign R&D, Multinational, Open Innovation

Introduction

The term "globalization" has attracted attention of a wide range of disciplines form scholars of advanced as well as developing and emerging economies. In economics and international trade, the process of globalization assumed a good deal of significance through the operation of multinational enterprises (MNEs). The role of MNEs in the era of globalization and the trends of FDI, particularly in R&D via opening up of MNEs' R&D centres in developing and emerging economies are of central research concern today. Although there are a number of different actors in globalization of innovation, MNEs have the central role because of their multifaceted role in more general process of globalization of innovation (Narula & Zanfei, 2005). Archibugi & Pietrobelli (2003) identified three of types of globalization of technology namely: *international exploitation of nationally produced technology; the global generation of innovation; global technological collaborations.* Enterprises, especially large MNEs, may generate innovations following all the three procedures. However, in recent years, the globalization of innovation comes up with a new face with the growth and spread of the MNEs and FDI beyond the national borders. A new dimension has emerged with the present wave of globalization, particularly since the 1990s is that the MNEs from developed countries are establishing their R&D units in developing countries particularly in India and China (UNCTAD, 2005; Krishna et.al, 2012).

With the growing pace of globalization the businesses of MNEs innovation strategy is also expanding as never before. Generally, firms expand globally as a consequence of home based 'ownership advantages' to be exploited in foreign markets. Although, MNEs are usually restrict their R&D activity close to headquarter, since the early 1980's they started Research and Development (R&D) in offshore locations to augment home base R&D capabilities. Major reason for dispersion of R&D activities was to secure new technological competencies distributed globally. Many R&D units are now working beyond the adaptation of products developed in home to local market. Many firms are acquiring new knowledge from the local environment for the parent unit at home. However, offshoring R&D by MNEs were restricted mainly in triad region (US, Western Europe, and Japan). In recent years new mode of organizing MNEs innovative activities are gradually emerging. MNEs around the globe are now eager to exploit developing countries' markets particularly the two emerging Asian major; China and India. Simultaneously, government of both these countries are creating conducive environment for MNEs with attractive policies like tax breaks, knowledge parks, and multiple knowledge hubs in major cities in the form of world class educational institutes. Policy and decision makers in both the countries realized that communication among government, university and industry is the key to innovation and sustainable growth.

As seen from *Booz & company annual global innovation 1000 survey 2007*; the top 80 US MNEs spend about $ 80.1 billion out of US$ 146 total R&D fund. Out of their total $117 billion R&D budget top 50 European companies spend $51.4 billion in overseas. Top 43 Japanese firms spend 40.4 billion out of a total of 71.6 billion in overseas R&D (Jaruzelski & Dehoff, 2008). Although, global FDI flows have been severely affected worldwide recently by the economic and financial crisis, (FDI Inflows are likely to fall from $1.7 trillion in 2008 to below $1.2 trillion in 2010) it was recovered by 2010 with an outflow/inflow of up to $1.3-1.5 trillion in 2011 and reached up to $1.6-2 trillion by 2011 (UNCTAD, 2005; 2009). The figures of R&D spending and other literature from UNCTAD and various other studies show that the largest multinational firms are also key actors in the generation and diffusion of innovation. MNEs use different means through which innovation develops and diffuses across national borders.

MNEs are extending their business within very competitive and fast moving market conditions. The MNEs often invests abroad to gain revenues and profits out of innovations embodied in the products or services it has been selling within its regional or domestic markets. They gain competitive advantage by exploiting global economies of scale and by arbitraging imperfections in the world's capital, materials, and labor markets. MNEs seeks to have product and service offerings that are designed and manufactured based on the world's most advanced technological know-how. MNEs are also very responsive to the specific variations in needs and customs that are peculiar to any given country or local situation, i.e. local needs (Katz, et al., 1996).

According *to World Investment Report 2005* (WIR 2005) MNEs spent about half of global R&D expenditures, and about two thirds of business R&D expenditures (UNCTAD, 2005). These expenditures are significantly higher than many individual countries' Gross Domestic Product (GDP). The world's largest R&D spenders are concentrated in a few industries, notably IT hardware, the automobile, pharmaceuticals and biotechnology industry (UNCTAD, 2005). MNEs play an important role in the innovative activities of their home countries and control or own a large part of the world's stock of advanced technologies (Narula & Zanfei, 2005).

Foreign Direct Investment (FDI) is one of the major mechanism through which MNEs acquire existing assets abroad or set up new wholly owned activities in foreign markets.

Other important mechanisms are trade, licensing, cross-patenting activities, and international technological and scientific collaborations. One of the major changes that have taken place in the post - 2000 globalized era is that the corporate R&D at MNE headquarters is no more hierarchically integrated and concentrated in the home country or in the triad region (where MNEs are known to have conventionally operated). This has broken down and it is here argued that, the internationalization of R&D of 'one way relationship' of the 1980s has given way to 'two ways or multiple ways of relationships' towards globalization of R&D and globally distributed R&D for production and innovation.

This phenomenon of internationalization of R&D did not gain much the attention of scholars till the early 1980's. Few early studies for example Ronstadt (1977, 1978) Behrman & Fischer (1980) studied US based MNEs and observed that R&D activities of MNEs depends upon the various push and pull factors. A new trend emerged in late 1980's when there was rapid increase in foreign-funded and foreign-performed R&D in most industrialized countries. *OECD Science and Technology Indicators Report* and the *United States National Science Board Science and Engineering Indicators* first reported in early 1990s, that there is acceleration in the internationalization of industrial R&D (Niosi, 1999). By the end of 1990s, however, it had become an important research area.

Lots of literature are available on the role of MNEs in the context of triad (US, Europe and Japan) or industrially advanced countries of North America and Western Europe. For example Mansfiled et al (1979); Behrman & Fischer (1980); Patel & Pavitt (1991) Zander (1999); Thursby & Thursby (2006) Niosi & Godin (1999); Gassmann & Zedtwit (1999); Belderbos (2003) have worked on various aspect of internationalization of R&D. However all the studies mentioned above are developing countries firms doing R&D in other developing countries. The works on MNEs doing R&D outside developing countries is comparatively rare. So, strong theoretical framework is missing. The developing countries and their significance come into picture from the point of international technology transfer and trade and market prospects. However, studies on developing countries and emerging economies involving the role of MNEs are just emerging mainly from the perspective of these countries.

The discourse of globalization of R&D via MNEs and their R&D operations in the two emerging economics i.e. India and China has spanned the mass media, newspapers and commentaries in international relations. For example; *Intel India Design Centre* in Bangalore has about 1,000 professionals; *Motorola*'s R&D centers in China has about 1,300. *GE's John F Welch Technology Cen*tre in India houses more than 2,000 engineers and technical staff. With over 100 patents and a strong mandate for research in new technology areas such as

Windows Live, the *Microsoft India Development Centre* (MSIDC) based in Hyderabad continues to expand its operations (*Business Line*. March 12, 2007). Microsoft's latest search engine 'Bing' is developed from MSIDC Hyderabad and Bangalore centre. IBM never used to operate outside Washington and Paris. But today it has two labs in India with over 500 scientists. These firms are developing significant number of their global products from their R&D centres in India. These developments provided a good rationale and a potential ground for undertaking this paper.

Linkages of MNE's R&D Units with Actors of Host Country's Innovation system

Firms create new knowledge through investments in R&D and must manage this knowledge through its dispersed network of subsidiaries. To remain competitive particularly in high technology industry firms, continuous access to new information, know-how, and ideas is essential to success. Presently, the knowledge produces and generated around the world in in an unprecedented manner which world has never witnessed before. It is very difficult for a firm or any other single entity to keep track of the development in various technology fields. There are new technologies emerging with the convergence or fusion of technologies. Firms must continuously monitor and absorb knowledge from other organizations including domestic and international firms, government laboratories, and universities. In high technology sector large firms are no longer the sole locus of innovative activity. The locus of innovation is dispersed like a "network" of inter-organizational relations. Moreover, the network-like structure of the organizations responsible for innovation may well be a temporary phenomenon arising from the relative immaturity of the technological paradigm. In modern capitalist economies the innovation process requires new and different organizational arrangements to combine specialized complementary assets, controlled by different types of agents, to be combined (Arora & Gambardella, 1990). Firms can access external knowledge by engaging in inter organizational alliances. Empirical research has confirmed that strategic alliances are an important source of scientific and technological knowledge (Ahuja, 2000). Alliances are formal, legal entities that take time to establish and, being costly in terms of managerial time and attention, must be limited in their number, and targeted to specific needs. In an environment where the nature, location, and type of potential knowledge sources are continuously changing, firms need to develop flexible mechanisms of knowledge acquisition (Almeida, et. al., 2011).

In a NIS, the linkages among the various actors are central for the best performance. Among the many other actors, universities, firms, research institutes, think tanks, venture capital firms, government policy, infrastructure etc. are important. It should be taken into account, that the efficient operation of a SI requires not only the activities of its component parts, but also the interaction among them. The innovative performance of a country depends to a large extent on how these actors relate and interact with to each other as elements of a broader system (Dahlman & Utz, 2005). Linkages can take in the form of joint research project, joint development of a product, personnel exchanges, joint patenting, technology licensing, equipment purchase, and also a variety of other channels. Better networking may lead enhanced resource flows to the companies. Therefore, the networks between the group of firms and extra-regional actors are of importance (Rickne, 2001).

MNEs are the main actors in knowledge transfer to the local firms in the developing world. Knowledge transfer occurs through the interactions with the local actors in the different stage of value chain. From host country's perspective, MNEs technological knowledge is the major contributor to develop local technological capability. Various kinds of linkages among the foreign firms with local institutions in host country have major impact on the capability and resource development of these firms. Firm's capability building depends upon the scope, quantity and quality of linkages formed among the foreign firms and local institutions' interaction (Giroud & Scott-Kennel, 2009). MNEs linkages in a host country can be of various forms *backward, forward or horizontal.* The linkages where foreign affiliates acquire goods or services from domestic firm are called *backward linkages*. When foreign affiliates sell goods or services to domestic firms is called *forward linkages*. *Horizontal linkages* involve interactions with domestic firms engaged in competing activities (UNCTAD, 2001).

However, not all value chain relationships are equally conducive to knowledge transfer. Several knowledge transfers occur unwillingly through the workers' mobility. Some knowledge transfer happens voluntarily. For example MNEs themselves want to increase the efficiency of their local suppliers for different steps in their value chain.

Firms very occasionally work in isolation to build their assets, but in interaction with other actors of the environment (Gulati, 1998, 1999). However, there are variations in the pattern of interaction of firms with the different actors in the innovation system. This variations is due to the of firm's embeddedness in their environment for creating knowledge to achieve competitive performance (Figueiredo, 2011). The embeddedness is important to accumulate capabilities for innovation in products, production processes, and services (Figueiredo, 2011; Andersson & Forsgren, 1996). The degree of subsidiary's embeddedness is a function of the adaptation between the subsidiary and direct and indirect counterparts of these relationships.

Subsidiaries accumulate innovative capabilities over time. Improvements in innovative performance are depends on the embeddedness of subsidiaries in the local context. The frequency and the quality of the linkages depend on intra-corporate counterparts (‘internal’ linkages) and local organizations (‘external’ linkages) and are important to achieve innovation capability.

Open Innovation

The closed innovation paradigms were popular concepts in 20th century. The innovation was considered as 'black box', and industries were mainly characterized by mass production. Firms were usually strong, self-reliant and corporate philosophy was to invest more in R&D to achieve radical innovation. In traditional or so called “closed model” firms use their own capability to generate and develop innovation to remain competitive (Chesbrough, 2003, De Jong, et al. 2008 page 11). Firms innovate using internal or external sources, then perfect the technology and make ready for commercialization. Like a funnel, the concepts narrowed down to those useful or beneficial concepts which best fits company's need (figure 2.10) . If innovation fails or resulted in ideas that did not match the corporate strategy, the idea often remain unused (OECD 2008)[1]. The innovation process was dropped unyielding innovations, and firms were only interested with radical innovations to achieve monopolistic advantages. Firms were also cautious about the intellectual property (IP) and usually kept it among themselves from the potential rivals.

Collaboration in innovation process was not new. It happens between or among firms and abundant innovation literature is available on the subject. Various studies find that firms do not innovate in isolation rather co-operate with external partners in different steps of value chain. However, the openness in innovation process is becoming more prominent now-a-days as evidenced in popular as well as scholarly literature. The concept gained more popularity since 2003, with the term “Open innovation” coined by Henry Chesbrough. The concept, draws a great deal of attention among researcher and business communities worldwide (Chesbrough 2003)[2]. Business management professionals, scholars are emphasized the need of open innovation strategies in today's globalized world as it is becoming an integral part of

[1]OECD. November 2008. "Open Innovation in Global Network." Pp. 1-7. Paris: Organization for Economic Co-operation and Development.
[2]Chesbrough, Henry. 2003. *Open innovation: The new imperative for creating and profiting from technology*. Harvard, MA: Harvard Business School Press.

global corporate strategy (Backer et al. 2008)[3]. The uniqueness of the concept of "open innovation, is it recognized both internal and external knowledge sources of information and a proper coordination of both will yield optimum benefit for a firm. While, the term "open" is associated with many license or royalty-free technologies available in the market, the open innovation is strictly based on payment of license fees (OECD 2008)[4]. However, the idea is still in germinating stage and primarily limited to the organizational level, but it is increasingly being discussed in the different level of innovation systems and related government policies. However, state government's role in Open Innovation is yet to be decided (De Jong, etal. 2008)[5].

The open innovation model is a more dynamic and less traditional and linear approach. In this model firms search for ideas and knowledge both from inside or from outside boundaries of firms (OECD 2008). Firms utilize both internal and external sources of knowledge to advance their innovation processes and quickly bring them to market (Figure 2.11). Open Innovation paradigm argues that organizations can make better use of their knowledge if they open up their innovation process. Also, opening up of innovation processes, means more knowledge spillovers. According to Chesbrough (2003) [6] the present-day innovation paradigm is increasingly shifting towards more open model because of the following reasons:
Firstly, the mobility of high-skilled knowledge workers has increased significantly in the recent years. *Secondly*, there is an increase in qualified manpower with better college and post-college training *Thirdly*, there are many private venture capital firms which supports innovation and entrepreneurship. *Fourthly*, in high technology sectors in particular, fast innovation cycles and less time to reach customer and market for many products and services. Also, the mass-market has become fragmented into many niche markets, where consumers needs varies. Also, due to globalization process, competitions among foreign enterprises are intensified to capture these niche markets. *Finally*, knowledge centers dispersed globally including the university, research institutions and so on, firms are trying to reap benefits from these dispersed knowledge pocket to enhance core competency. With all these factors closed innovation model increasingly becoming an obsolete concept and more and more firms are moving towards open innovation model.

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[3]Backer, Koen De, Vladimir Lopez-Bassols, and Catalina Martinez. 16-Dec-2008. "Open Innovation in a Global Prespective - What Do Existing Data Tell Us?" Paris: Organisation for Economic Co-operation and Development (OECD).
[4] OECD. November 2008. "Open Innovation in Global Network." Pp. 1-7. Paris: Organization for Economic Co-operation and Development.
[5]De Jong, Jeroen P.J., Wim Vanhaverbeke, Tarmo Kalvet, and Henry Chesbrough. 2008. "Policies for Open Innovation: Theory, Framework and Cases." in *Research project funded by VISION Era-Net*. Helsinki: Finland.
[6]Chesbrough, Henry. 2003. *Open innovation: The new imperative for creating and profiting from technology*. Harvard, MA: Harvard Business School Press.

Open innovation is defined as *'the use of purposive inflows and outflows of knowledge to accelerate internal innovation, and to expand the markets for external use of innovation, respectively* (Chesbrough 2006)[7]. Another definition of open innovation is *Open Innovation is the use of purposive inflows and outflows of knowledge to accelerate internal innovation, and to expand the markets for external use of innovation, respectively* (De Jong, et al. 2008). OECD report observe *Companies' innovation activities are increasingly international, and they are embracing "open innovation" – collaborating with external partners, whether suppliers, customers or universities, to keep ahead of the game and get new products or services to market before their competitors. At the same time, innovation is being "democratized" as users of products and services, both firms and individual consumers, increasingly become involved in innovation themselves* (OECD 2008)[8].

In today's highly complex competitive and globalized market, MNEs have to innovate and develop commercially viable products rapidly. In the complex, multidisciplinary and competitive global business environment, corporate R&D function has changed rapidly. To meet the pressing challenge to innovate more and quicker MNEs have changed their innovation strategies and adopted new approach. It is found that important innovation was increasingly being done at small and medium size entrepreneurial companies. University and research laboratories are gradually interested in forming industry partnerships to commercialize their research. Even individuals are today eager to license and sell their intellectual property. Rapid development of ICT particularly the web technologies and the Internet has opened new means to access worldwide talent. Even the major MNEs like International Business Machine (IBM), Eli Lilly Proctor and Gamble (P&G) are doing research with the new concept of open innovation, by using one another (even competitors') innovation assets (like products, intellectual property rights, and even R&D manpower) (Huston & Sakkab 2006)[9]. For example; P&G in 2000, realized that P&G couldn't meet its overall corporate growth objectives by spending more and more on R&D for less and less return, so they reinvent the company's innovation business model by connecting ideas across internal businesses. By doing this, 50 percent of P&G's innovation comes from outside the company. According to Huston, & Sakkab "*The strategy wasn't to replace the capabilities of our 7,500 researchers and support staff, but to better leverage them. Half of our new*

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[7]Chesbrough, H. 2006. *Open Business Models: How to Thrive in a New Innovation Landscape*. Boston, MA: Harvard Business School Press.
[8]OECD. November 2008. "Open Innovation in Global Network." Pp. 1-7. Paris: Organization for Economic Co-operation and Development.
[9] Huston, Larry, and Nabil Sakkab. 2006. "P&G's New Innovation Model." *Harvard Business Review* 84:3;

products… would come from *our own labs, and half would come* through *them*"(Huston & Sakkab 2006)[10].

As seen from the P&G's example, not even the largest R&D spenders are doing their entire R&D, rather increasingly tying up with other. Along with other activity like sales, manufacturing, MNEs, have increasingly shifted R&D activities across borders within their global value chain and rely on outside innovation for new products and processes. The world's innovation landscape had changed; firms are gradually shifting their innovation model from a centralized approach to a globally dispersed integrated model (Bartlett & Ghoshal 1989)[11]. New products and services are not only developed by one company but also in collaboration with partners such as suppliers, research institutes, competitors or even users (Hippel 2005)[12]. Thus the corporate are increasingly going towards open mode of innovation. The open innovation phenomenon is a complex issue and gaining increasing focus form different stream of academic discourse like *globalization of innovation*, *off sourcing of R&D*, *supplier integration*, *user innovation*, *external commercialization and application of technology* (Gassmann 2006)[13]. Open innovation argues that innovation paradigm has shifted from a closed 'inbound open innovation' to an open 'outbound open innovation' model (Chesbrough & Crowther 2006)[14]. Presently, it has taken center stage with the recent debate on globalization of R&D and the potential for the R&D function outsourcing.

Open Innovation is closely related with the systems of innovation literature (De Jong 2008, (OECD 2008)[15],[16], The basic difference is that the open innovation looks at the innovation system from the individual company's perspective, while the SI literature looks companies as black boxes (De Jong et al 2008)[17].

Analytical Framework

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[10] Huston, Larry, and Nabil Sakkab. 2006. "P&G's New Innovation Model." *Harvard Business Review* 84:3;

[11] Bartlett, Christopher A., and Sumantra Ghoshal. 1989. *Managing Across Borders*. Boston, Massachusetts: Harvard Business School press.

[12] Hippel, Eric von. 2005. *Democratizing Innovation*. Cambridge, MA: MIT Press.

[13] Gassmann, Oliver. 2006. "Opening up the innovation process: towards an agenda." *R&D Management* 36:223-228.

[14] Chesbrough, H, and Adrienne Kardon Crowther. 2006. "Beyond high tech: early adopters of open innovation in other industries." *R&D Management* 36:229-236.

[15] De Jong, Jeroen P.J., Wim Vanhaverbeke, Tarmo Kalvet, and Henry Chesbrough. 2008. "Policies for Open Innovation: Theory, Framework and Cases." in *Research project funded by VISION Era-Net*. Helsinki: Finland.

[16] OECD. November 2008. "Open Innovation in Global Network." Pp. 1-7. Paris: Organization for Economic Co-operation and Development.

[17] De Jong, Jeroen P.J., Wim Vanhaverbeke, Tarmo Kalvet, and Henry Chesbrough. 2008. "Policies for Open Innovation: Theory, Framework and Cases." in *Research project funded by VISION Era-Net*. Helsinki: Finland.

To study the external linkages this paper follows the typology (Table 1) developed by Ariffin (2000) Ariffin & Figueiredo (2006) and Figueiredo (2011). For this study these linkages are categorized into four types. The types of linkages are; *Joint research*, *Joint adaptation modification (JAM), Human resource recruitment- education & training (HET), Arm's length (AL)*. This typology makes difference between arm's length transaction and joint R&D. Increasing weights are given based on the degrees of quality of knowledge-intensive linkages. The linkages were ranked from 1 to 4 according to their intensiveness of the knowledge creation involved. Arm's length being the lower level of linkages is given the lowest score and the score increases according to the intensity of linkages. Joint R&D program is the highest level of linkages with deep involvement of different actors. This typology helps to map the degree of collaboration of subsidiaries with the local actors.

Table 1 Framework for explaining linkages of MNEs R&D units

Degree of Linkages	Rank	Type of external linkages with local organizations: universities (U), research institutes (RI), consulting firms (CF), suppliers (S) and clients (C)	
High	4	Joint research	Collaborative efforts with local organizations on different types and degrees of research, development and design of new products, processes, and software and joint problem-solving involving high degrees of trust
	3	Joint adaptation modification (JAM)	Acquisition and sharing of knowledge with local organizations for basic intermediate innovation activities
	2	Human resource recruitment, education & training (HET)	Recruitment of human resources and education and training programmes with local organizations
	1	Arm's length (AL)	Informal and /or one off type of interactions based on minimum exchange of information
Low/ absent	0	No linkage	

(Source: Ariffin, 2000 Ariffin & Figueiredo (2006) and Figueiredo (2011)& Figueiredo, 2011)

Objectives

Major objectives of this paper are as follows:

a) The nature and type of linkages these MNE's R&D centres are developing with local public and private R&D institutions and universities in the emerging economies?
b) To examine the difference in type of linkage in different industry group of ICT sector.
c) Type of linkages (core domain or peripheral domains) the with different actors
d) To understand the emergence of open innovation 'model'

Methodology

In view of the objectives discussed above, this study is based on an in house developed database. For the study purpose an in- house database has been developed with the collected information from different news sources. Many different newspapers are scanned form India, for example the Hindu Business Line; Economic Times, Business Standard. Beside this the newspaper database, *Lexis-Nexis* was searched using the keyword 'R&D centre and India' and all information about foreign R&D centres was downloaded. Also, different firm's annual report and their press releases were collected and stored. The information about newly established R&D units were limited for the period from 1990-2012.

The information collected from different sources are stored in a database prepared using MS Access. It is a relational database, which contains separate data files. All individual record of firms stored with different fields like the name of the firms, address in India, year of entry, major products, investment in manpower, investment, linkages, joint venture linkages or other mode of alliances etc. The records from the databases were taken for further analysis.

The firms are classified using the Global Industry Classification Standard (GICS). This classification system has developed by MSCI, a premier independent provider of global indexes and benchmark-related products and services, and Standard & Poor's (S&P). Only those inter-firms' agreements are being collected that contain some arrangements for Joint research, technology transfer, joint development, human resource development or arm length relations. This method of information gathering, called "literature-based alliance counting" (Hagedoorn, 1995; Duysters & Hagedoorn, 1996; Hagedoorn2002). This method has its drawbacks and limitations. For Example; only the publicly available alliances are collected and agreements, which are not publicly declared, will be missed. Under reported, small and low profile firms are generally not be reported. Despite these shortcomings, which are largely unsolvable even in a situation of extensive and large-scale data collection, the method is widely accepted as seen from the MERIT-CATI database. This method is a fairly good tool to perform empirical research which goes beyond case studies or general statements (Hagedoorn, 1995; Duysters & Hagedoorn, 1996; Hagedoorn2002).

Results

MNEs create linkages when they are directly involved in relationships with other firms in the host economy (via transactions or alliance-based relationships within or across industries) and consequently influence the output, capability development and productivity of partner firms. Linkages, therefore, embody inter-firm transactions, interactions and on-going relationships. MNE's subsidiaries have the potential to embed themselves within different types of knowledge networks in the host country, to accumulate their capabilities for innovation in products services, thereby strengthening their competitive advantage (Figueiredo 2011). Subsidiaries accumulate innovative capabilities over time. Improvements in innovative performance are depends on the embeddedness of subsidiaries in the local context. The frequency and the quality of the linkages to the local organizations may be called as 'external linkages'. These kinds of relations are important for firms to achieve innovation capability. In order to accumulate their capabilities to innovate, most firms depend on a wide variety of knowledge-supplying partners. There are variations in the way firms create their capabilities. Additionally, firms very occasionally and work in isolation to build their assets, but in interaction with other actors of the environment (Gulati, 1998). However, there are variations in the pattern of interaction of the firms with the different actors in the innovation system. This variations is due to the of firm's embeddedness with different actors in their environment to create knowledge to achieve competitive performance (Figueiredo, 2011).

To study the external linkages, the study follows the available typology described in table 1 (Ariffin, 2000; Ariffin & Figueiredo, 2006; Figueiredo 2011). This typology makes a difference between arm's length transaction and joint R&D. Increasing weights are given based on the degrees of quality of knowledge-intensive linkages. For this study, the linkages were ranked from 1 to 4 according to their intensiveness of the knowledge creation involved. This typology helps to map the degree of collaboration of subsidiaries with the local actors.
Among all types of linkages, Arm's length linkages are considered the lower type of knowledge base interactions and given the score 1. For example *Texas Instruments* has agreement with *Cranes Software* in 2010 to supply equipment and experimental modules. In these kinds of interactions or relationships, the actors are not deeply attached with each other.

So, the social closeness among the actors is lacking. These are generic and business-type of relationships involving exchanging of services and goods. However, through such types of linkages a firm can acquire different types of distinctive knowledge and skills.

Knowledge-intensive linkages involve the exchange of knowledge of increasing complexity. If firms have some kind of human resources, education and training programs with local organizations, is considered higher level of linkages than Arm length transactions and given weightage of “2”. The examples of these kinds of linkages may be as follows. In 2008, *Intel India Development Centre* along with *Educomp Solutions Ltd*. signed agreement to provide technology-aided educational projects in 9,000 government schools across the country. *Intel* along with *NIIT* have jointly developed ‘Multi-core' training curriculum in 2007. *Texas Instruments* along with Jawaharlal Nehru Technological University signed agreement to impart training to faculty and students to educate them in digital signal processing, embedded systems and related areas.

In the next level beyond the education and training is the acquisition and sharing knowledge with local organizations for product development and research. These types of agreements are higher than the joint human resource development program and are given weightage of “3”. For example *Infosys* along with *Intel India Development Centre* jointly implement different strategic development projects. *Freescale semiconductor, Intel, Texas Instruments, Honeywell, Mindtree* jointly developed *ZigBee* alliance protocol.

Collaborative efforts with local organizations on different types and degrees of R&D and design of new products, processes, and software and joint problem-solving involve the highest degrees of trust. It is considered the highest level of linkages with the local actors and given maximum weightage of ‘4”. The examples of collaborative R&D is: *STMicroelectronics* has set up joint R&D labs along with BTIS Pilani, IIT Delhi, IIT Kanpur, IISc in 2007. *Infineon Technologies, IBM, Chartered Semiconductor, Samsung* have agreed for joint R&D for advanced 65nm low-power and high-performance CMOS platform technology in 2006.

Types of Linkages in India

Foreign MNEs in India conduct R&D in many different ways. According to Reddy (2011) the foreign firms in India may have wholly owned stand-alone R&D units. These kinds of R&D units are closely in contact with the MNCs’ headquarters and report directly to the parent unit. MNEs linkages with different entities in India are in several different forms. It may be a joint venture R&D with Indian educational institutes, Indian companies or other foreign firms. The technology alliances can be with Indian companies, including outsourcing of R&D to Indian companies; and research collaboration with Indian universities and national research institutes (Reddy, 1997; 2011). It has also observed that In India there is recently many R&D service providers are emerging. Such service providers include both foreign and local companies. Indian R&D service providers have established their reputation globally as capable to deliver products and processes Also, India has a number of world class educational institutes to whom foreign firms prefers as collaborative partners. There are many examples of MNEs R&D units situated in Indian universities campuses.

Among the total 698 linkages of foreign firms identified in this study in IT sector, the maximum numbers of linkages are observed as joint development programs. There are about 291 (40 percent) joint development programs among foreign firms and other entities. There are 194 (about 38 percent) joined R&D programs, 36 (7 percent) and 71 (14 percent) alliances can be considered as arm length linkages (table 2). The details analysis of linkages among different entities in ICT sector shows that Joint development programs are the most predominant form of linkages.

Table 2 Type of linkages among foreign firms and entities

Types	All ICT Sector	**Technology Hardware & Equipment**	Semiconductors & Semiconductor Equipment	Software & Services
Arm length	129	51	17	61
HRD	41	17	7	17
Joint Development	291	110	44	137
Joint R&D	237	91	42	104
Total	698	269	110	319

ICT Firms' Linkages in India with different Entities

Linkages of foreign firms are broadly categories into four categories as shown in Table 3. Foreign firms linkages with other foreign firms located in India are put in the first category. University linkages are put in second row, linkages with local firms and Indian government institutes are in 4th and 5th columns respectively. In Indian case, government research laboratories like Council of Scientific and Industrial Research (CSIR), Indian Council of Medical Research (ICMR) etc. are grouped under government research institutes. Beside the universities in the name, the premier Indian educational institutes like Indian Institute of Technology, Indian Institute of Science are categorized under universities.

Table 3: Linkages of foreign firms with different actors of innovation system

	Total ICT sector	Technology Hardware & Equipment	Semiconductors & Semiconductor Equipment	Software & Services
Foreign firm	266	93	50	123
Indian educational institutes	69	27	11	31
Indian Firm	132	56	18	58
Indian government institutes	11	7		4
Others	10	2	1	7
Total	488	185	80	223

It is evident form the table 3 that the about 488 total entities 266 (54.5%) are the foreign firms and the rest are Indian institutions/firms..

<u>Linkages of Technology Hardware & Equipment Industry group firms[18]</u>

This industry group consist of three industries namely Communication Equipment, Computer peripheral and Electronic equipment and instruments.

<u>Communication Equipment industry</u>**:** There are 46 firms in this industry of this sample of firms. In this industry group, among the university linkages *Cisco, Ericsson* and *Motorola* have joint R&D program with IIT and IISc. Cisco has the most number of linkages in India and majority of them are with the local firms.

<u>Computer peripheral industry:</u> Among the total 19 firms in this group, *Sun Microsystem* has the most number of linkages. However, *Hewlett-Packard* has the highest number of linkages with the universities. Among the many academic collaborations HP has research collaboration with Tata Institute of Fundamental Research on High Performance Computing (HPC) solutions at its Computational Mathematics Laboratory (CML) in Pune. HP has also research collaborations with ISI - Kolkata, Indian Institute of Science, Bangalore, Indian Institute of Technology Delhi, BITS Pilani. Beside research collaboration HP has extended its PhD fellowship and student visit program to International Institute of Information Technology (IIIT), Bangalore, International Institute of Information Technology (IIIT), Hyderabad, International Institute of Information Technology(IIIT), Allahabad, National Institute of Design (NID), Ahmedabad, Bangalore, IDC, IIT, Mumbai, Shristi School of Art Design and Technology, Bangalore and so on.

In this group of firms, other form of collaboration is also observed. For example; *Sun Microsystems* has designed an *"eco consortium"* in India as part of its eco innovation

[18] It may be noted that due to methodological constraints only part of the total sample (ie 488 firms) is selected for empirical analysis for tracing linkages in different categories of firms.

initiative in 2007. The group consists of members like *APC-MGE*, *Advanced Micro Devices, Hitachi Data Systems* and *Wipro Infotech.* The consortium will work together to address the issues like limited power, space and energy in India as demand grows for infrastructure utilization. This consortium will enable customers to make their business eco-friendly and "green" and will address technology infrastructure issues in the data center. The consortium will share technology like; Wipro Infotech's system integration and consulting experience of guidance for scaling, APC-MGE will deal with power and cooling issues, AMD will look after energy-efficient computing technologies, Hitachi Data's green storage solutions will enable better use of storage assets to cut power needs and improve IT efficiencies.

<u>Electrical Equipment & Instruments</u> There are 11 firms in this group. *Agilent* has 7 various R&D partnerships with different universities or educational institute in India. Agilent accept or promote funding for doctoral research proposal from various IITs and IISc. *LG* has collaborated with IIT Delhi in 2008 for the development of refrigerator compressor technology. As discussed in the previous section Sun Microsystems has initiated *"eco consortium"* in India as part of its eco innovation initiative. Wipro Infotech, APC-MGE, Advanced Micro Devices and Hitachi Data Systems, are the members of the consortium. Hitachi Data's as a part of consortium provide green storage solutions will enable better use of storage assets to cut power needs and improve IT efficiencies.

<u>Linkages of Software and Services Industry group firms</u>

Linkages of 107 firms are analyzed in this group. The details of break up of this group's firms are as follows: Internet software and services, <u>14</u> firms; IT services (28 firms) Office Electronics 1 firm Software 70 firms. Among the total 319 linkages, 123 (55 percent) are with the foreign firms followed by 58 (26 percent) with the local firms. There are 31 (13 percent) linkages with the universities and 4 (1.7 percent) with the government or government funded research institutes. *Microsoft* and *IBM* are the most prominent actors in this group. IBM has a number of collaborative projects. For example; there are alliance among *IBM, Chartered, Infineon*, and *Samsung* (ICIS). The alliance develops sample chips in advanced 65nm low-power and high-performance CMOS platform technology. Beside this, *IBM* is also the part of *'Cloud Computing Consortium'* involving many firms. *IBM* has tied up with *Google* for cloud computing, *Yahoo* tied with IIT Hyderabad, Tata Computational Research laboratories for Cloud Computing research.

Satyam, Microsoft and *Dell*, formed a consortium for building its next-generation research analyst workbench on Microsoft's technology platform. Also Microsoft has collaborative development program with different IITs in open source platforms.
Among the Local actors

<u>Linkages of Semiconductor Industry group firms</u>

The linkages maps of 26 semiconductor firms are considered for this analysis. Among 75 linkages identified, 43 (57 percent) are with the foreign firms, 21 (28 percent) are with the local firms, 11 (15 percent) are with Indian universities or educational institutes and no linkages with Indian with government institutes.
Intel has maximum linkages followed by *Texas Instruments* and *Freescale semiconductor*. *STMicroelectronics* has also set up joint research and innovation lab with different IITs, IISc and BTIS Pilani. *Texas Instruments* has collaboration with IIT Kharagpur and IISc. *Texas Instruments* recognize IISc as premier research network of the top four leadership universities. With IIT Kharagpur, *Texas Instrument* develops semiconductor technologies that are aimed at improving the quality of healthcare diagnostics and reducing its costs.
Among the local actors Satyam has the maximum degree with 5 connections. IISc and Satyam have 3 connections each. Among the semiconductor firms, *Intel, Freescale, TI, Honeywell* and *MindTree* formed *ZigBee alliance*. ZigBee is a new standard, based on the IEEE 802.15.4 standard. It was set up in December 2004 when an alliance was created to promote and build upon this standard. The main advantages of ZigBee are that it uses very low power and its open standard nature. The ZigBee Alliance is an association of firms working together. The aim of the alliance is to develop products which are reliable, cost effective, consume less power, wirelessly networked, and based on an open global standard. ZigBee technology will be embedded in a wide range of products and applications across consumer, commercial, industrial and government markets worldwide. For the first time, companies will have a standards-based wireless platform optimized for the unique needs of remote monitoring and control applications, including simplicity, reliability, low-cost and low-power.

Network Analysis for ICT Sector[19]

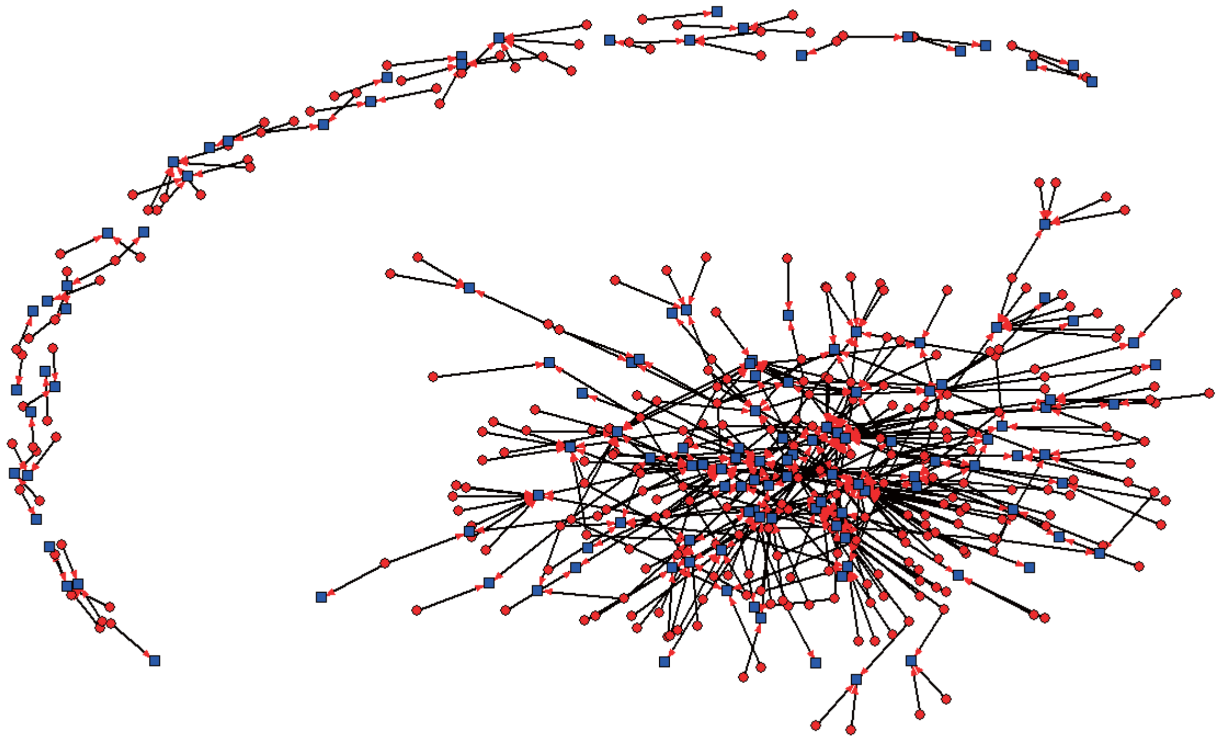
[19] It may be noted that here again only a small sample from total number of firms is selected for Network Analysis using UCINET software.

Network analysis measures Centrality, which is one of the most important and widely used conceptual tools for analyzing social networks. All empirical studies try to identify the most important factors degree centrality, *betweenness, closeness, and eigenvector centrality* within the network. The concept of centrality to two-mode data, in which the data consist of a correspondence between two kinds of nodes, such as individuals and the events in which they participate, is the number of linkages among different actors (Bargatti et al. 2002; Everett, et al. 2005). The centrality measure gives a fair idea which R&D units are centrally located within the sample. This analysis also gives some indication of the potential flow of knowledge and communication between the actors. These centrality measures are calculated using UCINET. The linkage maps of the foreign firms in ICT sector using UCINET are shown in figure 1. The figure shows that there is a clear core-periphery structure of network. There are actors which are formed at the cores. The actors with degree more than 10 are; *Sun Microsystems, Microsoft Corp, Intel Corporation, Texas Instruments Inc, BEA Systems, Cisco Systems, Inc. IBM, Hewlett-Packard, BMC Software and Toshiba Corp*. The centrality measures of major nodes are shown in table 4

Table 4 Centrality of major foreign firms

ID	*Mode	Degree	Betweenness	Closeness	Harmonic Closeness	Eigenvector	2-Local Eigenvector
Sun Microsystems	Columns	28	10691.487	44713	121.383	0.278	111
Microsoft	Columns	19	9686.51	44759	112.971	0.236	102
Intel Corporation	Columns	14	6186.075	44765	109.931	0.169	85
Texas Instruments Inc	Columns	13	5525.09	44741	110.924	0.153	82
BEA Systems	Columns	11	3822.395	44787	107.124	0.16	81
Cisco Systems, Inc.	Columns	11	3099.145	44797	105.717	0.169	83
IBM	Columns	11	2732.338	44955	93.449	0.054	33
Hewlett-Packard	Columns	11	2162.733	45103	85.034	0.016	25
BMC Software,	Columns	10	2453.279	44897	98.502	0.108	56
TOSHIBA CORP	Columns	9	2305.998	44853	100.924	0.096	55

Figure 1 Linkage map of foreign firms with the entities in India



Among the local actors Wipro Technologies is the most prominent actor with maximum number of linkages with the foreign firms. The other prominent actors of local innovation system are as follows Satyam Computer Services Limited (Now Mahindra Satyam), Tata Consultancy Services, HCL Info system and Infosys. Among the education and research institutes, Indian Institute of Science, Bangalore is one of the prominent actors. The centrality measures of local actors are shown in the table 5.

Table 5 Centrality measure of major local entities

ID	*Mode	Degree	Betweenness	Closeness	Harmonic Closeness	Eigenvector	2-Local Eigenvector
Wipro	Rows	26	15938.212	44646	129.583	0.449	187
Satyam	Rows	14	6372.883	44728	113.476	0.263	125
Tata Consultancy Services (TCS)	Rows	12	2683.442	44886	100.176	0.192	75
HCL Infosystems Ltd	Rows	11	4397.777	44840	105.362	0.172	93
Infosys	Rows	10	3028.849	44816	104.076	0.199	91
Indian Institute of Science, Bangalore	Rows	8	3435.051	44888	97.836	0.095	65

Open innovation

As discussed in the literature review section, open innovation is the latest corporate philosophy firms implement to combine in–house research, expertise, and capabilities with external knowledge, expertise to accelerate innovation in product and technology development of the firm. More and more firms are shifting their innovation policy towards 'open innovation model' in India irrespective of the sector and industry. With this latest trend open innovation forms a unique foundation for India academia and industry to intensify their ties with western scientific and industrial R&D institutions. Firms realized that industrial value chain can possibly be achieved with mutual knowledge shearing with academic and also with industrial partners. The following section is dealing with the few cases of innovation models by the foreign pharmaceutical firms in India. Some of the prominent examples of open innovation modes are as follows:

Xerox Corp, established its offshore R&D center in Chennai which is the Sixth such center around the world in 2012. The primary focus of this motive was to capture the Indian emerging market, collaborate with the Indian academics, researchers and even customers. Xerox's global CTO Sophie Vandebroek told in a press statement that Chennai R&D unit will be 'based on a new model of collaborative research and open innovation'.[20] Dr. Meera Sampath, director of the Xerox India Innovation Hub further asserted that *"Open Innovation is at the core of how we conduct research not only at the Xerox India Innovation Hub, but also at Xerox research centers around the world….Linking the talent in India with Xerox's 500 scientists at our centers in the U.S., Canada and France will allow us to leverage the power of truly global innovation networks and engage in cutting-edge research to create unique value for our customers around the world."*[21]

Software giant Microsoft also promotes as well as encourage open innovation program in India. In 2013, Microsoft along with Coimbatore based KGISL Group of Institutions started an innovation centre. The program aimed at increasing the employability of students, provides a platform for corporates to hire Microsoft Technology certified students of high caliber for internship and placements. According to the Microsoft India official "The programme would help students to improve their employability". The programme will offer 250 internship opportunities and 100 employment opportunities for students[22].

[20] 'Xerox India hub to follow open innovation model'
(Mar 22, 2010) available at http://articles.economictimes.indiatimes.com/2010-03-22/news/27586848_1_innovation-hub-innovation-lab-open-innovation
[21] Xerox Launches Innovation Hub in India (Mar 17, 2010) available at http://www.xerox.com/news/news-archive/2010/nr-innovation-031710-ind/enin.html
[22] Microsoft to open innovation centre at KGISL (May 9, 2013)
http://timesofindia.indiatimes.com/city/coimbatore/Microsoft-to-open-innovation-centre-at-KGISL/articleshow/19960275.cms

Consulting and technology services major Accenture has opened an innovation center at Narsee Monjee Institute of Management Studies (NMIMS), Mumbai. The innovation center will focus on Enterprise Resource Planning (ERP) software at the management institutes Mukesh Patel School of Technology Management and Engineering (MPSTME). In a release, Shantiprakash Motwani, vice president, Accenture said, "This initiative will strengthen our partnership with NMIMS University and will give an edge to the students."[23]

The Indian Institute of Technology (IIT) Indore and Computer Science Corporation (CSC) in India signed a memorandum of understanding (MoU), for IIT Indore to join the Collaborative Open Innovation Network (COIN). This initiative was started by CSC to promote upcoming talent. According to Ganesh Swaminathan, CSC director and head of Open Innovation program said in a statement, "…We are extremely proud to be associated with a premium institute like IIT Indore. With the COIN program we aim to bridge the gap between the industry and academia, which has been a longstanding issue for India. We believe that a student on the threshold of joining tomorrow's workforce should be given adequate exposure to real-world trends and industry expectations to help them learn and get hands-on experience with proven global work processes and practices."[24]

Dell Inc. India R&D centre has adopted an open innovation model wherein it collaborates and co-innovates with customers, start-ups, universities, partners and its internal R&D teams. "We have signed an MoU with IIT Chennai where a small team of three-four engineers from Dell will work on the next version of our High Velocity Cloud project, along with a professor and three students from IIT Chennai. We are working on a similar MoU in Bengaluru, where we are considering partnering with Indian Institute of Science and NIT Suratkal with a small team of seven-eight people in server systems software, systems management and software defined data centres,"[25]

Concluding Remarks

[23] Accenture opens innovation centre at Narsee Monjee Institute of Management Studies (Dec 28, 2012) http://articles.economictimes.indiatimes.com/2012-12-28/news/36036438_1_mpstme-mukesh-patel-school-innovation-centre

[24] CSC in India and Indian Institute of Technology Indore to Collaborate on Promoting Talent News Release -- October 04, 2012 Available at http://www.csc.com/in/press_releases/89885-csc_in_india_and_indian_institute_of_technology_indore_to_collaborate_on_promoting_talent

[25] Sangeetha chengappa, Dell makes India its second research hub outside the US, The Hindu Business Line(December 4, 2014) available at http://www.thehindubusinessline.com/features/smartbuy/dell-makes-india-its-second-research-hub-outside-the-us/article6662175.ece

This paper explored the structure of linkages of foreign R&D centers with institutions in India. Much of the focus has been to explore the way these linkages manifest with the local universities and public research institutions, local private business enterprises and its R&D centres. The main purpose of this exploration, beyond linkages between foreign and Indian entities, was to understand how open innovation concept is unfolding in the Indian context. Analytical framework was useful to explore the nature and character of linkages through some indicators and measures.

Among the total of 698 linkages of foreign firms in ICT sector was considered for this study. The industry group wise (hardware, software and Semiconductor) variation of the linkage patterns in India showed similar results. In India, linkages were mostly on joint product development program (291 links) followed by joint R&D (237 links). However, firms were almost equally involved in these two types of activities. Also, there were a number of human resource development programs conducted by foreign firms. This might be because of Indian firms were active in peripheral part of the MNEs value chain. In ICT sector foreign MNEs in India developed linkages more towards in **peripheral domain** like joint development rather than joint R&D.

The emerging Asian countries, particularly India are not only serve as one of the biggest markets in the world but also they have established a good deal of S&T and R&D ecosystems. The main advantage is that the Indian innovation eco-system is endowed with huge reservoir of talented and highly skilled human resources together with market potential. Foreign firms were increasingly shifting their R&D and clinical trial activity in these regions. Foreign firms were moving to capture these markets and also to exploit the huge talent pool at low cost. As a result, the collaboration between global MNEs and local Indian firms were increasing. This study had not found any significant pattern between the type of R&D units and the number of linkages. However large firms and their durations of establishment of R&D units had the effects on linkages. For example *IBM, Microsoft, Texas Instruments etc.* had established units in India since long, and their linkages in India were more with different actors of innovation system in India.

Reddy (1997) observed that foreign R&D units in India were closely linked with corporate R&D headquarters in the parent countries. According to Reddy's study Global Technology Units (GTUs) which works more towards firms' global product mandate are closely linked to the parents' manufacturing facilities worldwide, but they were very loosely linked with Indian manufacturing units. Generally, global products were manufactured in the most efficient locations in the MNEs' global structure. However, the situation has changed since then. Now, India is a big market and also the huge reservoir of high skilled manpower. It was depended upon the firms strategy either they wanted to capture the local market or exploit manpower pool in these countries. It was expected that Global units or the units which had more than one function must had more number of linkages than units which had served single market for example regional or local units. However, it was still premature to come into a conclusive agreement against the proposed hypothesis. For a conclusive evidence to show the relation between the type of R&D units and the number of linkages, further studies required.

Reddy (1997) observed stronger linkages between foreign firms and local university system. The conventional or traditional industries relied more on the local academic system than the new technology firms. In contrast to that study, this study has observed that, in India foreign firms preferred industries as their alliance partners. For example in ICT sector, among 488 linkages there were about 266 (about 55 percent) linkages were with the foreign firms 132 (27 percent) with the local firms and 69 (about 15 pwecent) the Indian educational institutes. The similar trends observed in break up of three other industry groups in IT sector. University and government research institute were less preferable linkage partner to the foreign firms in India. The empirical observation in this paper showed that foreign firms in India preferred to interact and had linkages with business enterprises and particularly the other foreign firms as their alliance partner rather than universities.

A number of firms also formed alliance for example consortium of Green computing, Cloud computing etc. along with the other foreign and Indian firms. Firms are also moving towards more open innovation mode. There are many examples of open innovation models adopted by foreign firms in India. Chesbrough's open innovation model suggests that R&D and innovation in large multinational corporations (for example IBM or GE) which was earlier confined to home based operations (in this case to USA based firms) has become much more open in the contemporary era. R&D and innovation centers of large global firms in India reflect Chesbrough's open innovation 'model'. Not only ideas but critical R&D inputs and R&D down stream innovation activities such as designing, branding marketing strategies flow from India (external to large corporations) to home based firms (to inside the firms in USA) and vice versa. The nature and character of R&D and innovation, which was earlier in the 1990s confined to mainly adaptive technology, has now moved into the realm of creative and open innovation mode. However, a more robust open innovation model or processes is emerging, the Apple's I-Phone being a case in point. For example the question remains how the benefits and intellectual property sharing happens among firms, institutes and with the inventors.

It was expected that foreign R&D centers in India were likely to interact more with public research institutions (universities and public research laboratories) than the private business enterprises. However, there were very little collaboration observed among foreign firms, Indian universities and government research institutes in India. The university industry linkage was very weak in India. Foreign firms preferred partnering with local institutes because India had a very strong ICT sectors.

Government of India through its various agencies had established a number of innovation schemes for technology transfers. Various Indian government agencies like CSIR, DBT, DST, and ICMR had funds to promote new business and entrepreneurship. However these mechanisms are not very successful in developing linkages with the foreign firms as it is evident form this study. This issue needs to be strengthened so that the country can be benefitted by the knowledge transfer mechanism by the foreign firms with the local entities.

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Software & Services	**Internet Software & services**	Ariba, Inc., eBay Inc, Google, InfoSpace, Inc., Selectica, SonicWALL, SupportSoft, Inc., USinternetworking, Inc.,VeriSign Services India Pvt Ltd., Yahoo !, Intec, Ltd., Interwoven Inc., Sonim Technologies, Stratify Software India Limited
	It Services	Accenture, ADP Wilco Limited, ASG Software Solutions/ Allen Systems Group, Inc., Automatic Data Processing, Capco Group, Capgemini India : La Vie est Belle, Cognizant Technology, COMPUTER Sciences Corporation, Convergys Corporation, Cordys, FCG Software Services India Pvt Ltd., Fiserv, Inc., Global Logic, iGATE Corp, InfoPro Corporation, Intellisys, International Business Machines Corporation, Kanbay International, Inc., Keane International India Private Limited, Logica Plc, MACH S.à.r.l., Nokia Siemens Networks, Symphony, UBICS Inc, Unisys India Private Ltd., Ventech Solutions, Virtusa Corp.
	Office electronics	**Canon Inc.**
	Software	**Adobe, Amdocs Ltd., Atrenta Inc., Autodesk, Inc., AVENTAIL Corporation (Merged with sonic wall)** **AXIOM Design Automation** **BEA Systems** **BMC Software** **Borland** **Bubble Motion** **Business Objects S.A.** **CA India Technology Centre** **Cadence** **Citrix Systems,** **Connectiva Systems** **CoWare** **CXO Systems, Inc.** **EMAGIA Corporation** **Emptoris, Inc.** **Ensim Corporation (Ensim India)** **Fluent India Pvt Ltd.** **Fortinet Inc.** **Global Automation, Inc.** **i2 Technologies India Pvt Ltd.** **Iflex (Majority owned by Oracle)** **IKOS** **Infor Global Solutions (Formally BAAN Software)** **Informatica Corporation** **INTOTO Software** **Kronos Incorporated** **Latens Systems Limited** **MAGMA Design Automation Inc,** **McAfee** **Mentor Graphics** **Microsoft** **NDS** **Novell India Development Centre (IDC),** **Oracle** **Parametric Technology Corporation (PTC)** **Pegasystems Inc,** **Pervasive Soft** **Rainbow Technologies, Inc** **Red Hat, Inc.** **Sanovi Technologies Corporation** **SAP** **Savvion** **Sequence** **SolidWorks Corporation** **Solix Technologies Inc.**

		Staccato Communications, Inc. **SumTotal Systems, Inc.** **SunGard** **Symantec** **Synopsys** **Synplicity, Inc.** **Telcordia Technologies Inc** **Telenity** **Tensilica, Inc.** **Tibco Software Inc.** **Traian** **Trend Micro Inc** **UGS Corp.** **Vanu Inc** **Veritas Software (merged with symantac)** **Vmware** **Wind River Systems Inc.** **Witness Systems Inc.** **ZOHO Corporation (formally AdventNet, Inc.)** **AIRBEE Wireless Inc** **TEKLA OYJ**

Open Innovation Effort, Entrepreneurship Orientation and Their Synergies on Innovation[1]

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Abstract

While open innovation has become a popular strategy for enhancing innovation in firms, open innovation in the context of entrepreneurship is not yet well understood. This research focuses on the role of entrepreneurship in the open innovation process and its impacts on innovation performance. Our primary research question is: What are the impacts of entrepreneurship, open innovation and their synergy effects onto innovation performance, especially onto Korean IT SMEs? A survey was conducted about entrepreneurship, open innovation, business models and sales, and innovation performance for approximately 400 Korean SMEs in the Information Technology sector. Regression results are presented and discussed.

1. Introduction

Since the advent of the knowledge-based economy, the amount of knowledge that exists is rapidly increasing. For example, the number of patent applications in the US Patent and Trademark Office increased from 130 in 1960 to 52,475 in 1970, and then to 144,921 in 2008. In addition to the increase in the amount of the knowledge, the speed of knowledge distribution is also rapidly increasing due to the development of the Internet and diffusion of smart devices. That is, new innovation paradigms are appearing in the world as the amount of knowledge and its distribution speed concurrently increase. This phenomenon is called ‘open innovation’. However, knowledge flows between firms do not occur automatically and are dependent on agreements of knowledge sharing and exchange within innovation cooperation (Pyka et al. 2009).

Open innovation (OI) is the use of purposive inflows and outflows of knowledge to accelerate internal innovation and to expand the markets for external use of innovation, respectively

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[1] The early version of this research was presented in 11th ASIALICS International Conference. The Authors have more improved and revised the article with the response and comment from the ASIALICS Conference.

(Chesbrough et al. 2006; Hughes and Wareham 2010). Research in evolutionary economics also suggests that a firm's openness to its external environment can improve its ability to innovate (Laursen and Salter 2006). Furthermore, evolutionary economists highlight the role of assisting organizations being local sources of variety, which allows them to create new combinations of technologies and knowledge (Nelson and Winter 1982).

Entrepreneurship is one of most strong drivers for economic development and innovation. Entrepreneurship refers primarily to an economic function that is undertaken by individuals, i.e., the entrepreneurs, acting independently and within organizations to perceive and create new opportunities and to introduce their ideas into the market under uncertainty by making decisions on location, product design, resource use, institutions, and reward systems. The entrepreneurial activity and entrepreneurial ventures are influenced by the socioeconomic environment and ultimately result in economic growth and human welfare (Carlsson 2012). As the economic entities that lead specific innovations such as the creation of new products, development of new production methods, development of new markets, and development of new raw material sources, the entrepreneurs who competitively innovate for profit are completely different from normal managers who only conduct routine business (Schumpeter 1947). Entrepreneurs choose strategies according to their dream of constructing their own dynasty, the will to succeed, and the joy of creation rather than economic motives (Schumpeter 1942). Entrepreneurship is the process of creating something new that has value by devoting the necessary time and effort, while assuming the accompanying financial, physical, mental, and social risks, and receiving the resulting financial, personal, and independent rewards (Hisrich et al. 2008).

This article addresses the critical research question that has not yet been analyzed in prior studies: *What are the impacts of entrepreneurship, open innovation and their synergy effects onto innovation performance especially onto Korean IT SMEs?* Small and medium-sized IT companies in Korea such as iRiver or Pantech, a cell phone manufacturer, have led rapid growth of Korean economy, although they themselves suffered extreme lack-of-demand. However, they competed with and stimulated large electronics such as Samsung and LG to become a leading company in electronics industry. However, rare studies have examined underlying mechanism of Korean IT SMEs' swift development, and the current study deals with the hardly-investigated issue.

This study also analyzes the introduction of new business models by the firms as well as key performance indicators such as the revenue ratio of new products. In addition, this study analyzes the difference in the open innovation of SMEs according to their regional and industrial characteristics by analyzing the effects of the differences between software (SW) and hardware (HW) within the IT industry, and the regional difference between Seoul-Gyeonggi Province and Daegu-Gyeongbuk Province in the relationship between inbound open innovation of firms and their performances, through which the verification of open innovation effects of general SMEs may be possible. Most of all, we examine how open entrepreneurship affects the relationship between open innovation and firm performance. Especially, the direct and synergy effects of open innovation efforts and entrepreneurship orientation of firms' top level management are investigated. Furthermore, for the same research tasks, the introduction of new business models was also analyzed with the revenue ratio of new products as the indexes of firm's innovation performance (Li et al. 2008; Ryu 2011).

This article offers several contributions. It is among the first quantitative empirical analyses of the open innovation and entrepreneurship effects in Korean IT SMEs. The Korean IT industry is receiving global attention with the expansion of Korean IT into the global market led by two large Korean conglomerates (Samsung and LG) together with the world's highest rate of Internet distribution and the presence of refined IT device consumer groups. The open innovation characteristics of some Korean IT enterprises were also analyzed (Spithoven et al. 2011; Lee et al. 2010). However, until now, there has not been sufficient analysis of open innovation and entrepreneurship orientation of Korean IT SMEs that are developing through close relationships with Korean conglomerates.

This study also quantitatively examined the synergy effects of the open innovation and entrepreneurship of SMEs onto innovation performance. Until now, the impacts of entrepreneurship and its' synergy effects with open innovation onto the innovation performance was not independently examined (Chesbrough 2003; Dodgson et al. 2006). This study provides practical implications for the specific roles of entrepreneurship when SMEs establish their strategies for innovation through the promotion of various open innovation activities and channels. The results from this study are suggesting the strong necessity of entrepreneurship to improve the process and performance of SMEs innovation efforts such as open innovation.

2. Open Innovation and Entrepreneurship

2.1 Open innovation and innovation performance

The book *Open Innovation* describes an innovation paradigm shift from a closed to an open model (Chesbrough 2003). Inbound open innovation, which is the practice of leveraging the discoveries of others, suggests that firm needs not and indeed should not rely exclusively on their own R&D and outbound open innovation suggests that rather than relying entirely on internal paths to markets, firms should look for external organizations with business models that are better suited to commercialize a given technology (Chesbrough and Crowther 2006). Open innovation is an emerging innovation management paradigm comprised of two dimensions: inbound open innovation, which is the practice of establishing relationships with external organizations or individuals with the purpose of accessing their technical and scientific competences for improving internal innovation performance, and outbound open innovation, which is the practice of establishing relationships with external organizations with the purpose of commercially exploiting their technological knowledge (Chiaroni et al. 2010).

Interestingly, models of open innovation offer the promise that firms can achieve a greater return on their innovative activities and their intellectual property (IP) by loosening their control over both (West and Gallagher 2006). In contrast to earlier models and fully integrated innovators such as AT&T (now Lucent), Bell Labs, and IBM who conduct basic research through in-house R&D, open innovation celebrates success stories including Cisco, Intel, and Microsoft who have succeeded by leveraging the basic research of others (Chesbrough 2003). By targeting UK manufacturers, i.e., small and medium enterprises (SMEs) in the manufacturing area, the relationship between the open innovation level of the firms and their performances were quantitatively analyzed by applying the concepts of depth of OI and breadth of OI to a survey for SMEs based on the Oslo Manual (Laursen and Salter 2006). That is, case-focused open innovation research was extended to survey-focused research. This research triggered subsequent research on the relationship between various factors such as company scale, technology innovation cycle, innovation communities or innovative networks, firm's absorptive capacity, industrial characteristics, modules, entrepreneurship, and open innovation (Bianchi et al. 2011; Chen and

Liu, 2005; Fichter 2009; Harryson 2008; Ili et al. 2010; Lee et al. 2010; Parida, Westerberg and Frishammar 2012).

In addition, the innovation directions from pioneers to mainstream, from high tech to low tech, from large firms to SMEs, from stage gate to probe-and-learn, from standalone to alliances, and from amateurs to professionals, have emerged as new trends of open innovation (Gassmann et al. 2010). In the meantime, through the analyses of asset-intensive industries, it was found that closed innovation has been converted to open innovation through three stages (unfreezing, moving, and institutionalizing) in networks, evaluation processes, organizational structures, and knowledge management systems (Chiaroni et al. 2010). The process of gradual conversion to open innovation creates great interest in the role of the CEO in the firm. One step further, the analysis of specific factors that influence the effect of open innovation and the level of these influences was attempted through studying the environmental factors such as patent protection, technological turbulence, and transaction rate in the process of outbound open innovation of the firms.

Advanced product development distinguishes itself by being surrounded by a "cloud of technology spillovers" available to external users in proportion to their competence to commercialize them through entrepreneurship such as process establishment by workers who leave other firms, competent purchasing, strategic acquisitions, imitation, etc. (Eliasson 1991, 2010). Spillovers and technological learners also have a deep relationship with open innovation. In addition, the history of "catching up" with the U.S. regarding Europe and other industrialized countries is directly or indirectly connected with ideas, knowledge, and technology transfers, which can be defined as open innovation. One of three factors of the technological regime in the model of technological and market catch up is access to external knowledge bases (Lee and Lim 2001). In the end, different modes of catching up are based on different open innovation channels, modes, and boundaries. At the firm level, different catching up modes have different open innovation modes, and this is connected to the different types of entrepreneurship.

In the meantime, open innovation has received increasing attention in scientific research, but thus far it has been analyzed in large high-tech multinational enterprises (MNEs) drawing on in-depth interviews and case studies (Van de Vrande, et al. 2009). SMEs differ significantly from larger firms with respect to how they can utilize open innovation activities for innovation outcomes (Parida, Westerberg, and Frishammar 2012). SMEs specifically and directly undertake their open innovation in the overall context of their firm and generate performance through their bridging capabilities based on external relationships, innovation partners, the role of networks, open source community, and strong ties with the outside and through the role of hub firms (Classen et al. 2012; Gardet and Fraiha 2012; Gronum et al. 2012; Lasagni 2012; Lowik et al. 2012; Piva et al. 2012).

Laursen and Salter (2006) identified two variables that describe the characteristics of open innovation: its search breadth, which is defined as the number of external sources, or search channels that firms rely on; and its search depth, which is defined as the extent to which firms draw from different external sources or search channels. For the variables measuring firm performance, this study uses the ratio of three new products, i.e., the new products of the relevant industries, the new products of the relevant firm, and the new products including products with gradual improvement. Laursen and Salter (2006) found out that the breadth and depth of open innovation do not unilaterally increase the firm performance but an inverted U-shaped relationship exists. Furthermore, they triggered other various research projects focusing on the effect of open innovation on firm performance. The managerial factors promoting open innovation include the establishment of extensive networks of interorganizational relationships with numerous external actors, in particular universities and research institutions, the organizational systems focused on accessing and integrating the acquired knowledge into the firm's innovation processes, the new evaluation criteria that focus more on external sources of innovation, and the use of knowledge management systems that are able to support the diffusion, sharing, and transfer of knowledge within the firm and with the external environment (Chiaroni et al. 2010).

However, the SME-specific open innovation exhibits characteristics that are different from those of the large conglomerates and large existing manufacturers (Bianchi et al. 2010; Parida et al. 2012; Raymond and St. Pierre 2010; Van de Vrande et al. 2009). In the relationship between the independent R&D of SME manufacturers and their performances, the medium and low level technical industries did not exhibit significant effects of R&D on their performances compared to the high level technical industries (Raymond and St. Pierre 2010). Open innovation of SMEs was divided into technology exploitation as outbound open innovation and technology exploration as inbound open innovation. The former channel includes venturing, outward IP licensing, and employee involvement, while the latter channel includes customer involvement, external networking, external participation, outsourcing R&D, and inward IP licensing (Van de Vrandeet al. 2009). These are included in the open innovation channel surveyed by Laursen and Salter (2006) based on the Oslo Manual. SMEs clearly differ from larger firms with respect to how they can utilize open innovation activities for innovation outcomes in several aspects such as lack of resources for R&D, unstructured innovation processes, and underdeveloped internal capabilities (Parida et al. 2012).

The motives of open innovation, particularly those of inbound open innovation, include increased customer satisfaction and the acquisition of new knowledge and were concurrently suggested with economic motives such as growth and revenue (Chesbrough and Crowther 2006; Parida et al. 2012). Furthermore, through the individual case analyses and interview research, it was confirmed that the significance of the open innovation results is intuitively understood by the firms as the addition of revenue generated by introducing new business models (Bianchi et al. 2011; Ili, Albers and Miller 2010; Van de Vrande et al. 2009 ; Yun and Mohan 2012b).

Hypothesis 1-1: As the open innovation of SMEs in the Korean IT sector increases, the ratio of the new products in the firm also increases.

Hypothesis 1-2: As the open innovation of SMEs in the Korean IT sector increases, new business models are added to the firms.

These hypotheses were established by applying the relationship between the open innovation of SMEs and their performances studied in the above discussions to the Korean IT sector, which is a representative Korean industrial area. Through testing of the above hypotheses, this study suggests the systematic analysis result of the open innovation effects of Korean SMEs in the IT sector. This study also provides an in-depth understanding of the Korean IT sector.

2.2 Entrepreneurship and its role on innovation performance

As the economic entities that lead specific innovations such as the creation of new products, development of new production methods, development of new markets, and development of new raw material sources, the entrepreneurs who competitively innovate for profit completely differ to normal managers who only conduct routine business (Schumpeter 1947). Entrepreneurs choose strategies according to their dream of constructing their own dynasty, the will to succeed, and the joy of creation rather than economic motives (Schumpeter 1942). Entrepreneurship is the process of creating something new that has value by devoting the necessary time and effort, while assuming the accompanying financial, physical, mental, and social risks, and receiving the resulting financial, personal, and independent rewards (Hisrich et al. 2008).

Entrepreneurship refers primarily to an economic function that is undertaken by individuals, i.e., the entrepreneurs, acting independently and within organizations to perceive and create new opportunities and to introduce their ideas into the market under uncertainty by making decisions about location, product design, resource use, institutions, and reward systems. The entrepreneurial activity and entrepreneurial ventures are influenced by the socioeconomic environment and ultimately result in economic growth and human welfare (Carlsson 2012).

Entrepreneurial orientation (EO) is defined as the propensity of a firm's top management to take calculated risks, be innovative, and be proactive (Morris and Paul 1987). Entrepreneurial orientation (EO) is also characterized by the dimensions of innovativeness, risk taking, and proactiveness, which all have the possibility of promoting the firm's technological innovation and performance (Li et al. 2008). Market-oriented firms that focus on articulated customer needs may not have opportunities to develop new products that customers cannot articulate, unless they also develop entrepreneurial orientations to ensure a proactive focus on innovations that meet emerging and unarticulated customer needs (Li et al. 2008). The curvilinear moderating effect of the entrepreneurial orientation on the relationship between market orientation and performance, which is the synergistic effect of MO and EO on performance, will be greatest with a moderate level of EO, which is a relationship that resembles an inverse U-shaped curve (Bhuian et al. 2005).

The effect of outbound open innovation on firm performance is influenced by environmental factors such as patent protection, technological turbulence, transaction rate, and competitive intensity. The effects of the open innovation of firms on their performances, i.e. on return on sales, are also modulated by environmental factors.

Entrepreneurship is a mechanism that translates economic knowledge into economic grow thin incumbent firms (Carlsson 2011). According to Carlsson (2011), entrepreneurship can accomplish any role that modulates economic knowledge to economic growth. This means that entrepreneurship can modulate the open innovation effects that will develop any firm's performance. The knowledge spillover theory of entrepreneurship identifies entrepreneurship as a conduit through which knowledge spillovers occur (Acs et al. 2009). According to the expected profits that are conditioned by the knowledge stock, entrepreneurship triggers new startups that are based on the new knowledge (Acs 2011). According to the knowledge spillover theory of entrepreneurship, entrepreneurship moderates the relationship between knowledge and new-to-market (Block et al. 2013). This study demonstrates that entrepreneurship moderates not only incremental innovation but also radical innovation. Breakthrough inventions are more likely to emerge in 'turbulent' Schumpeter Mark I contexts that are based on the entrepreneurship of individuals and individual firms (Fontana et al. 2012). This research topic requires that we should consider the role of small firms and/or individual entrepreneurs rather than focusing exclusively inside the R&D facilities of large corporations. Furthermore, the internal open innovation attitude that demonstrates the level of internal acceptability of new ideas, knowledge, and products, also influences the effect of the open innovation of the firms on their performance (Yun and Mohan 2012b). That is, the moderating effects of the firm's liberal environment, practices, procedures, or systems on the effects of open innovation on the performance were proved. It was found that the procedure and system factors among the liberal attitudes inside the firm were crucial factors that are dependent on the entrepreneurship of the firm leaders.

Lou Gerstner, the CEO of IBM who was headhunted from outside IBM in 1993 when the company faced a crisis, adopted the strategy of acquiring the idea sources from the outside, particularly from the consumers, while undertaking the production of new products and new businesses jointly by all divisions, escaping from the strategy of individual production and business conducted by individual divisions (Chesbrough 2003). Gerstner determined that IBM's dominant logic forward would focus on IBM's customers, moving from an "in order to do anything, we have to do everything" approach to a "do whatever the customer needs us to do, and work with what the customer already has" approach (Chesbrough 2003). Open innovation strategy promoted by the new CEO created tremendous profit through the external sale of unutilized technologies and the conversion of product groups to SW and solution-focused product groups according to the requirements and ideas of external consumers. Through individual case studies, Chesbrough (2003) demonstrated that entrepreneurship promoted the open innovation of firms and that it had a moderating effect firm performance.

Moore and Noyce, who are the founders of Intel, made an important decision: "Although the semiconductor industry depends on research breakthroughs for continued progress, Intel will operate without any formal research organization" (Chesbrough 2003). They directly experienced the longtime commercialization of the high tech research results of Fairchild because there were no linkages with any business division. So, they attempted to make their research results connect directly by establishing some key research departments linked to production departments rather than establishing independently. That is, the entrepreneurship of Intel CEOs created an open innovation system where new ideas were directly connected to production, thus creating profit for the firm.

The entrepreneurs who place their core value on openness and sharing promote open learning among employees through open communication, open support, and open innovation (Li 2011). Anderson, who was the CEO of BestBuy, has created numerous innovation results through the promotion of unlimited creative participation of employees through the establishment of Twelpforce. Alan G. Lafley, who was the CEO of P&G, opened the company and led to innovations through new methods by accommodating external ideas and he restored P&G, which faced a crisis in 2000, to a global enterprise when he retired in 2010 by suggesting the goals of open innovation results to locate ideas for more than 50% of new products from external sources. That is, it was confirmed that entrepreneurship led by CEOs promoted the relationship between the open innovation of the firms and their performance through the cases of BestBuy, which established a specific open innovation system, and P&G, which suggested the goals of the open innovation results (Li 2011).

By examining the factors that hinder inbound and outbound open innovation, the necessity for entrepreneurship is sometimes conversely presented as a remover or controller of the relevant hindrance factors. The core elements that correct the "Not Invented Here" syndrome that objects to the commercialization of technologies that were not developed within the company and the tendency of higher evaluation of the possibility of external R&D risk and failure than internal R&D are dependent on the entrepreneurship of the leaders of the firms (Chesbrough 2006). Firms believe that if they cannot find a profitable use for their technology, other firms will not find them either. So they don't sell their own technologies, and other firms do not sell it either (Chesbrough 2006).

Rather than relying only on a firm's excellent service to sustain a competitive advantage as a service provider, a more robust approach is to change the firm's service into a platform. The strategy of not falling into the commodity trap, which can place manufacturers and service providers in severe competition with imitation firms, is to establish an open business platform that compels external firms or individuals to undertake their businesses using the business platform of the firm (Chesbrough 2011). In order to compel other firms conduct their businesses on the firm's platform, which is escaping from the strategy of using their own platforms, is a decision that requires the entrepreneurship of the leader of the firm. Even though it can provide new ideas and technologies, as well as new market channels, OI has its own unique set of issues and challenges. Business leaders must eventually depart from the processes, reward systems, and cultural attributes that were once viewed as desirable, but in reality work against the foundation concepts of OI (Sloane 2011). That is, only when the company leaders transform the existing procedures of the company management, compensation systems, and cultural factors through entrepreneurship to be suitable for new innovation, can the open innovation of the firm be connected to their performance.

The extent to which strong ties can be sustainable sources of new knowledge depends on the application of bridging capabilities with the innovativeness of partner firms. Systematic meetings with customers and suppliers are the observed specific relational capabilities which are dependent on the entrepreneurship of the firm leaders (Lowik et al. 2012).

3. Research Model and Hypotheses

From above literature review and inspection, we suggest research model as Figure 1. Relevant hypothesis are also formulated. Revenue ratio of the new products and extents of new business model introduction was used as the indicators of firms' innovation performance.

Hypothesis 1-1: As the open innovation efforts increases, the revenue ratio of the new products in the firm also increases.

Hypothesis 1-2: As the open innovation efforts increases, the more new business models are added to the firms.

These hypotheses were established by applying the relationship between the open innovation of SMEs and their performances studied in the above discussions to the Korean IT sector, which is a representative Korean industrial area. Through testing of the above hypotheses, this study suggests the systematic analysis result of the open innovation effects of Korean SMEs in the IT sector.

Through the in-depth review on previous research, the direct and synergy effects of entrepreneurship onto innovation performances also suggested.

Hypothesis 2-1: As the entrepreneurship orientation increases, the revenue ratio of the new products in the firm also increases.

Hypothesis 2-2: As the entrepreneurship increases, the more new business models are added to the firms.

Synergy effects of open innovation and entrepreneurship are hypothesized as hypothesis 3-1 and 3-2.

Hypothesis 3-1: Open innovation efforts and entrepreneurship orientation have positive interaction effects (i.e. synergy effects) onto revenue ratio of new products in the firms.

Hypothesis 3-2: Open innovation efforts and entrepreneurship orientation have positive interaction effects (i.e. synergy effects) onto extents of new business model introduction of the firms.

That is, it is assumed that entrepreneurship will have positive effect on the enhancement of firm performance with the revenue ratio of new products encompassing both radical and incremental innovation. Compared with the individual analyses of the positive effect of entrepreneurship on innovation performance in the existing research, this study directly analyzes both the direct and synergy effect of entrepreneurship. Furthermore, this study analyzes the effects of open innovation and entrepreneurship by establishing the dependent variable of the addition of new business models, which is the most direct factor that firms perceive as a performance indicator. Based on the above discussions, the conceptual research model for this study is described in Figure. 1.

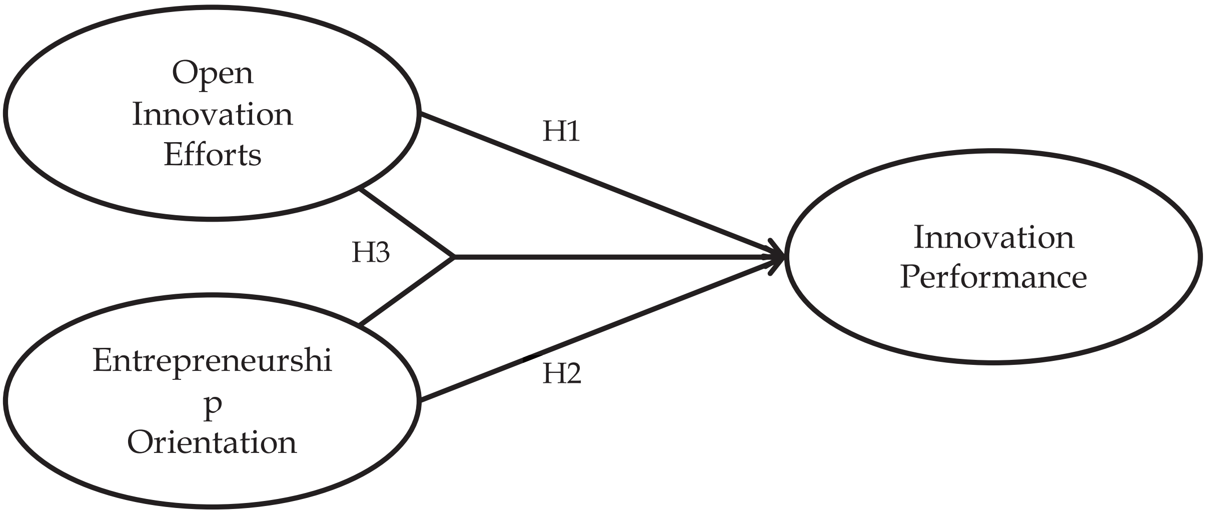

Figure 1 Conceptual Research Model for Impacts of Open Innovation and Entrepreneurship onto Innovation Performance

3. Data Collection and Analysis

3.1 Sample and data collection

The empirical study concentrated on small and medium sized IT firms in Korea in order to avoid confusion of the different effects of open innovation according to SMEs and large firms (Bianchi et al. 2010, 2011; Lasagni 2012). Generally, SMEs consider open innovation as a key activity that is essential to their business (Bianchi et al. 2010). SMEs are usually less bureaucratic, more inclined to take risks, possess more specialized knowledge, and are faster in reacting to the changing market demands, which together enables them to be better at gaining from open innovation activities compared with larger firms (Parida et al. 2012). SMEs in the Korean IT sector continually monitor external technologies and knowledge, and proactively manage the rapidly changing market and the requirements of the high level of technology from Korean conglomerates such as Samsung, LG, KT, and SK (Yun and Ryu 2012; Yun, and Mohan 2012a). As a consequence, these firms facilitate internal and external open innovation because they are able to internally or externally exploit technologies. Accordingly, open innovation has become a significant channel of knowledge from which Korean SMEs in the IT sector acquire several sources of innovation.

For the analyses in this research, we relied on two data sources. First, we used survey data that was obtained between September 19 and October 18, 2011. Second, these data were combined with the performance data from financial databases, annual reports, and interview results from ten firms; these data were collected between September and November 2011. The data collection for the survey was undertaken via surveys that were created based on the OECD innovation survey, which is based on the Oslo Manual (Laursen and Salter 2006). In order to enhance the response rate, the study was supported by the Korea Industrial Technology Association (KOITA). All KOITA members in the IT sector in Seoul-Gyeonggi Province and Daegu-Gyeongbuk Province were contacted directly via mail, telephone, and email. After sending the survey to 1000 randomly selected firms from both Seoul-Gyeonggi Province and Daegu-Gyeongbuk Province, responses from 504 firms were received. Excluding the survey responses that did not have valid responses, analyses were conducted on the responses received from 401 firms. As shown on Table 1, sample IT firms were well distributed between the regional characteristic of the Seoul-Gyeonggi Province and Daegu-Gyeongbuk Province, HW and SW, firm years with more than or less than 10 years. A test for non-response bias and for a KOITA membership bias did not exhibit significant differences. By conducting interviews with representatives from five firms in the Daegu-Gyeongbuk Province and five in the Seoul-Gyeonggi Province, the reliability and feasibility of the survey questionnaire were examined in advance. In order to avoid common method bias, objective data on the financial performance of the participating firms were also collected from financial databases and annual reports as supplementary data for the firms' performance.

The measurement scales and survey followed the precedents provided in the Oslo Manual, the OECD SMEs innovation survey, and the Global Entrepreneurship Monitor (Bosma et al. 2011; Laursen and Salter 2006; Parida et al. 2012). The participants rated all items on five-point Likert scale with anchor points of 'Not Used' (=1) to 'Highly Used' (=5). The internal consistency was examined using Cronbach's alpha (Nunnally 1978). Generally, a Cronbach's alpha of 0.70 or higher is an acceptable value for reliability (Li et al. 2008; Nunnally 1978). As shown in Tables 2 and 3, the Cronbach's alpha values for the 16 items in open innovation and 15 items in entrepreneurship were well above 0.70; thus, the results are acceptable.

Table 1 Sample composition

		Frequency	Percent
	Total	**401**	**100.0%**
Area	Seoul-Gyeonggi area	205	51.1%
	Daegu-Gyeongbuk area	196	48.9%
HW/SW	HW orientation	204	50.9%

	SW orientation	197	49.1%
Firm year	Less than 10 years	188	46.9%
	More than 10 years	213	53.1%

*Average firm size, measured by number of employee, is 51.6 employees/firm.

Table 2 Reliability and diversity test of open innovation and its knowledge source measure

Construct level Cronbach's Alpha	.922				
Open Innovation Sources	Percentages				
	Not used	Low	Medium	Medium high	High
Use of external private research center	5.5	24.9	49.6	18.5	1.5
Use of Technical collaboration between university and institution	2.7	21.4	39.9	29.7	6.2
Use of Technical collaboration with national/public institution	5.7	20.9	41.6	28.7	3.0
Use of nonprofit institution	7.7	36.2	43.9	11.2	1.0
Benchmarking of global enterprises in the same line of business	1.7	11.7	39.7	30.7	16.2
Use of competitors in the same line of business	0.7	14.7	46.9	28.9	8.7
Use of Supplying firms	1.0	19.7	46.1	29.9	3.2
Use of Customer or user	1.0	14.5	40.6	33.9	10.0
Use of Consulting business firms	4.2	31.9	43.6	18.2	2.0
Use of newly employed external manpower	4.0	19.5	46.1	28.2	2.0
Use of external patent information	5.5	25.7	37.4	27.4	4.0
Use of Fairs, exhibitions, and seminars	3.2	16.0	35.7	38.4	6.7
Mass media and information network	1.0	12.5	43.4	36.2	7.0
Use of firms in other lines of business	1.5	20.9	50.4	23.9	3.2
M&A of external firms and research centers	17.0	25.2	30.7	21.4	5.7
Use of external technology licensing	11.2	26.2	41.1	19.0	2.5

3.2 Dependent variable: Innovation Performance

At first, three proxies were used in order to simultaneously reflect on various types of innovative performance. The various types of performance included the fraction of the firm's turnover relating to products new to the world market, the fraction of the firm's turnover pertaining to products new to the firm, and the fraction of the firm's turnover pertaining to significantly improved products (Laursen and Salter 2006). The ratios of three types of different innovation products in three years against the 2010 sales were used as the first dependent variable. The variable included the three types of dependent variables used by Laursen and Salter (2006).

New economic revenue channels created by the sales of new products were established as another dependent variable. As the results of the analyses of numerous previous cases, it was indirectly confirmed that the open innovation results are recognized as the virtual addition of economic revenue channels (Ili et al. 2010; Van De Vrande et al. 2009; Yun and Mohan 2012b). Furthermore, in the interview of 10 firms from Seoul-Gyeonggi and Daegu-Gyeongbuk Province that was conducted as part of this study, the open innovation results perceived by the individual firms were intuitively considered to increase the virtual economic revenue channel created through the introduction of new products.

Here, we used new economic revenue channels as indicator of new business model introduction. The extent of new business model introduction, that is 'number of new economic revenue channel generated', was also chosen one of two measures for innovation performance with revenue ratio of new products. The purpose of establishing these two different dependent variables was to measure the open innovation performances of the firms in more dimensions through an objective and intuitive method.

3.3 Independent variables: Open Innovation Efforts

Two variables were introduced as determinants of innovative performance: breadth of open innovation and depth of open innovation, which reflect openness in terms of external search strategies of firms as in the research by Laursen and Salter (2006). The breadth of open innovation was constructed as a combination of the 16 sources of innovation knowledge or information listed in Table 2. The number of sources that received responses of more than 3 out of 5 in the Likert scale was established as the breadth of open innovation of the firms. This is the same method as that adopted in previous research that established the number of channels used as open innovation sources, i.e., the number of the sources with the highest scores out of a four-point scale measurement were designated as the breadth of open innovation. This study had 16 channels and had Cronbach's alpha values of 0.922 with internal consistency.

The external search depth was defined as the extent to which firms drew intensively from different search channels or sources of innovative ideas (Laursen and Salter 2006). The depth of open innovation was constructed using the same 16 sources of knowledge as those used in constructing the breadth. In this case, every firm established a mean value of the scale from the five-point Likert scale measurement for the 16 channels and this was defined as the depth of open innovation. This measurement revised and complemented the values that were established as the depth of open innovation among the eight external partners that received four points out of the four-point scale measurement. Thus, it should be noted that the depth of open innovation in this research is that firms that use the average degree of open innovation from the 16 sources are more 'open' with respect to search depth than firms that do not. As the Cronbach's alpha coefficient of the depth of open innovation exceeds 0.7, including those cases where all sources recorded five points, the depth of open innovation of this study also has internal consistency.

This research encompassed eight external sources: suppliers, clients or customers, competitors, consultants, commercial laboratories/R&D enterprises, universities or other higher education institutes, government research organizations, and private research institutes (Laursen and Salter 2006). Although all channels in the survey did not include all possible sources, it is clear that they included the open innovation knowledge channels that they are established on a wide and mutually exclusive basis.

In order to simplify the level of open innovation, this study estimated the level of open innovation by multiplying the depth of open innovation by the breadth of open innovation (Yun and Mohan 2012a; Yun and Park 2012). This simple concept also secured the reliability on the basis of each reliable variable. As the two existing open innovation variables contain different aspects of open innovation, this method can include both the depth and breadth of open innovation, and it is also useful in securing the single measurement values of the level of open innovation. Compared with the very close inter-relationship between the depth and breadth in the existing study by Laursen and Salter (2006), this study has a different relationship in order that it can concurrently demonstrate the different aspects of open innovation through the multiplication of both concepts.

3.4 Independent variables: Entrepreneurship Orientation

Entrepreneurship has cultural aspects, but there does not need to be a simple link of culture to behavior although it is reasonable to expect some traceable connection because a stronger entrepreneurial culture may not always predict more successful entrepreneurship—or faster economic growth—because the constraints within which choices are exercised also affect outcomes (Foreman, and Zhou 2011). Entrepreneurial orientation has been characterized using dimensions of innovativeness, risk taking, and proactiveness (Li et al. 2008). The leadership characteristics of a corporate entrepreneur consist of seven key factors: understanding the environment, being visionary and flexible, creating management options, encouraging teamwork, encouraging open discussion, building a coalition of supporters, and persisting (Hisrich et al. 2008). The Global Entrepreneurship Monitor (GEM) group conducts surveys that measure the entrepreneurship of countries targeting the enterprises, governments, and public institutions of the global members. GEM's entrepreneurship global survey provides a universal survey framework that is used globally. Among GEM's survey items, the entrepreneurship related items were categorized into business inception opportunity, business operation, and social environment, and these were established as moderating variables in this research as shown in Table 3. The 15 detailed items have internal consistency, which is demonstrated exceeding the Cronbach's alpha coefficient of 0.7. This is the utilization of existing research on survey methods used by numerous countries as the primary method to measure entrepreneurship.

Many of today's researches about entrepreneurship have focused on the cognitive processes through which individuals reach the decision to start a new firm (Audretsch and Keilbach 2011). Our entrepreneurship survey is based on the model used by GEM, but it also has similar cognition to that of Audretsch and Keilbach (2011) because the entrepreneurship survey in this study consists of items relating to business inception opportunity, business operation cognition, and social image of the business founders. In addition, as the construct level Cronbach's alpha of 0.936 far exceeds 0.7, entrepreneurship is considered to have convergent validity (Li et al. 2008).

Table 3 Reliability and convergent validity of entrepreneurship orientation measurement

Construct level Cronbach's Alpha	0.936
	Item
Business Inception Opportunity	Sufficient opportunity for new IT/SW business inception
	More business inception opportunities than people who want business inception
	More IT/SW business inception opportunities in past 5 years
	Individuals can easily have the opportunities for IT/SW business inception

	Many opportunities for high level and high growth IT/SW business inception
Business Operation Cognition	There are many people who know about IT/SW business inception
	Much knowledge about IT/SW business operation and management
	Much knowledge about resource organization necessary for IT/SW business
	Much knowledge about technology providers and developers necessary for IT/SW business
	Much knowledge about legal rights necessary for IT/SW business
Social Image of the Business Founders	Thinks of IT/SW business inception as the proper way to get rich
	Thinks of IT/SW business inception as a desirable career choice
	Successful IT/SW business founder deserves high position and respect
	Frequently hear about the successful IT/SW founders from mass media
	IT/SW is an individual who has both the competence and ability

3.5 Control variables

Laursen and Salter (2006) established the following as control variables: R&D intensity, firm size (i.e., number of employees), startup time, and size of the perceived product market. Studies have used firm size, R&D intensity, industry, and country of origin as control variables. In some cases, the control variables were established diversely and focused on the specific activities of SMEs such as firm age, firm size, environment, hostility, heterogeneity, product dynamism, market dynamism, and degree of internationalization (Parida et al. 2012).

According to the interviews with the Korean IT SMEs, practical R&D investment was not conducted at a consistent minimum level sufficient to be established as an independent control variable in most firms. Accordingly in this study, the R&D investment was not included in the control variables because it was a meaningless variable for practical analysis. The other values that were established as common control variables in previous research such as the mean number of the employees in the past three years, firm scale, firm age, difference of location (i.e., Seoul-Gyeonggior Daegu-Gyeongbuk), and difference of sectors (i.e., H/W or S/W in the IT sector) were also established as control variables in this research.

3.6 Analytical procedures

Linear Ordinary Least Squares (OLS) regression models were used to study the effects of open innovation on performance and the moderating effect of entrepreneurship between open innovation and firm's performance. For all models, the variance inflation factor was calculated to determine potential multicollinearity (Laursen and Salter 2006; Parida et al. 2012). In order to test for moderating effects, moderated multiple regression analyses were used. In order to reduce the multicollinearity between the interaction term and the original variables, the mean centering procedure that is regularly used in leading research and that is described in detail in several publications was used (Cohen et al. 2003). In addition, only one interaction term was considered for each model (Cohen et al. 2003). The cross-product term was considered in the basic model for the moderating regression. The regression coefficient and partial F associated with the resulting change in the R^2 were examined in order to test whether or not a moderating effect existed.

In much research on understanding the form of the interaction between variables, researchers have analyzed simple slopes at one standard deviation below and above the mean of the moderator (Cohen et al. 2003; Kim and Cable 2005; Kim et al. 2009). This analysis method provides understandings of the relationship between the independent and dependent variables at different levels of moderating effects. However, this analysis method slightly distorts the real aspects of the data due to the oversimplification that exceeds the real aspects of the data in order to demonstrate the slope.

4. Results

It was also confirmed on Table 4 that a high correlation exists among open innovation, entrepreneurship, and the ratio of new products or introduction of new business models. Thus, the analysis of the moderating effect must be conducted using an incremental regression analysis method.

Table 4 Descriptive statistics and correlations

Variables	M	SD	1	2	3	4	5	6	7
1. Open Innovation Efforts	39.345	20.91 2	-						
2. Entrepreneurship Orientation	3.107	0.584	0.464**						
3. Number of employees	51.617	92.180	0.285**	0.207**					
4. Firm Age	10.471	6.357	0.075	0.049	0.351**				
5. Geographical Area	1.490	0.500	-0.146*	-0.148**	-0.177**	-0.157**			
6. HW/SW	1.490	0.500	0.093	.136**	-0.127*	-0.148**	-0.053		
7. Revenue Ratio of New products	52.556	26.708	0.319**	0.303**	0.140**	0.007	-0.073	0.036	
8. Number of New Business Model	1.304	0.461	0.286**	0.345**	0.020	-0.080	-0.018	0.272**	0.207**

**p<0.01, *p<0.05

Through Table 5, it was further confirmed that in the cases of the dependent variables of the ratio of new products and introduction of new business models, there was an open innovation effect both in Step 1 and Step 2. That is, the open innovation effect proved to be meaningful regardless of the control variables. Thus, Hypothesis 1-1 and Hypothesis 1-2 were adopted.

Meanwhile, for the dependent variables of ratio of new products and introduction of new business model, the open innovation, entrepreneurship, and OI*entrepreneurship proved to be statistically meaningful in Step 3 and Step 4, demonstrating the moderating effect. The partial F associated with the resulting changes in the R^2 is significant in Step 4 in two dependent variable models. Therefore, Hypothesis 2-1 and 2-2 were adopted. Furthermore, as each step progresses, the values of R^2 and the adjusted R^2 also increased, which indicates a definite moderating effect. The R^2 values of the model with the moderating effect were 0.135 and 0.228 in the two dependent variables, which were sufficiently meaningful with the level not lower than that of 0.206 from Li et al. (2008). Because the moderating variables were added, the explanatory ability in the form of the gradual increase in R^2 values in the order from Step 1 to Step 4 is considered more significantly than in the previous research.

Table 5 Results of the OLS analyses

Dependent Variables	Revenue Ratio of New Products		Introduction of New Business Model	
Variables	Step3	Step4	Step3	Step4
Number of Employees	0.966	0.712	-0.402	-0.714
Firm Age	-0.685	-0.569	-1.148	-1.066
Geographic Area	-0.010	-0.170	1.047	0.835
HW/SW	-0.128	-0.248	4.980**	4.937**
Open innovation	3.499**	3.704**	3.558**	3.786**
Entrepreneurship	2.874**	2.796*	4.111**	4.160**
OI*Entrepreneurship		2.073*		2.538*
R^2	0.124	0.135	0.216	0.228
F	8.277**	7.850**	16.621**	15.232**
Adj. R^2	0.109	0.117	0.203	0.213

**$p < 0.01$
*$p < 0.05$
OI*Entrepreneurship values are obtained by multiplying each standardized value, i.e., through (Z OI)*(Z Entrepreneurship)

5. Conclusion and Implications

5.1 Summary

Our study is significant in its first step to recognize the importance of the effect of the open innovation of Korean IT SMEs on their performance and to undertake in-depth analysis research. In order to understand the Korean IT sector, it is essential to research SMEs that are engaged in R&D, innovation, and production in close relationship with the large conglomerates, as well as the direct research on those conglomerates. This study also has significance in that it analyzed the general characteristics of open innovation of Korean IT SMEs. One step further, additional research is required in the future in order to analyze the relationship between open innovation and firm performance from the perspectives of the relationship between Korean SMEs and conglomerates, the relationship with IT-related universities in Korea, and the relationship with refined consumers or users based on the fast Internet culture. Furthermore, this study has value in that the quantitative research is done to understand the relationship between the open innovation of SMEs and their performance. The necessity for open innovation strategies based on various channels can be suggested to IT SME entrepreneurs. According to this study, at first, the leaders of Korean IT SMEs must construct and operate strategic systems that can continually obtain new ideas and knowledge from their routine daily contacts such as customers, suppliers, and consumers rather than technology licensing, M&A, or independent R&D that requires significant resources, time, and expenses.

The second major finding from this study is that the strength of the positive effect of open innovation depends on the entrepreneurship and its essential roles on improving innovation performance. In this study, we have found both the strong direct and synergy effects of entrepreneurship orientation. Through many case studies thus far, it has been seen that the attitudes and leadership of the firm leaders, or the entrepreneurship promote the specific open innovation of the firms, which is connected to new profit generation (Chesbrough 2003, 2006, 2011; Li 2011; Lowik et al. 2012). However, in the existing case studies, only qualitative identification was conducted on the synergy effect of entrepreneurship and this was primarily investigated in conglomerates. The existence of an open innovation moderating effect of entrepreneurship has also not yet been examined or identified, even in SMEs, except in some individual case analyses (Lowik et al. 2012). It is very meaningful that the entrepreneurship in Korean IT SMEs proved to have a synergy effect on the relationship between open innovation and firm performance. That is, the promotion of entrepreneurship is required first prior to the investigating the individual open innovation strategies of firms or the construction of open innovation systems. Because rather than the situation where the entrepreneurship of the firm leader is not high, the reverse situation can more effectively promote a positive relationship between open innovation in a firm and their performance, it can have a very significant meaning for strategies of SMEs in the rapidly changing Korean IT sector.

It is true that Korean SMEs, particularly in the IT sector, have been accustomed to stable and passive management practices in supplying their products to the large conglomerates. Nevertheless, if the leaders of the firms do not voluntarily promote an open innovation environment and pursue the challenging management philosophy, the acquisition of technologies, knowledge, and ideas from outside can reach its limit in the innately vulnerable independent R&D investment situation, as was analyzed and proven in this research. In particular, the SME leaders in the IT sector, where the technology is rapidly changing, must recognize the difficulty of conducting proactive and aggressive open innovation strategies while maintaining their conservative attitudes. Accordingly, the open innovation strategies of SMEs must be focused on promoting the risk bearing, change in reality oriented, and positive innovation attitudes of firms.

5.2 Implication

The implication of this research can be described in detail as follows. From the study conducted, it is objectively found that entrepreneurship has a moderating effect on open innovation. Most of all, the entrepreneurial orientation and attitude of the CEO was crucial for open innovation in SMEs. In firms, especially in SMEs, it was found that there is much resistance to open innovation; thus, the CEO attitude is vital for the success of open innovation. In SMEs, the CEO should 'control' the open innovation strategy in order to gain the benefits related to open innovation. Secondly, open innovation-oriented SMEs in the IT industry appear to have different business models. SMEs that practice open innovation more aggressively can build different business models. From the interviews, it was found that higher levels of open innovation trigger more diverse business models. This indicates that open innovation has a direct effect on developing new business models. Thirdly, in the Korean IT sector SMEs, customers appear to be more important as an open innovation channel compared with universities and research institutes. Therefore, in SMEs, the CEO should attempt to build several customer-based open innovation channels by themselves such as customer innovation community, regular customer open innovation meeting, and customer open innovation festival. For SMEs in the Korean IT sector, the role of entrepreneurship is crucial in succeeding in open innovation and increasing innovation performance.

5.3 Limitations

Finally, some limitations of this study must be considered. First, the sample refers to medium and small sized firms; as such, the results may not be directly transferable to larger firms that have systemic governance systems for leadership and/or entrepreneurship. Korean IT conglomerates and large enterprises are famous for their independent R&D at a global level. Thus, separate research on their open innovation strategies, entrepreneurship, and firm performance should be undertaken. Second, the findings reflect the current situation in Korea. Thus, it would be worthwhile to conduct a similar study in the United States and European Union because the IT sector situations in Korea differ from those in the USA and EU. Third, a more objective method of measuring open innovation, i.e., a more scientific method of data measurement that can replace the present survey, is required. Although this research is survey-based with statistical significance, a more objective measurement of open innovation must be conducted in order to significantly increase the feasibility and reliability of the research and to secure the objectivity of the research results.

5.4 Future research

Based on these findings, we encourage further research into open innovation in IT SMEs in concrete channels. First, the open innovation characteristic of SMEs must be systematically analyzed according to the major open innovation channels. Additional research is also required for the open innovation characteristics of major channels faced by the current Korean IT SMEs such as consumers, customers, universities, and big enterprise customers. Second, systematic case analysis research is also required for open innovation channels, status, and characteristics utilized by Korean IT SMEs for their open innovation. By analyzing real cases, the open innovation examples of Korean IT SMEs must be examined practically. Third, the characteristics of dynamic open innovation that occurs in the process of conducting their businesses after establishing specific relationships with Korean conglomerates in the IT sector should be analyzed. Analyzing the open innovation characteristics of the process where the major domestic IT conglomerates such as Samsung, LG, and SK create the value chain with SMEs being considered as a way to more precisely understand the open innovation characteristics of Korean IT SMEs.

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The Philosophy of 'Open Innovation': Historical Development of Philosophy of Open Innovation and Its Reflection from Taoism

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A knowledge paradigm based on free inflows and outflows is open innovation. In open innovation, open flows of new knowledge create paradoxes in certain firms or organizations. These paradoxes lead to new creativity, which results in innovation. Inflows of new knowledge and ideas boost diversity and promote collisions among ideas eventually bringing about creative innovation at a new level.
The aim of this study was to explore the ideological foundation of open innovation strategies and the open business model, which are appearing as new industrial paradigms based on information technology (IT).
First, we examined the ideological foundation of Deleuze, Whitehead, and Popper. Next, we scrutinized Taoism to discover concrete bases for open innovation. Taoism completely coincides with the logical basis of open innovation as such. The theory "the supreme good is like water " of Taoism means to vacate oneself and fill the space with others to create paradoxes thereby filling oneself with a more creative method. Taoism provides a way to present paradoxes through the idea of vacating and opening in order to reach a creative stage of leaving nature as it is.

Key words: open innovation, "the supreme good is like water ", paradox, Taoism, open business model

1. Introduction

Because the age of knowledge based economy has arrived, everybody lives with a flood of knowledge. In other words, currently, finding the necessary knowledge and ideas within a firm has become inefficient. Even at the individual level, the issue of how fast an individual can find the appropriate knowledge for given questions has become a measure of determining his/her competitiveness. A knowledge paradigm that is based on the free inflows and outflows of knowledge is open innovation. In open innovation, open flows of new knowledge create paradoxes in firms or organizations. These paradoxes lead to new creativity which results in innovation. Inflows of new knowledge and ideas boost diversity and promote collisions among ideas to eventually bring about creative innovation at a new level. Taoism completely coincides with the logical basis of open innovation as such. The theory "the supreme good is like water" of Taoism means to vacate oneself and fill the space with others to create paradoxes thereby filling oneself with a more creative method. Taoism raises others by lowering oneself in order to raise oneself to a new level under paradoxes.

The aim of this study was to explore the philosophical bases in an era in which open innovation strategies and open business models are appearing as new industrial paradigms based on information technology (IT).

This research was basically done with literary analyses and thinking experiments. The logical structure of open innovation was analyzed in terms of its concept and contents through an epistemological analysis of the discussion by Professor Chesbrough who presented a paradigm of open innovation. Rather than analyzing diverse additional discussions on the concept ambiguously, the present study focused on the analysis of the logical structure of the concept unique to open innovation. Next, the logical trends and traditions of open innovation and closed innovation were summarized through a literary analysis of diverse fields including philosophy, economic theories, and scientific paradigms. Based on the aforementioned discussion, the analyses of the philosophy and logic of open innovation in Tao Te Ching were established (De Landa, 2009; Deleuze and Guattari, 2001).

Essentially, Cho (2011) based on Wang Bi's version was referred to, and the discussion by Gi (2007a) based on the white paper version that represents early Taoism was mainly analyzed. The logics and philosophy of open innovation were analyzed centering on the core contents of 81 sections of Tao Te Ching.

2. Logical and historical roots of Open Innovation

Chesbrough (2003) proposed open innovation as a technological innovation strategy and a new management paradigm. In an analysis of IBM's case of open innovation, he proposed the value of a strategy for businesses to actively utilize technologies for other purposes than in-house purposes when the technologies are not utilized by them as well as actively obtain technologies necessary for them from the outside in order to utilize the technologies. In this discussion, he defines open innovation as free movements of technologies and knowledge basically between firms. In diverse cases of firms that have implemented open innovation such as P&G and Intel that Chesbrough analyzed in the process of establishing the concept of open innovation, he defined firms' acts of actively introducing technologies not developed by them from the outside and using the technologies for the development of new products or process innovation or utilizing in-house technologies not in use as new sources of innovation outside the businesses as a basic category of open innovation(Yun and Mohan 2012a, 2012b; Yun, Park and Mohan 2011). In addition, in a study conducted on Chinese firms, it was indicated that not only the intensity of innovation but also the scope of innovation and spillovers of innovation positively affected the firms' sales growth (Choi & Williams, 2012).

In addition, Chesbrough (2006) defined diverse business models aiming at open innovation itself, in particular, those business models to distribute and consume technologies and knowledge across firms' boundaries as open business models and analyzed in detail, concrete cases such as intellectual ventures, InnoCentive, and Ocean Tomo. That is, he presented those business models to create economic profits from open innovation itself as open business models. In particular, he presented those business models that focus on the trade and commercialization of knowledge and technologies as open business models. There are three kinds of knowledge existing in the world—knowledge that has economic value and is protected by patents, knowledge that has economic value but is not protected by patents, and knowledge that does not have clear economic value and is not protected by the law. Through open business models, firms have been able to efficiently sell their knowledge and technologies not utilized by themselves to others. Although it will not be easy, it is a way to overcome the "Chesbrough Paradox of Technology Trade." Furthermore, external technologies needed by firms can be effectively found and safely introduced to firms leading the firms to new innovation. The Chesbrough Paradox of Technology Trade was at one time a concept suggested by Chesbrough as the Arrow information Paradox. However, his attempt to shed new light on the paradox, to deeply observe the essential characteristics of the paradox, and to present open business models as a solution is completely new, and subsequently, this researcher names it the "Chesbrough Paradox of Technology Trade" or the "Chesbrough paradox."

In fact, most new, creative, and economically valuable technologies have been placed in the situation of the Chesbrough paradox. On the one hand, purchasers are not willing to buy technologies and knowledge that are the subjects of trade unless they sufficiently recognize the technologies and knowledge and judge that they are relevant technologies and knowledge. On the other hand, if the purchasers sufficiently recognize and know the technologies and knowledge before they pay for the technologies and knowledge, an incentive will form for them to unduly use the relevant technologies without paying economic prices. This situation surrounding technology trade is named the "Chesbrough Paradox of Technology Trade" or "Chesbrough paradox." Open business models overcome the Chesbrough paradox and develop stages of technology trade based on their own knowledge. In addition, Chesbrough pays attention to this paradox with a creative view from the viewpoint of open innovation and analyzes and interprets it within the conceptual frame of the open innovation business models.

Meanwhile, in the second IT revolution period represented by the mobile Internet, location information, the development of smart devices, and users' participation in innovation, open service innovation pays attention to the characteristics of the contents of open innovation (Yun, 2010; Chesbrough, 2011). Open service innovation pays attention to the fact that in the age of the knowledge based economy, the contents of open innovation at their core are mainly services. The mobile app trade business model App Store is a typical open service innovation business model. The innovation through which new services are created, distributed, and consumed through open innovation is open service innovation. The enhanced levels of knowledge and technologies of the general public as consumers or users are becoming a motivational power to create innovative services in new forms. If all industries create new sustainable growth engines through open service innovation, they can get out of commodity traps. For instance, music consumers' participation in music production as creators of music, T-shirt consumers' participation in T-shirt production as T-shirt designers or evaluators, and agricultural product consumers' participation in agricultural product production by determining the kinds of agricultural products to be produced and the distribution of the agricultural products are open service innovation. That is, the innovation that enable firms to provide existing production, distribution, and consumption of products and services, together with added services having additional values by providing knowledge and ideas through open innovation is open service innovation. This is the actual contents of open innovation in the age of the knowledge based economy. Through open innovation, open service innovation has passed the stage of providing creative innovative products, which are physically different from existing products and is reaching the stage that provide services which are creatively different from existing services.

Newton mechanics, which has become the basis of scientific revolutions, contains typical closed innovation paradigms. The rationality to analyze the past and the present and accurately predict the future within the frame of mechanical world views is inherently based on closed paradigms (Kim, 2001; Einstein 2007; Gallo 2011). This tradition of closed world views is projected because it is based on the economic paradigm of the neoclassical school in the West. When all information is disclosed and trading costs are zero, the economic activities of rational economic men reach a rational balance by matching demand and supply. In addition, this paradigm is based on the premise that long-term business fluctuations will reach Pareto optimality, which is the rational balance point by themselves within the frame of economic systems. The economic paradigm of the neoclassical school also presents internal stabilization of economic systems based on the premise that economic systems are closed systems. In addition, among the school of thoughts in the Orient, Confucius, Mencius, and the tradition of neo-Confucianism also have established ideological systems basically based on closed systems. Based on central royal authority, self-contained and stable closed systems formed mainstream bases of neo-Confucianism within the authoritarian class order of the feudal lord class, the noble class, the artisan class and the merchant class (Gi, 2007a, 2007b; Gi, 2010).

Quantum mechanics brought about a complete revolution to existing closed physical world views to the extent that the controversies over the epistemological base are continued despite that it has achieved wonderful success as a theory of physics today (Jang, 2002). In other words, quantum mechanics presumed uncertainty instead of assuming that when characteristics and initial conditions are known, future characteristics and conditions are necessarily predictable by considering the law of changes. Werner Karl Heisenberg once presented the uncertainty principle indicating that it is impossible to predict time and space simultaneously by applying quantum mechanics to microscopic worlds. The epistemological effects of quantum mechanics brought about ideological development in relation to not only physical complex systems but also to socioeconomic complex systems (Isaacson 2011; Nobuyuki 2007; Young and Simon 2005). That is, quantum mechanics provided opportunities for open systems, complex systems and uncertainty to appear as new ideological paradigms in not only in natural sciences but also in the social sciences. For instance, the philosophy of organism of Alfred North Whitehead who established the modern process philosophy is deeply rooted in relativism and the quantum theory, which are central ideas of modern physics (Kwon, 2011). Meanwhile, Joseph Schumpeter denied the balance of economic development and suggested that the paradigm of innovation resulted from constructive destruction and unbalanced growth. He denied the closure and predictability of economic systems and suggested discontinuous development lead by creative entrepreneurship and large businesses that lead innovation (Schumpeter, 1942). Schumpeter's economic paradigm is currently associated with the assumption of open systems, long tale economy, collective intelligence, and open innovation paradigms in many economic and management studies.

3. Philosophical Basis of Open Innovation: Whitehead, Deleuze, and Popper

Studies on the philosophical exploration and interpretation of open innovation themselves have not been conducted until now. However, it is true that discussions on open innovation in terms of the history of Western philosophy, which is directly related with the logical structure and content of open innovation, have been actively conducted recently, in particular. In the present study, the philosophical structure and content of open innovation will be established through the process philosophy of Whitehead, the philosophy of flow of Deleuze, and Popper's discussion on open society and falsificationism (Gunich, 2001, trans. by Lee Jeong-Wu & Kim Dong-Seon).

Whitehead is the founder of process philosophy, and he establishes aesthetic creativity (kalogenesis) as the ultimate value in his philosophy (Whitehead, 1978, 1991). The metaphysical premises of process philosophy are different from those of immanent realism, for instance, materialism, sensationalism, and Kantian structures (Ju, 2011). Whitehead tried to explain the universe we faced through organismic world views (Whitehead, 1947). In Whitehead's process, balanced complexity should be the purpose aimed by the current actual entities not only among current entities but also in relationships with future moments (Jeong, 2011). When seen from the viewpoint of Whitehead, all actual entities have creative characteristics and destructive characteristics simultaneously. In process philosophy, good is active and creative while evil is passive and noncreative. To him, disorder and ambiguity that are conditions for creativity become conditions for ultimate effectiveness and harmony (Whitehead, 1951). According to process philosophy, ultimate reality of the world is not material substances that stay in certain space-time but particulate "actual entities" that have spirituality and materiality simultaneously and occupy a certain space-time (Ju, 2011). Because process philosophy starts from the denial of "empty actuality," if we discard the concept of empty actuality, we will come to understand each actuality as obtaining its purpose by itself. Whitehead suggested dynamis as an existence continuum. Furthermore, he also includes superjects that finished adnation and reached satisfaction in dynamis. In Whitehead's latter period of thought, the ultimate value is aesthetic creativity aiming at the harmony of unity and contrast rather than simple creative advances toward newness. Eventually, Whitehead (1978) defined beauty as the form of unity in diversity. After all, to Whitehead, good is reaching the situation of total harmony and order, and the sort of relative losses (evil) that have come to occur in this process is natural in the process of creation of actual entities (Jeong, 2011). To him, although current good may be evil in the process, eventually, both current good and evil are good in terms of processes only when they contribute to creativity. That is, the purpose of Whitehead's philosophy can be identified at creativity occurring in the process. To him, creativity is the universal of universals and its inside is filled with many things in heterogeneous diversity. As such, as part of process philosophy, Whitehead introduced part of the quantum theory and developed organicism in his discussion (Kwon, 2011).

Deleuze (1986) provided a lead to view humans and the world from the viewpoint of the ontology of of time images (Jang, 2011). Simularcra refers to images or moments that mean a sort of diverse, pluralistic and deranging creations which are transformed and crushed depending on the observers' viewpoints, that is, those creations that frequently erase the same things, determination, identity or similar things. Taking note of the sameness between simularcra and Taoism in terms of contexts and contents, Jang (2011) who defined Taoism as materialistic metaphysics once utilized the two concepts in his analysis of modern movies. The homogeneity of the philosophical bases of Lao-tzu and Deleuze can be interpreted in terms of tentative knowledge. According to him, movies which are composite arts that include almost all cultural areas, such as music, fine arts, and literature, are composed of the simularcra of those images that got out of the reason oriented thinking centered on letters or words held by Christianity or Confucianism and affirm the potential of the feeling or sense of chaos possessed by images (Deleuze, 1989b). Lao-tzu's Tao Te Ching, which is generally called Taoism, is a huge cultural heritage of mankind that enables thinking of the cultural contents of simularcra of images along with the knowledge of Nomadology possessed by the Stoic School of Ancient Greek discussed by Deleuze (Jang, 2011). Common denominators of Deleuze and Lao-tzu are not limited to culture. A considerable portion of Lao-tzu's open innovative viewpoint already coincides with that of Deleuze. The basis of this argument will be concretized later in the discussion. In terms of thinking of simularcra of time images, Lao-tzu's Tao Te Ching and Deleuze's Nomadology are examples of the homogeneity of the ways of thinking possessed by East Asia and Europe (Deleuze, 1990). People unceasingly try to fill because of their desire for memories and unceasingly try to vacate because of their desire for forgetting. Deleuze's simularcrum and Lao-tzu's Tao Te Ching share the thinking device for memories called forgetting or vacating. In fact, Deleuze pursued the philosophy of immanence not to presume the unity of transcendence in advance but think and conceptualize multiplicities based on their uniqueness (Lee, 2007). Deleuze consistently persisted in thinking of multiplicite without unity presumed in advance as far as possible. In other words, Deleuze talked of a philosophy to take note of the changes and transitions rather than a certain state. Furthermore, Deleuze referred to ontological univocality to concretely give equal beings individual differences, thereby specifying the existence of tentativeness (Byeon, 2011). Whereas Whitehead's philosophy is called the philosophy of organism or process philosophy, Deleuze's philosophy is called the philosophy of differences, the philosophy of virtuality or the philosophy of flow (Kim, 2011). Virtuality has a fundamental meaning by itself in the understanding of beings as soon as the idea of processes is accepted. Whereas Whitehead's creativity has the status of the ultimate, to Deleuze, only virtuality and entelechy exist without the ultimate. To Deleuze, creativity is "eternal activity to unceasingly produce new synthesis" that penetrates through the bottom of the process of existence. Deleuze uses the term abstract instead of the term eternal. To him, abstract machines are attached with years or dates and thus they are created and become extinct. They are not eternal and are characterized by virtuality (Kim, 2011). Whereas Whitehead expresses moving from dynamis to actuality as entry, Deleuze expresses the process to move from virtuality to actuality as articulation or stratification. Whereas entry has a passive nuance, Deleuze feels regretful for changes from virtuality to actuality because he assesses actuality ethically negatively while assessing virtuality positively. Whitehead and Deleuze set different beings as mediators in the process of transition from dynamis or virtuality to actuality. Whereas, the former assumes gods although not based on the premise of eternality, the latter assumes abstract machines as concrete agencements. Whereas Whitehead assumes the ultimate of creative advances from multiplicity to unity, Deleuze assumes virtuality through mutual exchanges between multiplicity and unity.

When The Open Society and Its Enemies was first published in 1945, many critics said that there was no book that would surpass this book in theoretical criticism of totalitarianism when they assessed this book (Lee, 1999). Popper himself once said that The Open Society and It's Enemies was conceived to oppose the totalitarian gale termed Nazism and Marxism that were sweeping over Europe in the 1930s (Popper, 1959). This book thoroughly digs up the deep root of inhumane totalitarianism through the entire process of the human history beginning from the thought of Plato. In fact, Popper held on to the standpoint of critical rationalism that advocates critical reason instead of dogmatic reason while maintaining the tradition of rationalism that emphasizes the role of reason rather than experience in cognition and practice (Popper, 1945; Lee, 1999). By emphasizing criticism instead of dogmatism, critical rationalism contains the principle of open attitude to learn consciously through mistakes and continuous corrections of mistakes. Popper himself defines open societies as those societies that accept criticism and those societies that are based on individualism where freedom and rights are guaranteed (Popper, 1945). Popper does not assume societies of laissez-faire as open societies. On the contrary, he suggests applying national protectionism to economic areas, too. Even if a country protects its people from physical violence, if the country cannot protect the people from misuse of economic power, the country cannot actually protect the people's freedom (Lee, 1999). Meanwhile, he denied historicism that imposes the frame of certain inevitable laws or destinies that do not even exist on humans and aimed for open society that contains the dignity of man, respect for reason and belief in individuals' freedom. He suggests gradual social engineering based on open society and reason. He intended to gradually reconstruct society based on knowledge or principles obtained through scientific studies. Popper regards that scientific reason and open conversations based on scientific reason will enable the most reliable understanding of humans and the world (Park, 2006). To Popper, scientific theories do not mean theories that are verified by numerous cases but those that clearly present conditions that can be reputed or disproved by him (Popper, 1972). On the contrary, he indicated that theories that present their arguments vaguely and thus seem like being proved always but do not clearly present how the arguments can be disproved are nonscientific theories (Popper, 1957; 1987; 2001). That is, Popper argues that certain sciences are certified not because they have been verified through many cases but because their falsehood has not yet been proved even through all kinds of refutations. To him, all scientific theories are true only until they have not yet been disproved and they are not absolutely true in that they can be disputed any time. Therefore, Popper finds that the most fundamental condition for individual sciences to become strict research is the condition that critical thinking intended to disprove preceding theories should be actively set forth (Popper & Eccles, 1977). Furthermore, he indicated that the development of social science is poor because this critical thinking is not acknowledged (Park, 2001). Popper (1945, p. 250) indicated that the process of history provides the process of rationality to us and suggests the relationship between open society and critical thinking.

TABLE 1. Logic and Philosophy of Open Innovation

Logic of OI		Philosophy of OI		
Logic	Reason	Philosophy	Interpretation	Related
Vacancy	Vacancy as a structure of open innovation	-process -balanced complexity -dynamis -entry from dynamis to actuality, passive	Fill with other knowledge and technologies in the process of vacating	Whitehead
Paradox	Paradox as a content of open innovation	-fluidity -simulacra and multiplicite -virtuality -negative against stratification or segmentation from virtuality to actuality	Fluidity made by new knowledge contradictory to existing technologies	Deleuze
Goal	Creation of new outcomes of innovation through acquisition of external technologies and discharge of internal technologies not utilized	-critical rationalism -falsification	Open attitude toward new viewpoints and knowledge, accept these until these are disproved, that is, until these are denied by new knowledge	Popper
Characteristics	Aim for creative innovation and creative outcomes of innovation	-heterogeneous diversity as the universal of universals -eternal activity and abstract machine -open attitude toward critical thinking	The source of creativity created by open innovation is heterogeneous eternal activity and critical thinking	Whitehead Deleuze Popper

The relationship between the logical structure and philosophical contents of open innovation is summarized in Table 1. One of core logics of open innovation is the structure of vacancy. This enables new ideas and knowledge to come into oneself by vacating oneself. This creates the process of structurally balanced complexity presented by Whitehead (1947). In addition, vacancy always assumes new dynamis. The opening of open innovation involves the structure of vacancy, and if there is no vacancy, a hopeless situation in which the dynamis will enter into actuality and will be finalized will occur.

In contents, open innovation pursues new innovation through unceasing collisions with different things contrary to it. This corresponds to the aspect of the contents of nondefinitive states that coincides with Delueze's fluidity. The virtuality that has not been finalized in the paradox made by simulacra and multiplicite is expressed. As indicated by the fact that Delueze himself was negative against stratification or segmentation from virtuality to actuality, complete relief itself of this paradox results in the suspension of open innovation.

Open innovation aims at the creation of new outcomes of innovation by the acquisition of external technologies and the discharge of internal technologies not utilized. The open attitude toward new viewpoints and knowledge indicated by Popper and the scientific study method of falcificationism to accept certain ideas and knowledge as truth until they are denied are very similarly contained in the processes of objective setting and maintenance. This is the approach to deny the completeness of certain innovation and adopt it until a new idea flows in so that a paradox occurs, and the paradox is denied by another new idea.

Open innovation ultimately pursues creative innovation that replaces existing products and processes. Whitehead finds creativity from heterogeneous diversity as the universal of universals. Deleuze suggests the derivation of creativity from the abstract machine with eternal activity that does not stop. Finally, Popper suggests the exploration of creative new truth and knowledge with an open attitude toward critical thinking about existing knowledge. Eventually, Whitehead, Deleuze, and Popper find a lead to creativity from unceasingly open attitudes toward all pieces of new knowledge.

4. Analysis of the Philosophy of Vacancies as the Structure of Open Innovation

In the section above, through Whitehead, Deleuze, and Popper, the philosophical basis of open innovation was identified as pursing creativity largely through vacancies as the structure of open innovation and paradoxes as the content of open innovation. The cores of the structure and content of the philosophy of open innovation are vacancies and paradoxes, respectively. In the ideological stream of the Orient, Lao-tzu's Tao Te Ching took vacancies and paradoxes as its philosophical basis. Therefore, analyzing Tao Te Ching through the philosophical structure and content of open innovation will be a way to understand the basis of the philosophy of open innovation. First, Tao Te Ching analysis centered on vacancies that are the structural characteristics of the philosophy of open innovation. Lao-tzu's Tao Te Ching is available in diverse versions, such as Wang Bi's version, Jang Myeong's version, a white paper version, and a bamboo pole version. Because the tradition of Confucianism occupied the mainstream of learning in China following the tradition of Taoism, Wang Bi's version annotated by Wang Bi is the Tao Te Ching which is the most widely read in China and Korea. Additionally, because Wang Bi's version pursued the Way of a True King of Neo-Confucianism, the orientation toward the public and the ideological freedom unique to Taoism were considerably embellished. The white paper version is the closest to the original intention of Lao-tzu. In Korea, Gi (2007a) dealt with the populism of Lao-tzu squarely based on the white paper version. The present study was conducted based on the white paper version and Gi's (2007a) while referring to some parts of Wang Bi's version.

TABLE 2. Vacancy, Philosophical Structure of Open Innovation in Taoism

Division	Taoism
Top of chapter 4	Tao is like an empty vessel that yet can be drawn from without ever needing to be filled. It is without bottom; the very breeder of all things in the world.
Bottom of chapter 5	Yet heaven and earth and all that lies between is like a bellows; empty, yet yielding a supply that hardly fails.
Bottom of chapter 6	And the gate of the profound woman is the root that heaven and earth sprang from.
Top of chapter 8	The highest good is like that of water. The goodness of water is that it benefits the ten thousand creatures; yet itself hardly ever scrambles.

Top of chapter 10	Can your mind penetrate every corner of the land, but you yourself never interfere? Can you renounce the grosser mind for comprehending all inside knowledge?
Bottom of chapter 11	Take advantage of what is, turn some *existing* into a great advantage: just make as much as you can out of it here. Feel free to recognize the possible usefulness of what is not yet here. Prosper by clever use of something of the not-yet kind.
Bottom of chapter 12	The wise man is concerned with his navel and belly before his eyes.* He can consider the tummy first, not the eye.
Bottom of chapter 15	The wise man does not want to fill himself to spilling over.
Top of chapter 16	Attain complete humility towards the void; hold firm to the basis of quietude. The myriad things take shape and rise to activity, now, I watch them fall, worked on, back to their repose and roots.
Bottom of chapter 17	The wise man is a clever ruler; he values his words highly. It is so hard to get a single word from him at any price that when his task is finished, a work well done, everyone says, "It happened by itself, and we did it."
Bottom of chapter 19	And some private, secret means. Let them foster less ardent desires.
Top of chapter 20	Abandon learning and there will be no sorrow.
Top of chapter 21	The marks of great virtue follow alone from the [one] Tao.
Top of chapter 23	To be always talking goes against nature.
Bottom of chapter 25	The ways of men are conditioned by those of earth. The ways of earth, by those of heaven. The ways of heaven by those of Tao, And the ways of Tao by the Self-so's Tao in turn models itself after Nature.
Bottom of chapter 30	What is against Tao will hardly survive.
Top of chapter 31	Fine weapons are instruments of evil as soldiers can be: quite ill-omened things, often hated. Those with fine Tao turn away from weapons that are most often hated.
Top of chapter 32	Best Tao is absolute and eternal. As such it has neither name nor fame.
Bottom of chapter 33	He who knows others is learned; but he who knows himself is wise, nay, in the end, it could be illumined.
Bottom of chapter 34	And the wise man never at any time hardly ever makes a show of greatness. By such a dogged, keen strategy, some [clowns] achieves greatness.
Top of chapter 35	IHold the great symbol and great form of Tao know-how. He who visualizes or holds the great symbol form at its best can go about his work (in such as his empire), yet without doing harm
Top of chapter 37	The Tao never does; it takes no action. Through it, everything

	is done, yet, there is nothing left undone.
Top of chapter 38	The high-standing man hardly ever shows off that he has some supreme powers or prowess deep inside himself. He keeps such powers, and in this way, he really owns virtue. The man of low virtue is hardly losing virtue, and so, he is devoid of virtue. The man of low virtue can lose sight of some virtue by never losing sight of it. Rather low or indecent power can't get rid of the appearance of being some power.
Top of chapter 40	Reversion is the action of Tao. In Tao, the only motion is a return; and the one useful quality is named soft [or polite] gentleness, so, polite or weak gentleness [or humility] is the function of Tao.
Bottom of chapter 44	Who stops in time knows when to stop. Who stops in time nothing can harm; if free from danger, he can long endure and feel forever safe and secure. He can long endure who stays forever safe and secure.
Bottom of chapter 46	There is no greater guilt than [sudden] discontent. There is (...) greater disaster than greed. [Eventually] there is hardly a greater sin than desire for possession.
Top of chapter 48	The student of Tao reduces his assets by dwindling or losing a bit each day.
Top of chapter 49	Good ones I declare good; and I [often] treat those who are good with goodness, as I approve of the good man. I also treat those who are not so good with goodness. I often approve of the [said] bad; he gets goodness.
Bottom of chapter 52	Shut down life's various openings. Close its doors, and till the end your strength may remain. Next, your whole life can seem without toil.
Top of chapter 54	Well planted can hardly be plucked. Who is well established [in Tao] can hardly be pulled away. The firmly grounded is hardly easily shaken. Who has a firm grasp does not easily let go. Who has a firm grasp of Tao can't be separated from it. A really firm grasp can't be relaxed.
Top of chapter 55	He who has a lot of mystic might also should be strong in secret able influence-might - quite free from getting harmed, at times like a tender child: full of childlike virtue at its best.
Top of chapter 57	So a wise man decreed: So long as I "do nothing" the people get transformed of themselves.
Top of chapter 58	When the government is non-discriminative, lazy and dull, the people are contented and not spoiled.
Top of chapter 59	In managing human affairs, there is no better rule than to be sparing, which is to forestall.
Top of chapter 60	Ruling a big kingdom is like frying a small fish.
Top of chapter 61	A big kingdom can be compared to the lower part of a river, like the low ground which all streams flow down towards.
Top of chapter 62	Tao is thought up as the mysterious secret of the universe; it could be the storehouse of "all things", like the pivotal

	worship center in the south-west corner in the [old Chinese] house. It is the good man's treasure and the bad man's support and resort.
Top of chapter 65	In old times, those who practiced Tao well, did hardly aim to enlighten people, but to make them ignorant and hold them that way.
Bottom of chapter 67	Through not presuming to be the first and best there is, one can develop one's talent and strength; let it mature to dominate a world.
Bottom of chapter 75	Those who interfere not with their living are wise in exalting life. Maybe he who seeks only little after life can excel in making life valuable. But all that have hearts setting only little on life could be superior to those who set store by life.
Top of chapter 77	The wise man acts, but does not possess, accomplishes but lays claim to no credit.
Top of chapter 79	To allay the main discontent, but in a way that begets further discontents, can hardly be top successful.
Top of chapter 80	Let there be a small country with few people.

As shown in Table 2, the core contents of 43 chapters out of a total of 81 chapters of the Tao Te Ching contain the philosophy of vacancy of open innovation at their core. In fact, diverse contents, in particular, the philosophical contents of vacancies and paradoxes, coexist in each chapter. For this study, the parts that fit the intent of the present study were qualitatively extracted. Although the philosophies of vacancies and paradoxes are found throughout the entire Tao Te Ching, as part of the approach for the purpose of the present study, the contexts of the philosophy of vacancies and the philosophy of paradoxes in Tables 2 and 3, respectively, were extracted. Therefore, the above tables themselves do not have absolute meanings. However, the fact that the philosophical contexts of the structure and content of open innovation are immanent in the entire Tao Te Ching is meaningful.

The white paper version based interpretation of the Tao Te Ching close to the original based on materialistic metaphysics provides a viewpoint that diverges from the Confucian knowledge that dominated Joseon and China before modernization, Christian knowledge that came in through the western process of modernization, neoplatonism knowledge, anthropocentric knowledge or idea centered knowledge (Jang, 2011). This is in line with the simulacra presented by Deleuze as time images as a sort of confusional creations. The tentative natures of situations are maximized through the philosophy of vacancy to draw simulacra. These tentative natures are eventually connected to creativity. Therefore, many messages in the Tao Te Ching based on the philosophy of vacancy philosophically conceive the message of creativity.

For the vacancy as the structure of open innovation in the Tao Te Ching extracted as shown in Table 2, first, the vacancy expressed by none or no act can be identified such as no artificial act, no worry, and no name. Those who embellished and distorted Tao Te Ching with neo-Confucianism concluded that the “none”, ‘nothing exists’, and meant escapism. However, the vacancy in Tao Te Ching is the “none” in that it means not doing things artificially which contains a message of resistance against the existing order and creative alternatives, on the contrary (Gi, 2007a, p. 607). In other words, the Tao referred to in Tao Te Ching is the creator who is “the unmoved mover” and is said to be endlessness because it has no beginning or ending (Gi, 2007a, p. 626). Tao Te Ching unceasingly requires ignorance as in chapter 20 (if you stop learning, you will have nothing to worry about) or chapter 65 "from old times, nice leaders with Tao did not make their people smart but made them naïve". This is intended to tell us not to be bound by spatial senses or phenomena (Gi, 2007a, p. 742). In other words, it is to tell us not to be bound by the current situation but see new knowledge, ideas, and truth with open attitudes. The numerous expressions of none and ignorance in the Tao Te Ching do not deny the huge intellectual properties of today or advocate agnosticism, meaning that Tao can never be known (Gi, 2007a, p. 742). On the contrary, these expressions are to tell us unceasingly vacate us to be open to new perceptions. The contextual meaning of these expressions completely coincides with that of the philosophy and structure of vacancy of open innovation. As in chapter 32 "Tao has no eternal name since it is the normal way of nature" and chapter 37 "Tao is not to do things by force but to let things be done naturally"; Tao Te Ching presented the "none" thereby suggesting for us to vacate our existing knowledge and intention system and accept new things with open attitudes. In chapter 11 "having things is beneficial because the lack of those things makes their use", chapter 38 "virtuous persons do not make unreasonable plans but small-minded persons make unreasonable plans", chapter 57 "if the king does not make events artificially, the people will live naturally and happily by themselves" and chapter 75 "those who do not artificially plan their lives are better than those who regard their lives precious", Tao Te Ching presents creative beings made by the vacancy of none and the creative fullness made by vacancy that has not been achieved artificially. That is, Tao Te Ching indicates creative innovation made by the vacancy of none.

Second, as in chapter 4 "Tao acts while being vacant, is never completely filled and is deep", chapter 5 "the space between the sky and the earth like bellows or pipes. It is completely vacant and thus nothing is blocked in it", chapter 15 "those who found enlightenment do not want to be filled with their own thought and arguments but listen to others", and chapter 16 "reach complete vacancy and keep true quietness, then, when all things are created in harmony, you can see them all", Tao Te Ching also expressly mentions vacancy itself and presents the philosophy of creative filling. By vacating, one can be fully filled with creative ideas, fill himself/herself with others' ideas and knowledge, and then, the knowledge, which is the source of new growth and creation, can grow at the extreme of vacancy. The chapters of Tao Te Ching that expressly mention vacancy can be interpreted as being directly connected with the philosophy and structure of vacancy of open innovation. chapter 19 "keep the original simplicity and do not have excessive personal greed", chapter 21 "all actions taken will conform to Tao only after regarding complete vacancy as virtue", chapter 23 "nature does not speak", chapter 34 "by not thinking oneself great, one can reach a high level of Tao", and chapter 48 "following Tao is to vacate every day enduring losses" also proposed for us to vacate ourselves and reduce ourselves quietly in order to more abundantly fill ourselves with external knowledge, emotions, and agreements.

5. Analysis of Paradox in Taoism as the Content of Philosophy of Open Innovation

TABLE 3. Paradox, Philosophical Process of Open Innovation in Taoism

Division	Taoism
Top of chapter 1	The way that can be told of is hardly an eternal, absolute, unvarying one; the name that can be coded and given is no absolute name.
Top of chapter 2	So: Being and not-yet-being interdepend in growth; grow out of another, they can produce each other. And hard and easy interdepend in completion
Bottom of chapter 3	Through his non-do actions all [such subjection] runs

	well [for some time].
Top of chapter 7	Well, they do not live only for themselves; that is why they live long.
Bottom of chapter 9	If your work is done, withdraw! That is heaven's way. It can be opposed to lots of ways of man.
Top of chapter 13	"Be glad for favour. Still receive favour or disgrace with regular apprehension. Be cautious not to lose the winning sort of favour. Lower favour and disgrace can cause one dismay;
Top of chapter 14	Look at it, it can't be seen. Listen to it, it can't be heard. Grasp at it, it can't be touched.
Top of chapter 18	When the great Tao declined, Humanity and righteousness appeared.
Top of chapter 22	He does not show himself much, he is therefore luminous and clear. He does not define himself, therefore he is distinct.
Top of chapter 24	Who is proud of his work, achieves nothing well lasting.
Bottom of chapter 26	If the ruler is light-hearted, the minister will be destroyed. If he is light, the foundation is lost; if he is active, the lord is lost.
Bottom of chapter 27	Truly, the good man is the teacher of the bad, as they say. But the bad man is the lesson of the good, in part some material from which the good can learn.
Top of chapter 28	He who knows the white yet keeps and cleaves to the black becomes the standard by which all things are tested; he becomes the model for the world.
Top of chapter 29	Those that grab at it lose it. Who makes can spoil well; who holds can lose.
Top of chapter 36	What is in the end to be shrunk can first be stretched. The one who is to be made to dwindle (in power) can first be caused to expand; and then it is necessary first to expand.
Bottom of chapter 39	The humble is the stem upon which the mighty grows. Yes, humble oneness is the basis for all honour. So even the exalted ones depend upon the lowly for their base.
Top of chapter 41	The way out into the light often looks dark; one who understands Tao seems dull, as Tao which is bright appears to be dark. The Tao which goes forward appears to fall backward; the one who is advanced [in Tao] seems to slip backwards; the way that goes ahead often looks as if it went back.
Bottom of chapter 42	"Violent and fierce people hardly die a natural [elegant] death."

Top of chapter 43	The softest things in the world overcome the hardest things in the world.
Bottom of chapter 45	The greatest [harlequin] eloquence seems to stutter or seems like stuttering.
Bottom of chapter 47	The wise man can understand much without seeing - Or achieve much without [visible] action.
Top of chapter 50	He who aims at life could achieve his death. Out of living, death pops up. Who comes to life can go to death.
Bottom of chapter 51	The right Tao gives birth, shields from storms, and seems hardly possessive. The right shields hardly laying claim to you. A man must rear others, control some, but never lean upon them.
Top of chapter 53	Some Tao main path is easy to walk [or drift] on, but safe and easy. All the same people are fond; men love by-paths, love even small by-paths: The by-path courts are spick-and-span.
Top of chapter 56	He who knows does not speak [artfully]. He who speaks hardly knows.
Top of chapter 63	Accomplish seemingly do-nothing. Attend seemingly to no-affairs. And do completely without ado. What runs, acts without action, does without doing.
Top of chapter 64	The wise man does not act in the open, and so does not spoil or harm; yes, he takes seemingly no action and therefore hardly fails. He who grasps things [often] loses them. He does not grasp a lot, he does not let slip a lot.
Top of chapter 66	So to be ahead of the people, you have to follow them in your own person.
Top of chapter 68	A skillful leader of troops is never oppressive with his military strength.
Bottom of chapter 69	There is no greater catastrophe than if a foolishly underestimated enemy robs and destroys your most cherished treasures.
Bottom of chapter 70	The wise man wears a coarse cloth on top and carries jade underneath his dress, within his bosom.
Top of chapter 71	Who knows that he does not know is the highest. To know when one does not know is best. Who pretends to know what he does not know is sick-minded
Bottom of chapter 72	The wise man knows himself but hardly shows off.
Top of chapter 73	Who is brave in daring can kill or get killed [on a bus]. On the other hand, one who is brave in not daring, can survive or give life.
Top of chapter 74	When the people are not afraid of death, why threaten them with death sentences?
Bottom of chapter 76	So the hard and mighty eventually should be cast

	down; and the soft and weak may be set on high.
Top of chapter 78	Thus, the yielding may conquer the resistant and the soft the hard.
Top of chapter 81	He lives for other people, seemingly, and grows richer himself if the more he uses for others, the more he has for himself - He gives to other people to get greater abundance.

Paradoxes mean prepositions that cannot be mathematically determined to be true or false. For instance, let us see the preposition set forth by Socrates in order to express his wisdom, “I know that I know nothing.” If he truly knows nothing, his words indicating that he knows it will be true and if he knows something, his words that he knows nothing will become false. Therefore, the words set forth by him is a paradox that can be neither true nor false. Human history is filled with statements that partially look like paradoxes but are true in fact and statements that partially look like truths but are paradoxes in fact. As mentioned by Anatol Rapoport, a mathematical psychologist of Toronto University in Canada, if paradoxes had not impacted thinkers and philosophers, the horizon of cognition in the areas of philosophy and mathematics could have not been expanded as it is today (Werlitz, 20011). Paradoxes refer to discourses beyond common sense that tell truths at new dimensions using apparently contradictory words (Gi, 2007a, p. 769).

Paradoxes as the basis of the content of the philosophy of open innovation refer to the presentation of ideas that are contradictory to or different from existing knowledge or technologies leading to innovation at new dimensions. Therefore, these paradoxes include, but are not limited to, the concept of mathematical paradoxes in a strict sense and are considered more widely as creative innovation made by collisions between new added ideas contradictory to existing knowledge and existing ideas. This is almost the same as the concept of paradoxes in previous studies such as Werlitz (2011) or Gi (2007a). Tao Te Ching contains desperate resistance for the survival of the weak and the loser by throwing down civilization and values, disclosing the paradoxes of existing order and civilization and giving prominence to free lives in natural conditions, which are the opposite of the foregoing (Gi, 2007b, p. 772). Through paradoxes, Tao Te Ching asks us to see nature rather than civilization, essence rather than phenomena, unmoved movers rather than movers, nonexistence rather than existence, death rather than life, shade rather than light, darkness rather than brightness, valleys rather than peaks, and chaos rather order and encourages us to respect motherhood rather than fatherhood, weakness rather than strength, softness rather than hardness, ignorance rather than wisdom, and simplicity rather than decorations (Gi, 2007a, p. 772). Based on the content of the philosophy of open innovation for new knowledge or ideas to break through the blockade of concepts and express differences to go to new creative knowledge, the very paradoxes exist (Deleuze, 2004, trans. by Kim Sang-Han, p. 49). The creative genesis made by paradoxes which are the ideological maximum of differences is the philosophical dynamic of open innovation. In fact, differences are not phenomena but are close to the noumenon of phenomena. Therefore, paradoxes become the crucible of the creative birth of new innovation. Although it is true that God makes the world while doing calculations, the calculations make differences that can never be eliminated. The very unfairness of differences means irrevocable equality forms conditions of the world (Deleuze, 2004, trans. by Kim Sang-Han, p. 475). That is, irrevocable equality forms conditions of the world (Deleuze, 2004, trans. by Kim Sang-Han, p. 475). Therefore, paradoxes, which are the peaks of differences, have come to add creativity of diverse kinds of virtuality. As shown in Table 3, a considerable part of Tao Te Ching unceasingly presents the peaks of differences made by paradoxes and their creative implications in the form of indefinite virtuality. Chapter 50 "what that is born dies inevitably", chapter 76 "what that is strong and large will be placed low and what that is weak and soft will be placed high", and chapter 78 "what that is weak beats what that is strong and what that is soft beats what that is hard" propose creative messages through typical paradoxes. In other words, the creative results made by the philosophical contents termed paradoxes become the motive power of Taoism. The arrangement of contradictory knowledge and technologies inevitably ends up with creative new knowledge. The point at which open innovation is trying to arrive through unceasing arrangements of existing knowledge or technologies in its contents is the very new knowledge. Tao Te Ching has value as a motive for the philosophical basis of the content of open innovation in that it presents creative alternative knowledge through typical paradoxes or through the presentation of the tentativeness of differences although not typical. Chapter 1 "although Tao can be pointed, the Tao pointed is not the Tao of normal nature and although Tao can be identified by naming it, it is not the cause of normal nature" presents the epistemological openness of the entire Taoism through the presentation of the paradoxes or contradictions of "although Tao can be pointed, the Tao pointed is not the Tao of normal nature and although Tao can be identified by naming it, it is not the cause of normal nature." Although there may be some who question closely suggesting that the epistemologically interpretation of 2,400 year old documents is sophistry, the fact that Mohism, which is earlier than Taoism, already discussed the theory of being true to the name and sophisticated logic should be noted (Gi, 2007a, p. 637, 2006a, 2006b). At a time similar to the time of Socrates, Mo-tzu already discussed empirical epistemology and Tao Te Ching electrically discussed agnostic epistemology through chapter 1 (Gi, 2007a, p. 640, 2008). Chapter 1 of Tao Te Ching mentioned doubt about the cognition of existence and Chaung-tzu's story of a butterfly dream can be also read in the same context. Therefore, if philosophy begins with questions and doubt, Taoism should be said to be the beginning of oriental philosophy (Gi, 2007a, p. 641, 2006b). The doubt and agnosticism made by paradoxes have come to unceasingly pursue creativity based on powerful tentativeness. The aspect of the content of open innovation, that is, differences, collisions, or paradoxes between existing knowledge and new ideas ends up with new creative innovation through the agnosticism of innovation or doubt about innovation.

Chapter 2 "existence and nonexistence help each other" presents value relativism and the spirit of resistance as the direction of the entire Taoism along with the paradoxes that are posed here and there in chapter 2, that is, paradoxes of beauty and ugliness, right and wrong, and good and evil. Of course, it is true that the value relativism of Taoism does not stay with theories that both are good or both are bad but pursues creative alternatives containing the spirit of resistance. Paradoxes contain the philosophical content of open innovation as new creation.

The logical structures of chapter 3 "if a king does not govern the people artificially by force, he shall have no trouble in governing the people", chapter 7 "because they do not try to exist by themselves, they can exist for long", chapter 9 "retiring after you made contribution is the right way in the world", chapter 13 "respond to both grace and disgrace with wonder and treat great troubles as carefully as you treat your body", chapter 14 "even if you see, you cannot see, even if you hear, you cannot hear and even if you grab you cannot hold", chapter 18 "when great Tao has disappeared, humanity and justice appeared", and chapter 22 "even if a wise man does not reveal his wisdom, it will be disclosed to the world" ended up with paradoxes and creative proposals. Paradoxes are the core of all of the following logics: all things will be governed if they are not governed, that everything will be achieved by not trying to achieve it, that grace and disgrace should be responded in the same manner, that Tao is seen but you cannot see it, and that wisdom will be disclosed to the world even without trying to reveal it. The conclusion is creative knowledge, ideas, or implications that cannot be univocally expressed. This is the philosophy of paradoxes of open innovation. The addition or collision of new ideas that are contradictory to each other and different from each other are bound to bring about creative innovation.

The logics of paradoxes in Tugendlehre, such as chapter 39 “noble things originate in humble things and high things are based on low things”, chapter 41 “bright Tao looks like dark and advancing Tao looks like stepping back”, chapter 42 “strong and tough ones can never die comfortably”, chapter 45 “eloquent speeches are felt to be inarticulate”, chapter 51 “Tao gives birth to but does not own everything in the world and raises everything in the world but does not depend on it”, and chapter 63 “make plans but do not make unreasonable plans and perform works but do not perform the work consciously”, are also based on the philosophical basis to move toward creative new prepositions based on the presentation of different or contradictory prepositions. They are unreasonable contradictions between humble things and noble things, brightness and darkness, being tough and not being able to live long, eloquent speeches and inarticulate speeches, giving birth and not having, and making plans and not making plans. The conclusion presented by these paradoxes contains much more creative and vital messages than other conclusions. Open innovation of paradoxes is as such. With the addition of new ideas different from, contradictory to, or paradoxical to existing knowledge and technologies, creative outcomes of innovation different from existing ones can be achieved.

6. Conclusion

In this study, the ideological context of the logic of open innovation was reviewed, and vacancy was presented as the structure of the philosophy of open innovation and paradoxes as the content of the philosophy of open innovation based on Whitehead’s process philosophy, Deleuze’s tentativeness philosophy and Popper’s logic of open society and falsification.

In the context of a more systematic understanding of these vacancy as the structure and paradoxes as the content of open innovation, Tao Te Ching was examined with the analytic tool of the philosophy of open innovation. For an in-depth understanding of vacancy as the structure of the philosophy of open innovation and paradoxes as the content of the philosophy of open innovation, the materialistic metaphysic base of Taoism should be examined. This study identified that Taoism has quite similar reasoning structures to the structure and content of open innovation. Therefore, reading the white paper version of Tao Te Ching based on early Taoism, which is materialistic metaphysics, should be very useful as a way for business leaders, members or preliminary business founders to enhance the philosophy of open innovation and cultivate the mind for open innovation.

ACKNOWLEDGMENT
This work was supported by the DGIST R&D Program of the Minsitry of Science, ICT & Fucture Planning (13-IT, 15-IT).

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How User Entrepreneurs Succeed: The Role of Entrepreneur's Caliber and Networking Ability in Korean User Entrepreneurship

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ABSTRACT

User innovation is a new economic paradigm that is able to create a new engine for social and economic development. Furthermore, many users are not limited to their role as a user but evolve to business starters, thus becoming user entrepreneurs. This study aimed to reveal the important factors of successful user entrepreneurship by closely investigating two Korean successful user entrepreneurship cases. Based on the findings, the importance of an entrepreneur's caliber and networking ability was found. An entrepreneur's innovation ability from expert knowledge and great familiarity and experience with the business as a user coupled with strong will to entrepreneurship was the most important success factor at the early stage. In further developing the user innovation technologically and commercially, the most important factor was an entrepreneur's networking ability that can give access to complementary assets for successful development and commercialization. With this, the innovation community, composed of related users and producers, has played a crucial role in the successful entrepreneurial process.

KEY WORDS: User Innovation, User Entrepreneurship, Innovation Community, User-based Entrepreneurial Innovation, Open Innovation, User-based Open Innovation, User Network

Introduction

With the advancement of the knowledge-based society, knowledge and technology are being firmly established as important engines for new innovation and growth (Yun et al., 2011; Yun & Mohan, 2012). The market economy of the modern society is a knowledge-based economy in which both knowledge and technology act as important motives of economic growth (Burton-Jones, 2011).

In particular, new types of paradigms in the knowledge-based economy are appearing in new ways. The thought that knowledge from users or user groups is the most important source to continue innovation seems to be settled (von Hippel, 1986). Knowledge from users and user groups now serves as an essential engine for economic growth and company development (Herstatt & von Hippel, 1992). The era has come when companies are not able to sweep over the market by exclusively focusing on their own capabilities and knowledge (Morrison et al., 2000).

Firms continuously try to understand the global trends of new technology development and to introduce them to their members as promptly as possible (Choi, 2010; Kim & Zhang, 2012). In particular, firms attempt to find new technological chances and market opportunities from users and user groups (von Hippel, 1976, 1977, 1986, 1988; Franke & Shah, 2003; Chatterji & Fabrizio, 2012).

Numerous technological innovations are taking place in our daily lives in the modern society based on user-originated ideas and knowledge. User communities of important products or industries of the modern society, such as smartphones, automobiles, medicines, and everyday consumer goods, are being created in both online and off-line platforms. In such communities, new products of companies are analyzed and evaluated. At times, even the directions for new technological innovations are suggested. Companies organize and support user communities; leading companies of important industries do not hesitate to help users share their ideas and knowledge not just among themselves but also to all the members of the company. The possibility and value of user innovation in which the products and services innovations originated from users have continuously been more extensive for the complete advancement of modern society.

Most importantly, nowadays, aside from innovations that companies carry out based on user-originated ideas and knowledge, user entrepreneurship in which user or user groups do not just work as sources of innovation but also act as producers for commercial purposes is also receiving great interest from both the business and academe.

This research, which is based on the cases of two Korean user entrepreneurs, aims to investigate the concrete process of user innovation and its development into user entrepreneurship. It also aims to reveal the motives, conditions, and capabilities that have allowed user innovations to go beyond the idea stage and to progress to commercial success as well.

Coupled with two detailed cases, this study conducts deliberate literature review for user innovation and user entrepreneurship to answer the research questions set forth. The research question is to figure out key success factors for user innovator to be a successful entrepreneur and, to follow the whole pictures of process on user entrepreneurship using Korean cases. The support of the elaborated review about the related researches gives this study a sound base to suggest meaningful implications to business leaders who have interest to understand and utilize the power of user innovation and user entrepreneurship.

Literature Review and Research Framework

User Innovation

von Hippel (2005b) defines user innovation as the maximization of the efficiency of product and service consumption by the users of the current market products and services through the addition of innovation in their consumption processes. User innovation, or “lead users” innovation (von Hippel, 1986), has its’ historical roots from the science of “muddling through”

(Lindblom, 1959). This tradition has long been continued, and now it connected to a concept of "lean start-up" which is a new paradigm of launching business from active experimentation and feedback with customer and user (Blank, 2013). User firms or individual customers would at times develop or modify products for their convenience and this user innovation occupies 10–40% of the whole industry sector.

***Table 1**. User Innovation Areas and Percentage*

	Area or Industry	User Innovation Percentage/Items
Industrial Goods	CAD S/W	24.3%
	H/W	36.0%
	Library Information System	26.0%
	Surgical Equipment	22.0%
	Apartments OS Service S/W	19.1%
	Dell Idea-storm	6,270 items
	Cross-industry sample of 'High Tech' Netherlands SMEs (498 samples)	41% of development only case 34% of modification only case 54% of development or modification
Consumer Goods	Outdoor Wear	9.8%
	Extreme Sports	37.8%
	Mountain Bike	19.2%

Source: von Hippel (2005b); Di Gangi & Wasko (2009); Gault & von Hippel (2009)

With the widespread user innovation in the business field, the importance of user innovation has also been emphasized in many studies over the last 30 years (von Hippel, 1976, 1977, 1986, 1987, 1988, 2005a, 2005b; Finkelstein & von Hippel, 1979).

Technology Entrepreneurship (TE) is the trigger of commercialization of new technology and knowledge. It facilitates new creation of companies based on new technologies and knowledge, and has close relationship with user innovation because it takes users into account as important sources of knowledge (Antoncic & Prodan, 2008; Berry, 1996; Hindle & Yencken, 2004; von Hippel, 1986).

Social entrepreneurship, market transformation through technological change, and emerging technologies in emerging market also have deep relations with technology entrepreneurship and user innovation (Hu et al., 2011; Phillips, 2011; Walsh & Groen, 2010). Corporate entrepreneurship which tries to renew established organizations, also seeks to obtain new technologies and knowledge from users (Chen et al., 2014; Corbett et al, 2013). From the diverse researches and literatures, it is widely known that technology entrepreneurship accept user as one of most important sources and channels of technology and knowledge adoption.

It is not difficult or a surprise to find out many major innovations developed by users (von Hippel, 1976, 1977; Shah 2005). For example, user-generated innovation took place in various sectors, including 76% in scientific instruments, 67% in manufacturing equipment for semiconductors and other electronic parts assembly, and 60% in sporting goods. It is also not a surprise to observe considerable number of users have created innovations (Morrison et al., 2000; Franke & Shah, 2003; Franke & von Hippel, 2003; Lüthje et al., 2005; von Hippel et al., 2010). 26% of library information system users, 19% of Apache software users, and 39% of sporting goods consumers carried out innovation for individual purposes. Users also actively created innovations in a wide range and variety of industries and products (Allen, 1983; Kline & Pinch, 1996; Franz, 1999; Ferris, 2002; Chateerji & Fabrizio, 2012; Burger-Helmchen & Cohendet, 2012; Pedrosa, 2012;

Schuhmacher & Kuester, 2012; Parmentier & Gandia, 2013; Dell'Era & Landoni, 2014). For example, users have created innovations in various sectors such as automobiles, astronomy tools, medical equipment, furnaces, designs, video games, and services.

It is incontrovertible that users play a vital role in innovation. However, critics share a different view, arguing that unlike manufacturers, user innovators do not pursue economic or commercial activities. von Hippel (1988) who established the concept and theory of 'user innovation' argued that manufacturers consider user-generated innovation to have commercial value. These manufacturers elaborate the idea to introduce to the market while users who actually created innovation do not make an attempt to make the product or to grant licensing to others (von Hippel, 1988). For example, user-generated innovations in scientific instruments, such as electron microscopes and well-regulated high-voltage power supplies, were largely created by engineers and scientists in the academe. Instead of commercializing their ideas, they tend to release such innovations through publications, symposiums, and communications with other scientists and engineers (von Hippel, 1988). Innovations created in semiconductor and printed circuit board assembly processes were led by employees in user firms. These employees intend to share such innovative ideas with their equipment manufacturers and other user firms to solve the problems promptly rather than to make money.

In the past, researchers on user innovation came up with the aforementioned findings because they studied user-generated innovation mostly created by employees of user firms or engineers and scientists in the academe. Considering the opportunity cost, it is unlikely that employees with a high level of job security, as well as scientists and engineers who have a bright future in their fields, will start their own business with their innovative ideas. This is because start-up entrepreneurs need to endure high levels of risk (von Hippel, 1988; Shah & Tripsas, 2012; Shah et al., 2012)

User Entrepreneurship

Although past researchers have found that users do not have a commercial intention in many user-generated innovations, it can also be observed that in many cases, users actually do start their own business or sometimes diversify into a new business based on the innovations that they have created as a user (Newbert et al., 2006). As such, user innovations can evolve into two different cases, namely, user entrepreneurship and non-user entrepreneurship.

It was Shah and Tripsas (2007) who raised entrepreneurship issues on previous findings and started to discuss user entrepreneurs. Shah and Tripsas defined that user entrepreneurship is the commercialization of new goods and services produced by innovative user groups or individuals. They also mentioned that user entrepreneurs deal with problems in their daily lives first before starting a business and they create new products and services to solve these problems on their own. User entrepreneurs are distinct from other entrepreneurs because they earn economic benefits through commercialization. In addition, they benefit from their innovations as they use the products or services they need.

Another study conducted by Shah and Tripsas (2012) suggested that whether the business environments are favorable to user entrepreneurs or to manufacturers is dependent on the profit estimates from commercialization and the profit threshold that is critical to sustainability. They divided business environments into five areas based on two factors of profit estimates and profit thresholds and explained which areas fit better for a user entrepreneur or a manufacturer to start a business. Their study is meaningful as it can provide strategic indicators and appropriate suggestions in the decision making process for both users and manufacturers

Users as innovator, which already mentioned by Adam Smith long before, have two different roles of 'intermediate user' as innovator and 'consumer user' as innovator (Bogers et al., 2010). It means user entrepreneurship can differently evolve and grow according to the user's role, intermediate user or consumer user.

There also has mentioned high correlation between user's tendency of openness and his tendency of entrepreneurship (Chaston & Scott, 2012; Christensen et al., 2005; Johnson, 2001; Onetti et al., 2012). Thus, if a user or customer have strong tendency of pursuing 'new' knowledge for his own usage, he may also have more tendency of entrepreneurship than other users who have less will to seek new knowledge (Liu et al., 2002).

Characteristics of User Entrepreneurship: The Dispersion and Economic Performance

Let us look at the characteristics of user entrepreneurship. First, we examine the number and dispersion of user entrepreneurship in different sectors. The whole dispersion as well as the sectors or the industries that have shown a great number of user entrepreneurship can give us much information to look at the whole picture of user entrepreneurship.

According to related studies, which were conducted from 1978 to 2007, 52% of the medical equipment start-ups that have succeeded in receiving investment by leading medical equipment manufacturers were set up by doctors who are the users of the medical equipment (Shah et al., 2012). In the juvenile product industry, 84% of start-ups were established by parents, grandparents, and caregivers from 1980 to 2007 (Shah & Tripsas, 2007). In the atomic microscopy industry, the first three companies were founded by users for themselves (Mody, 2006). Also, 43% of major innovations in extreme sports industry, such as windsurfing, skateboarding, and snowboarding, were commercialized by users (Shah, 2005). It was the video game users who commercialized the very first machinima, which is the new genre of movie that has been created by applying video game technologies into movies (Haefliger et al., 2010). The aforementioned studies demonstrated a widespread user entrepreneurship and it can also be noted that many user innovations tend to be commercialized by the users themselves because they have strong expertise on the innovations. However, manufacturers could not support it enough.

The two recent working papers led by Shah and colleagues have been advanced by adding more data for user start-ups and by suggesting a theoretical framework (Shah & Tripsas, 2012; Shah et al., 2012). Shah et al. (2012) grouped user start-ups into three categories, namely, professional user entrepreneur, end user entrepreneur, and hybrid professional / end user entrepreneur. They utilized the Kauffman Firm Survey (KFS) to study each category of user start-ups and conducted a comparative analysis between user start-ups and the entire 2,408 start-ups in 2004. The data covers the demographic characteristics of user entrepreneurs (including their education, career, gender, race, and ethnicity), the characteristics of companies (including self-financing / external financing), the amount of investment into R&D, earnings growth, job creation, and the outcomes in intellectual property. Their study is significant as it covers the quantified characteristics of user start-ups in earnest.

Considering the overall economic performance of user start-ups, according to Shah et al. (2012), 10.7% of all start-ups and 46.6% of all innovative start-ups established in 2004 were founded by users. In line with this, user start-ups survived for more than five years. In terms of venture capital investment, 4% of the user start-ups have succeeded in getting investment through venture capital, while only 1.1% of whole start-ups and 3.7% of non-user innovative start-ups could succeed in gathering investment. The number demonstrates that user start-ups are widely spread in many industries and they generate higher economic outcomes compared to other types of start-ups. This means that it is worthwhile to study user start-ups more thoroughly as they are more likely to succeed and contribute to the economy by creating new businesses and by revitalizing the current industries.

Process of Commercialization of User Innovation

Commercialization and transfer of technology and innovation, from laboratories in academe and government to industries, has only met a fraction of its underlying potential (Linton & Walsh, 2008). Originally, users innovate for their own usage. But if a lead user has a chance to let others to use his own innovations, he can move further to commercialize his own innovations in the related industries (Di Gangi & Wasko, 2009; Morrison et al., 2000; von Hippel, 2005a).

Traditionally, technology commercialization had 3 approaches; internal approach, quasi-internal approach, and external approach (Markman et al., 2008). Original technology commercialization is traditionally based on internal approach. Whereas, user innovation usually has both aspects of quasi-internal approach and external approach together. Thus, lead user entrepreneur commercialization process, that has quasi internal and external approaches, can be contrasted to traditional original technology commercialization process (Franke et al., 2006).

Companies develop their products by probing potential markets with early versions of the products, learning from the probes and crossing the chasm between early user and early majority (Lynn et al., 1996; Moore, 1993). This is a typical process of commercialization based on user originated knowledge and innovation. Commercialization process is a kind of diffusion process by which an innovation is communicated through certain channels over time among the members of a social system including users (Rogers, 2010).

There has been a close observation on the process of commercialization through a specific case study of user start-ups. Lettl and Gemünden (2005) selected five radical innovation cases on medical technologies in Germany to inspect the process of commercialization of user innovation. They defined the entrepreneurial role of users in the process of commercialization and suggested the four prerequisites of users to play the role. Those include 1) high problem pressure, 2) user as inventor, 3) high degree of innovativeness, and 4) missing competencies and resources that give them the necessity of networking. User entrepreneurs actively engage in establishing networking with communities, universities, public and private institutions, relevant manufacturers, venture capital, and other subcontractors in order to achieve necessary competencies and resources, including technology, marketing, finance, human capital, infrastructure, and sales network. These findings demonstrate that successful commercialization of user innovation and successful user entrepreneurship need to have the user's innovative and networking abilities that enable the acquisition of necessary complementary assets.

The study conducted by Haefliger et al. (2010) emphasized the importance of complementary assets for user entrepreneurs. In this case, innovations generated by lead users in the game industry were applied to the movie industry, which is very much different. The major success factors they pointed out were the ability to acquire complementary assets, ability to combine video games and machinima art technology with the moviemaking process, and the ability to resolve intellectual property issues. The ability to combine existing knowledge with brand new knowledge and the ability to resolve intellectual property issues can be included in the ability to acquire complementary assets.

von Hippel (2005b) also notified the importance of networking ability and innovation community as essential instruments for networking. He defined innovation community as a community that is composed of users or manufacturers as its members and contributors who transfer and combine the information necessary for innovation. In other words, he defines the innovation community as the community that supports user innovation with the participation of producers and users. To put it simply, user innovation can be connected to each other with users and producers through the innovation community (Di Gangi & Wasko, 2009).

Although there are many related researches, such as the aforementioned, studies on user innovation and user entrepreneurship are still in their early stage. Except for the study of Lettl and Gemünden (2005) and Haefliger et al.

(2010), there are few studies on user start-ups that covered the actual process of successful user entrepreneurship and how it thrives. This study aims to discover the details of Korean user start-ups and its success process. It focuses on two main success factors of user start-ups. One is the user's ability (problem recognition ability, innovativeness, ability as an inventor, and abundant experiences), and the other is the ability to acquire complementary assets, which can also be expressed as networking ability.

Research Framework: Scope and Methods

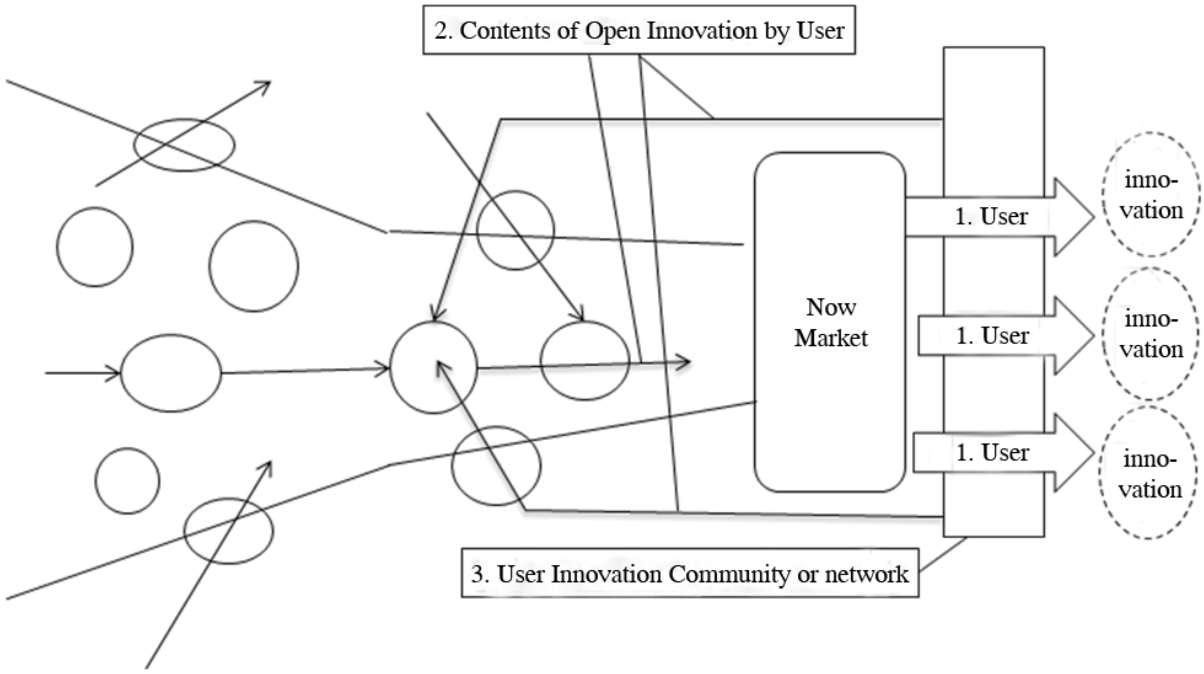

Figure 1. Analytical Framework of the Study

As shown in Figure 1, the analytical targets of this research are composed of 1) the *user* who is the principal subject and origin of entrepreneurial innovation, 2) the *contents* of user-based entrepreneurial innovation, and 3) the *user community and network* that systemize the process of the users to be connected to the innovation and the acquisition of complementary assets.

First, the roles and functions of the users as the subjects of entrepreneurial innovation and the characteristics of the leading class of user innovation need to be analyzed (Christensen, 1997; Nonaka & Konno, 1995). The reason why users do not just stay as the sources of innovative ideas but present themselves as the subjects of new entrepreneurial innovation, the conditions of the users who can lead this innovation, and the success factors of this user-based entrepreneurial innovation were the major targets of the analysis (Henkel, 2006).

Second, the specific contents of user-based entrepreneurial innovation were the targets of the analysis in this case study. The motives of conversion from user purpose to entrepreneurial purpose and the characteristics and advantages of the user-based entrepreneurial innovation were also analyzed (West & Gallagher, 2006).

Third, the role of the innovation community and user network in which the users do not just settle on their user innovation but systematically convert themselves as the subjects of entrepreneurial innovation for commercial purpose were studied (Lynn et al., 1996; Keinz & Prügl, 2010; Konsti-Laakso et al. 2012; Bogers & West, 2012). The group of users that produce the innovative products in the innovation community can be directed by the lead users to create various user innovations and entrepreneurial results. By examining the existence, role, operation methods, and contents of the user community in the user-based entrepreneurial innovation, the reality of user-based innovation and entrepreneurship can be more clearly understood.

This study limited its research scope to analyze the two cases of user-based entrepreneurial innovations in Korea. It is because the purpose of the study is to examine and understand thoroughly the specific process and the characteristics of user-based entrepreneurial innovation and to acquire useful implications by studying the representative Korean cases genuinely. For user-based entrepreneurial innovation cases, the analytical targets of this study, two representative Korean SMEs that succeeded in acquiring global competitiveness and are now maintaining their position, were selected.

In-depth interviews were basically used as the main research method. A total of four interviews in each firm were executed. Interviews were conducted three times with the core R&D manager of the analytical target company and once with the CEO of the company. Furthermore, the level and characteristics of entrepreneurial innovation of the companies were surveyed in advance through the questionnaire survey on the status of entrepreneurial innovation of each company. The specific contents of the study were also supplemented with additional data obtained through the secondary data survey, such as literature and the press release of relevant companies and the industry groups.

Case Study

MegaGen Implant Co., Ltd.

MegaGen Co., Ltd. is a specialized implant company established in 2002 as the sixth domestic implant company. The company has a total of 250 employees with 30 of them engaged in research work. The head office is located in Gyeonsan City, Gyeongbuk Province. This company organized Mir Dental Network, which has 20 dental hospitals as members in Korea and foreign subsidiaries in Qingdao, China, and Europe. At present, MegaGen Implant is acknowledged as the company that continuously produces the most innovative new implant products in the world with a sales increase of more than 100% every year.

User

User innovation will be analyzed through the entrepreneurship motivation and process of Chairman Kwang Bum Park who established MegaGen Implant. Chairman Park has the experience in operating Park Kwang Bum Dentistry and Gawoojeong Dentistry before establishing MegaGen Implant. In the process, he accumulated his long experience in user innovation as the user of implants in his position as a dentist. As a user, when he found something unsatisfactory in the implants imported from foreign countries and could not carry out the innovation for himself in the application process of the products to his patients, he immediately requested for the supplementation of the products to foreign manufacturers by suggesting his innovative ideas.

In addition, Chairman Park systematically accumulated his knowledge on the problems and improvements of using the implants every month through a study group between himself and other dentists. When all the implants were imported without any domestic production, he actually had experienced being rejected when he continuously suggested innovation to manufacturers by collecting opinions through a case presentation of many questions or modifications raised by him or his colleagues when they were using the implants.

In the meantime, the price of the implant soared after the foreign exchange crisis, making the price of implant parts increase by about USD $700–800. Accordingly, the conditions for the inception of a user-based open innovation business became ripe when the requests for user innovation were continuously rejected in the situation in which the price competitiveness of foreign products rapidly decreased. However, Chairman Park only had medical knowledge and innovative ideas for the implants and he had no sufficient knowledge on the manufacturing technology for implants. Nevertheless, he was fortunately connected to an engineer who was suitable for his requirements and expectations and was able to register MegaGen Implant on January 3, 2001 with his clinical skills and the manufacturing technologies of the engineer.

While consistently providing MegaGen Implant with users' innovative ideas, he also succeeded in establishing Mir Dental Network throughout the entire country, including Daegu-Gyeongbuk and Jeonnam-Gwangju to secure a stable number of implant users. Until today, the new products of MegaGen Implant were based on the ideas and innovation requests of Chairman Park who is also a dentist of the Mir Dental Network. New innovative ideas were created and diffused with their specific process of treatments to patients.

Contents of Entrepreneurial Innovation by User

The specific case of user-based entrepreneurial innovation includes the case of artificial bone development as shown in Figure 2. Artificial bones were developed to make implant operation possible by supplementing the bones of those who cannot undergo implant treatment because of the thin and weak bones in their jaws and gums. This idea was suggested by Chairman Park himself who had worked with the elderly. In order to develop new products that could realize his innovative ideas, he even let his R&D director attend graduate school to study the area of implants and to acquire knowledge on the process of bone development specifically in relation to inorganic materials. At present, he has three domestic patents related to artificial bones. Two of them have been developed using his own technical capability and one has been applied jointly with POSTECH. He is also applying for foreign patents related to artificial bones. The development of artificial bones is the result of typical user-based open innovation developed through the idea of Chairman Park. As such, he has sent another researcher to graduate school to acquire external ideas and have additional joint research with POSTECH.

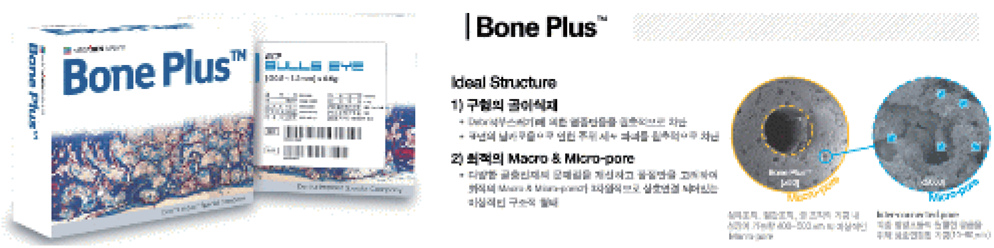

Figure 2. Artificial Bones of MegaGen Implant

Second, most implant manufacturers use the method of widening or roughening to make the implant surface easily attachable to the bones. However, Chairman Park and other Mir Dental Network dentists discovered many times that this implant has a decisive defect of easy exfoliation caused by the great thickness of its surface layer. As an alternative to overcome this problem, Chairman Park directly raised the necessity and requested the company's research team to develop active substances. Through the continuous process of discussion with Chairman Park, the research team succeeded in developing 'Biostimulators' by forcefully injecting calcium ions into the existing technology of the Hydroxyapatite (HA)[1] coating method. In order to utilize external technologies necessary for this development process, the research goal was achieved more promptly and efficiently through joint research with Professor Jin-woo Park of Kyungpook National University. As for the development process of this case, the source of the idea was Chairman Park himself who requested the research of the surface treatment to Professor Jin-woo Park. In line with this, Professor Jin-woo Park developed the new products through joint research with MegaGen Implant. At present, the relevant patents are being jointly applied and the new products are released in the market. In this case of development, user-based open innovation combined with the user innovation idea of Chairman Park, the research capability of the external company, and the research team of the company is also being realized.

Third, the development of large-diameter implants ('Rescue®') can be cited. During his dental treatment process, Chairman Park acknowledged the necessity of new implant innovation for patients who are not suitable for implant operation because of the poor quality of their bones and suggested innovative ideas to solve the problem. The suggestion of user innovation by Chairman Park was immediately connected to the independent research of the MegaGen Implant research team. The technology of a large-diameter implant, which was developed as a one-of-a-kind technology in the world and was connected to the production of new innovative products, changed the concept of the implant. Existing implants have long and narrow shapes, but these large-diameter implants have thick and short shapes, which can be considered as completely new products that have transformed the concept of existing implants. As shown in Figure 3, large-diameter implants have an external type in which teeth exposed outside are externally wound up and an internal type in which they are internally wound up. This is also the result of product development differentiated by the user innovation motives of Chairman Park generated in his patient treatment process. This status of this technology in terms of attaining domestic and foreign patents is pending.

External Type Internal Type

Figure 3. Large-diameter Implant

Innovation Community and Network

MegaGen Implant operates an innovation network to obtain user innovation ideas directly and systematically from dentists and to connect them to new product development. This is called the 'Mir Network' (http://www.mirnetwork.com) in which there are 19 Mir dental hospitals throughout the country that serve as members. It is a network in which knowledge, experiences, and management concepts are shared with other clinics and managements trying to provide patient-focused clinical and managing services that give an end the concept of existing supplier-focused hospital service. Mir Network tries to share clinical research and management knowledge through various conferences and seminars even with the dental hospitals outside of the boundary of Mir Network for much broader development. In particular, the mutual sharing and suggestions of various ideas and knowledge are the major sources of new product development by MegaGen Implant.

In fact, new innovative ideas related to implants do not automatically come from the dentists themselves. New user innovation ideas are suggested and realized through accumulated experiences and mutual exchanges of opinion. In the case of Mir

[2]Hydroxyapatite (HA) is a biostimulating ceramic that is used in powder form as a metal coating material in the medical field with a structure, and its main component is similar to that of human bones or teeth. With its excellent biocompatibility, it has the advantage of making the implant in the bones or skin easily assimilated into the surrounding biostructures.

Network, the participating dentists started to gather implant research from 1990 and they are trained to suggest user innovation ideas through the accumulation of their long experiences. The study gathering has been regularly held once a month where the ideas about the treatment and products have been stated and discussed through seminars and many others. These activities organize the basis of the current Mir Network.

In addition, MegaGen Implant is open to new ideas suggested by Mir Network, establishing the system and internal practice so that they can be reified promptly through tests and experiments. In other words, MegaGen Implant has an organizational and cultural system in which the users' innovative ideas can be directly connected to the development of new products.

Moreover, MegaGen Implant operates an exclusive unique network organization related to the internal innovation of the company, which is called the MegaGen Conference. In this MegaGen Conference, which is annually held with the participation of all members who have innovative ideas as well as research members of the company, innovation success cases are presented and discussed by the team unit. Through this conference, innovative motives can be shown to the research department and production department so that these departments are able to gain a positive outlook toward new ideas and innovative suggestions from users. The MegaGen Conference is a place to present various companies that are both inside and outside open innovation activities, such as performance presentation by task force unit composed during new product development with the participation of an internal and an external workforce, presentation of innovation results by the dentists separately appointed as the external advisory members, and holding of workshops for the industry–university consortium in the case of the bio industry and presentation of results.

Disec Co., Ltd.

Located in Gumi, Gyeongsangbuk-do, Disec Co. was established in 2004 and is expanding its new product business boundary to manufacturing silicon plates for solar cells and solar cell devices after starting as a company that produces ceramic parts for semiconductors / LCD processing equipment. In 2008, the company's total sales amounted to USD $5 million and it has nine R&D employees among its thirty employees in total. At present, only six employees are working in the company's research team because of the company's system in which the researchers directly follow up the stages of commercialization and production when R&D is successfully conducted and will return only after the technology is stabilized. This company originally started as a secondary vendor in the field of ceramic parts for LCD processing equipment, having Samsung Electronics, Hynix, and Dell Japan as its major clients.

The band saw method, which is the existing silicon ingot cutting method, only allows cutting one at a time according to certain specifications. Therefore, Disec had to cut silicon ingot at least eight times to make 25 silicon bricks, cutting only two ingots a day with 10 hours of working time a day. On the contrary, in the case of the Diamond Endless Multiwire Saw, which is the result of user-based open innovation wherein Disec independently innovated the device as the user and became the manufacturer of the device, Disec could cut the length and breadth of the ingot at the same time within two hours and the price of the device was only USD $600,000, which lessened the inefficiency of the existing machine. To solve the problem of the disconnection of thin wires, diamond beads are inserted between the wires, making its 'endless' characteristic possible. It adopts the principle in which all rollers can operate when tension is applied to each roller to make it operate like a belt system, cutting the inorganic materials as they pass.

User

The president of Disec is an ordinary engineer who studied mechanical engineering in a university and majored in ceramics in graduate school. He worked for a company called Shinhan Diamond, which processes diamond tools for a long time. Because diamond tools are actually used in ceramic processing, he naturally developed an interest in ceramics and considered it his specialty. While working as a factory manager and director in a ceramic-related company called Worldex until just before starting his own company, he came to possess 'technical connectivity in the ceramic field'.

When he experienced a breakage of an expensive cutting device and the decrease of efficiency in the process of using a ceramic cutting device, he recognized the necessity of innovation in these cutting devices. Therefore, using his vast experience and knowledge accumulated in the ceramic field, he presented himself with user-based open innovation in which he himself innovates and manufactures the device. In other words, the company advanced to user-based open innovation in the solar cell device business after starting from the business of ceramic parts for semiconductors / LCD processing equipment. At present, the company has stepped forward to engage in the business of manufacturing silicon plates for solar cells. This process of innovation is the process of the business boundary being extended to user-based open innovation through the addition of the innovation necessity of the president as a user and his existing ideas and knowledge accumulation.

Content of Entrepreneurial Innovation by User

While the solar energy-related industry is rapidly developing, there is one technology developed and solely owned by Disec and this is a silicon cutting technology called 'Diamond Endless Multiwire Saw', which received NET New Technology Certification.[2]

The products mostly used by Disec are made of inorganic materials, such as ceramics. In particular, silicon is very much used in its semiconductor devices. This company used to cut silicon ingots in its operation, but existing products were not suitable for use after cutting according to the desired specifications. The price of the cutting device with the band saw concept used for existing silicon cutting was approximately USD $1 million, but its efficiency was very low compared to its price and working time of only 10 hours a day. In order to solve this problem, the company started to develop new devices for itself and to refrain from ordering from other companies outside.

In the beginning, they had the biggest difficulty in making the thin wires 'endless' because the thin wires used to be disconnected in the cutting process. The result of successful R&D for five years is the 'Diamond Endless Multiwire Saw' as shown in Figure 4.

Figure 4. Diamond Endless Multiwire Saw

About USD $4 million was invested to develop the product, which was beyond the capacity of small- and medium-sized

[3]A system conducted by the Ministry of Science, ICT and Future Planning and the Korea Industrial Technology Association to discover new technologies developed by domestic companies, research institutions, and universities to promote the commercialization and technical trade of new technologies by assuring the reliability, thus preparing the basis for their early advancement into the market.

companies. The cost for technical verification also proved to be high because USD $100,000 was needed for the actual cutting of single silicon ingot (830 t x 830 t x 250 t). As silicon ingot was very expensive, the technology of the wire saw was verified through many trials and errors by conducting experiments on the wire with silicon ingot made by Disec itself with the defected silicon that the company had purchased. Experiencing the process, which would have been abandoned without the strong will of the company's president as the user and the concentration of all its employees, is the core success factor of this user-based open innovation process. In fact, they had intended to manufacture the efficient silicon cutting device, which could be used in the company. However, with the advancement of the solar energy industry, they tried to apply the device to solar energy and to improve it to make it suitable for the solar energy industry. They succeeded in manufacturing the new products for themselves, accomplishing user-based open innovation.

Innovation Community and Network

While carrying out the national task enforced by the Korea Energy Management Corporation in 2006, Disec started to develop the Wafer to settle the necessity of innovation for its silicon ingot cutting device. This development task was jointly conducted with Professor Yeong-rang Kim of University of Incheon who had once engaged in the Siltron development-related field. Through this joint research, cutting device technology was developed and secured technology was connected to two cases of joint patent application.

Disec is currently carrying out joint research tasks in the solar cell area with Gumi Electronics and the Information Technology Research Institute. It is also jointly conducting LCD ceramic-related research with Kumoh National Institute of Technology. Through these processes of joint research, Disec could accumulate the technology for prototypes through open innovation, which started from user innovation. In fact, the company is currently in the stage in which Wafer production is available only if additional capital can be secured.

Disec is actively participating in various academic societies and conferences, as well as actively carrying out exchange activities with academic organizations, such as the Korean Society for Precision Engineering, the Korean Ceramic Society, and the Korean Institute of Chemical Engineers. In addition, the company is also expanding its cooperation and collaboration with local universities through activities, such as reinforcing company education by inviting local university professors with regard to technology. Recently, the company does not fail to secure cutting-edge technologies from Japanese companies in the same line of business.

Disec also does not neglect various types of new collaborative research, such as joint research with domestic researchers through government research tasks, societal activities, connection with local universities, and cooperative activities with government-funded institutes. These innovation networks served as the motives for Disec to strengthen its capabilities with open innovation in which new products are manufactured inside the company and not through merely staying at the device innovation stage as a user.

Conclusion

Findings from the Study

Through the study, the most important deciding factor and motive of the entrepreneurial process can be confirmed as entrepreneur's networking ability through innovation community, in which user innovation is connected and opened to both users and producers for further cultivation and development in both the technological and commercial aspects. The user entrepreneur's caliber also played an essential role to make the whole entrepreneurial process successful. The major findings from the study can be summarized as follows.

First, user entrepreneurship can start only when the user has both the innovation ability and strong will as an entrepreneur.

Entrepreneurs' basic caliber and innovation ability that come from their technological capability as an expert and their long experience as a user coupled with their strong entrepreneurial will can be a sound ground for successful user entrepreneurship. The president of MegaGen Implant has identified the necessity of innovation as a long-time implant user and has found the direction for further development based on his knowledge as an expert and long experience as a user. He has suggested specific targets of implant innovation and cultivated and shared it with his colleagues in the implant user community. By strongly showing the vision for new businesses and by inspiring the colleagues in the implant user community, they could go beyond being mere users who just give suggestions to the incumbent producers. With this, they have finally become entrepreneurs who seek commercial success for themselves. In case of Disec, the president could step forward from a simple user to a device producer because he has accumulated enough experience and knowledge as a user in the related fields. Considering that he already accumulated related knowledge and experience as a user, he could suggest improvement ideas for silicon cutting device. Based on his knowledge and experience, he could be a successful user entrepreneur in the silicon-related and diamond cutting field.

Second, the user's networking ability through innovation community performed an essential role in developing entrepreneurship, thereby adding the success to the business. User entrepreneurship requires knowledge and capabilities from the outside that can lead the entrepreneurship to commercial and technological success. From the early stage, although user entrepreneurs usually have strong innovation ability and strong will for new business, they also usually lack complementary assets that are essential for further technological development and commercial success. Through the entrepreneur's networking ability and innovation community, which consist of related users and producers, user entrepreneurship can be supplied with important complementary assets and can be further developed to be commercially successful. In the case of MegaGen Implant, new ideas and knowledge necessary for user entrepreneurship could be consistently secured through Mir Network, a user network of implant using dentist. Mir Network played the role of a strong innovation application target, which applies new innovation and provides feedback from the application result. Most importantly, Mir Network has served as the first marketable customer group, to which MegaGen can sell its innovative implant products. Disec also concentrated on securing the ideas and knowledge necessary for the ongoing innovation through the joint research and network with external knowledge providers, such as universities, government-funded research institutes, and academic societies.

Third, to encourage network performance in the innovation community and to ensure user entrepreneur's innovation ability gets further developed, user entrepreneurs carried out ongoing efforts to R&D and innovation activity. For example, strong, open-minded, and creative R&D groups in the company, which can connect user innovation to the external innovation community, were always maintained for such purpose. In MegaGen Implant, strong and active R&D groups were maintained, which aggressively carried out new product development and demonstrated their creative innovation results outside every year through MegaGen Conference. In Disec, a research group composed of a small number of employees did exist, which concentrated in new product development. They focused on the overall process of new product development to check whether new product is in accordance with the innovation request and standard that is given directly from the president of Disec as a user. This research group has led the strong innovation in connection with the president as a user who did not hesitate to invest USD $5 million for new product development although the company still belongs to the category of small and medium sized companies.

Implications and Future Research

User innovation and user entrepreneurship have different aspects in contrast to traditional technology commercialization. Original technology commercialization traditionally had internal approach, while user entrepreneurship usually has quasi-internal or external approach (Markman et al., 2008; Franke et al., 2006).

Through the cases, we have observed how a user evolves from a mere user to a 'user innovator', to a 'user entrepreneur', and to finally an active 'founder of innovation ground' for new innovations on the base of user community. In the whole evolutionary process of user entrepreneurship, user's basic capability and his networking ability have played essential roles.

User innovation and user entrepreneurship suggest new paradigms of technological and commercial innovation and economic development. It also suggests new paradigms related to product development, business commencement, and innovations both to the companies as existing intermediate users and to consumers as the final product users. It has its own characteristics and advantages because innovations are not from the current producers but from users who have much more familiarity to the product and services. Many cases of successful user entrepreneurship can be seen in which users have started their own business based on their knowledge as experts and great familiarity and experience with the business as users. This study closely investigated the complete entrepreneurial process of two successful Korean user entrepreneurs. For the findings, both the entrepreneur's caliber and networking ability have been found to be most important. Entrepreneur's caliber includes both the entrepreneur's innovation ability and his strong will for entrepreneurship. Entrepreneurs' innovation ability usually comes from their knowledge as experts or great familiarity and experience with the business as users. Although entrepreneurs' innovation ability and their will for start-ups can be sound ground for successful user entrepreneurship, user entrepreneurs can hardly succeed without their networking ability, because without it, they could not be supplied with essential complementary assets for further development and commercial success from the outside. The existence of an innovation community composed of related users and producers can be the best source of ongoing user innovation and successful user entrepreneurship.

Societies and governments that want to be fuelled with new technological and economic development from user innovation and user entrepreneurship can support the emergence and development of such innovation community through diverse methods. Also, to encourage the entrepreneurial spirit of potential user entrepreneurs, policies must be made to lower the risk of failure.

This study has contributed in focusing on the whole entrepreneurship process of successful user entrepreneurship in Korea. Through a close and deliberate investigation, the importance of an entrepreneur's caliber and networking ability has been revealed. Deliberate literature review on user innovation and user entrepreneurship has strengthened the validity of the study. With only few researches focused on real-world user entrepreneurial process, it is expected that this research can give meaningful implications to both the practitioners and policy makers. For future research, if more cases of user entrepreneurship in different industries can be searched, it can give more generalizations to the results. The studies for the effects of governmental policy to support user innovation and user entrepreneurship can be another stream for further research.

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A study on the dynamics of platform business models

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Abstract

The purpose of this paper is to analyze the dynamics of platform business models. As such, it intends to answer the following research questions: 1) What kinds of factors and structures affect the dynamics of platform business models? and 2) How about the dynamics of platform business models in the App Store and hotel booking industries?

To answer the aforementioned research questions, this study analyzed two firms—Google Play (Android market) and Apple's App Store—in the platform business model industry. This research also analyzed two firms—Hotels.com and Booking.com—in the hotel booking platform business model industry.

To gather the needed data, this study combined and used interview methods, brainstorming, literature reviews, and simulation. Based on the interview and literature review, simulation models were subsequently developed. The simulation models were facilitated through brainstorming and interviews, and subsequently received validation. The additional simulations were introduced to select future strategies for weak firms, and these were validated through a comparison of the interview and literature reviews.

First, this study found that platform business models have three category factors: a supplier open innovation platform, a customer open business model platform, and characteristics of industries that belong. Second, in

accordance with the openness of platforms between firms in the same industry or industries, we found that the dynamics of platform business models differ from each other.

According to our simulation, Google's Android market will be able to follow Apple's App Store market if it would be able to close its customer business model platform. However, Hotels.com would survive longer than its current state and eventually come up as a winner against Booking.com if it fully opens up a customer business model platform that is similar to Booking.com's platform.

For the purposes of this research, the study was restricted to the Korean market. As such, future studies should focus on the world market and research global factors to facilitate our simulation models.

Key words: Platform business model, open innovation, open business model, system dynamics

1. Introduction

1.1. Research question

The purpose of this paper is to analyze the dynamics of platform business models. As such, it intended to answer the following research questions:

1) What kinds of factors and structures affect the dynamics of platform business models?
2) How about the dynamics of platform business models in the App Store and hotel booking industries?

More specifically:

1) Why did Hotels.com grow so quickly as a business?
2) How did Booking.com follow Hotels.com success?
3) Why did Apple's App Store become successful quickly?
4) How did the Android market catch up to the App Store's popularity?
5) Why did the App Store become more successful than the Android market in terms of paid apps?

1.2. Research scope and method

This research analyzed two firms—Google Play (Android market) and Apple's App Store—in the platform business model industry. Also, this research analyzed two firms—Hotels.com and Booking.com—in the hotel booking platform business model industry. With the Korean market as the location boundary of this study, the app store industry such as Apple and Google as well as the online/mobile hotel booking industry as represented by Hotels.com and Booking.com were examined in regards to the Korean market, even though their markets are global.

This study combined and used interview methods, brainstorming, literature reviews, and simulation to gather data. Based on the interview and literature review, simulation models were developed. The simulation models were facilitated by brainstorming and interviews, which were subsequently validated. The additional simulations were subsequently introduced to select future strategies for weak, and these simulations received validation through a comparison of the interview and literature reviews. For this study, six app development firms and six hotels were interviewed. <Appendix 1> shows the interview lists and the half-structured questionnaire that were used in this study.

2. Literature review and research framework

2.1. Literature review

The question of whether providing a new technology to secondary developers stimulates innovation is central to public policy and firm strategies in many high-tech industries (Boudreau 2007). However, there is scant systematic evidence on this situation, wherein a kind of platform for open innovation or supplier innovation exists (Chesbrough 2003; Lyons et al. 2012). Platforms provide an architecture to combine internal and external innovations in ways that create value throughout the chain of activities that deliver useful technology to the market (Chesbrough 2003). In addition, within the networked world, firms are recognizing the power of the Internet as a platform that can co-create value with customers (Sawhney et al. 2005).

Many high-tech industries offer products or services that can be described as systems of interdependent components built around or on top of "platforms" (Gawer and Henderson 2007). Because of this, the behavior of platform owners toward other firms in the ecosystem was subject to much scrutiny. There are two fundamentally distinct approaches to the opening of a technology platform and their different kinds of impact on innovation (Boudreau 2010). One kind of impact is granting access to a platform and thereby opening up markets for complementary components around the platform. The other kind of impact is giving up control over the platform. When a technology system continues to innovate after it was opened, a new trade-off, which might be referred to as "diversity versus control," will occur (West 2003). Indeed, drawing on external knowledge has been one of the more persuasive arguments for opening innovation (Chesbrough 2003; von Hippel 2005).

Leading platform owners have strongly focused on attracting and tying external complementors to their platforms. As such, these complementors apply several distinct types of control mechanisms along their external innovation process, including the following: a) market regulative control, b) co-regulative control, c) restrictive control, d) sanctional control, e) motivational control, and f) informative control (Scholten and Scholten 2012). These control mechanisms can be applied at dedicated phases of the platform-based innovation process in order to steer external complementary innovational efforts on top of the platform. Basically, we make platform innovation drive the enterprise growth (Meyer and Mugge 2001). Several software platforms, such as smartphone app stores or hotel booking platforms, drive innovation and transform industries (Evans et al. 2006).

We also looked into previous studies with regard to hotel booking platforms. One study characterized online reviews for small and medium hotels in Portugal. This paper collected and analyzed 1,500 online reviews for 50 small and medium hotels. It found several key factors that appear on online reviews about hotels (Chaves et al. 2012). One case study of the online hotel market claimed that online travel agents (OTAs), such as Booking.com, play an important role in building hotel reputation. Moreover, these OTAs encourage hoteliers to exert effort in the quality of their service. This shows that information supplied by past guests through OTAs generate a price premium for hotels with good reputations. Information gleaned from customer reviews is of great interest to both companies and consumers as it is usually presented in the form of unstructured free-text. As such, automatically extracting and rating user opinions about a product is a challenging task (de Albornoz et al. 2011). The electronic distribution of room information, prices, and availability has changed the channels that people use to reserve hotel rooms, from travel agents and hotel chains' call centers to using online booking platforms (Carroll and Siguaw

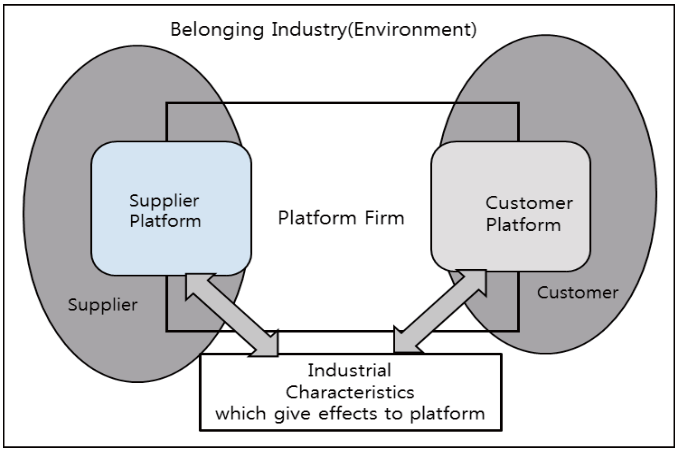
2003; Tso and Law 2005).

Studies on smartphone app store platforms were also reviewed. Application distribution platforms or app stores, such as Google Play or Apple's App Store, allow developers and users to submit feedback to downloaded applications in the form of ratings and reviews. A study investigated how and when users provide feedback, inspected the feedback content, and analyzed its impact on the user community by analyzing over one million reviews from Apple's App Store (Pagano and Maalej 2013). Software vendors lack the perspective to develop software within a software ecosystem. The inability to function in a software ecosystem has already led to the demise of many software vendors, leading to loss of competition, intellectual property, and eventually, jobs in the software industry (Jansen et al. 2009). Mobile application stores have revolutionized software and content delivery in that these stores focus on applications, building around them an ecosystem of developers and consumers (Cuadrado and Dueñas 2012). The App Store disallows platform customizability and applications that overlap with existing functions are rejected. At the other end of the spectrum—the Android store—base platform functions (e.g., keyboard, authentication) can be replaced by market applications. Recent years have witnessed incredible popularity and adoption of smartphones and mobile devices, which is accompanied by a large amount and a wide variety of feature-rich smartphone applications (Zhou et al. 2012). For example, a number of third-party alternative marketplaces have also been created to host thousands of apps (e.g., to meet regional or localization needs). Even though some portion of the mobile app explosion can be understood by software reuse in the Android mobile app market along two dimensions—reuse by inheritance and class reuse—a more significant portion should come from the platform attribute (Ruiz et al. 2012).

2.2 Research framework

This work builds on the research framework shown in <Figure 1>. Platform firms generally have a supplier platform, a customer platform, and industrial characteristics. A supplier platform opens them to a supplier wherein the supplier and platform firm interact to innovate at such point. Thus, a supplier platform triggers supplier-based open innovation or supplier open innovation (Gassmann 2006; Gassmann et al. 2010). Customer platforms open up their business model to other firms. As such, customer platforms are similar to open business models (Chesbrough 2010; Chesbrough 2012; Chesbrough 2013). Open business models allow ideas to travel from invention to commercialization through at least two different companies and not just through a hosting company. There are several platforms that have different characteristics in accordance with the industry it belongs to (Carroll and Siguaw 2003; Cuadrado and Dueñas 2012; Pagano and Maalej 2013; Yacouel and Fleischer 2012).

From the research framework, we built basic components for the dynamic models of a hotel booking platform and a smartphone app store platform: the supplier platform, which is a kind of supplier open innovation platform with an openness from low to high levels; the customer platform, which is a kind of open business model platform with an openness from low to high levels; and industrial characteristics, which should be concretely found in the industry.



<Figure 1> Structure of platform firm

3. Causal loop model building

3.1. Basic causal relationship models of BM and OI platform dynamics

The basic causal relationship models of BM and OI platform dynamics of <Figure 2> have three parts: a decision, supplier, and user. The decision part has the following: a) open innovation (OI) / closed innovation (CI) decision, b) open business model (OBM) / half-open business model (HBM) / closed business model (CBM) decision, c) openness to suppliers, and d) openness to customer (user). On the other hand, the supplier part has the following: a) # of supplier, b) percentage of verified supplier, c) # of app and service, and d) quality of app and service. Meanwhile, the user part only has a) # of user. The revenue part has a) revenue collectivity, b) # of total transaction, c) # of verified transaction, and d) sales of platform. The platform part has a) system quality of platform, b) investment into platform, and c) overall value of platform.

There will be a balancing loop in a) “open to supplier” and “percentage-verified suppliers” and b) “open to supplier,” “open to user,” and “revenue collectability.” It means that OI and OBM can have a balancing loop in these two parts. OI and OBM are not always the best answer and they depend on situations.

We see here that 1) the OI/CI decision is about openness to the supplier side, while 2) the OBM/HBM/CBM decision is open to the customer (user) side. The left part of the causal model is a supplier side that includes a) OI/CI decision, b) openness to suppliers, c) # of supplier, d) percentage of verified supplier, e) # of app and services, and f) quality of app and services. Meanwhile, the right part of the causal model is a user side that includes a) OBM/HBM/CBM decision, b) openness to customer, c) # of user (user size), and d) revenue collectability. The middle part of the causal model is a platform side that includes a) # of total transactions, b) # of verified transactions, c) sales of platform, d) investment into platform, e) system quality of platform, and f) overall value of platform.

At first, we looked into Apple’s App Store and the Android market case of the “supplier side” OI/CI decision in the causal loop model. Apple’s App Store and Google Play’s Android market have the same level of openness to users, but they have different levels in openness to the supplier (Pagano and Maalej 2013).

[Apple’s App Store]

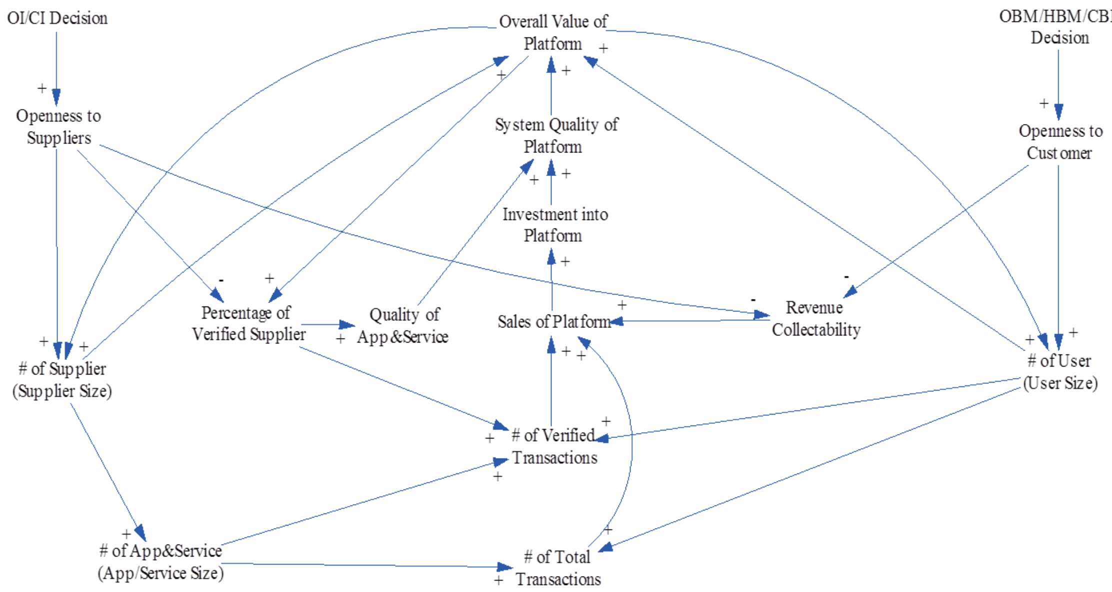
1) Disadvantage in # of App: CI → openness to suppliers ↓ → # of Supplier ↓ → # of App ↓

2) Advantage in # of Quality of App: CI → Percentage of Verified Suppliers ↑ → Quality of App ↑

[Google Play's Android market]

1) Advantage in # of App: OI → openness to suppliers ↑ → # of Supplier ↑ → # of App ↑

2) Disadvantage in # of Quality of App: CI → Percentage of Verified Suppliers ↓ → Quality of App ↓



<Figure 2> Basic causal relationship model of BM and OI platform dynamics

If a firm chooses OI, the combined impact of "advantage in # of app" and "disadvantage in quality of app" to the "overall value of platform" can differ, in accordance with the size of the "coefficient." If the coefficient (i.e., impact) of "openness to suppliers" to "# of supplier" is greater than that (i.e., impact) to the "percentage of verified supplier," OI will be superior to CI. But, if the relative coefficient size (i.e., impact) is adverse, CI will be superior to OI.

Recently, at Apple's App Store, we observed talented app providers remaining in the App Store but leaving the Android market. The causal relations are as follows: quality of app in Apple's App Store ↑ → # of verified transactions (i.e., paid app) ↑ → sales and investment of Apple's App Store ↑. In this case, it means that CI may be superior → i.e., the coefficient (i.e., impact) of "openness to supplier" to "percentage of verified suppliers" is greater than the "# of suppliers."

Next, we looked into Hotels.com and Booking.com's case of the "user side" OBM/HBM/CBM decision. Hotels.com and Booking.com have the same level of openness to the supplier, but they have different levels of openness to the customer (Yacouel and Fleischer 2012).

[Hotels.com]

1) Disadvantage in # of User: HBM → Openness to Customer ↓ → # of User ↓ → Overall Value of

Platform ↓

2) Advantage in Revenue Collectability: HBM → Revenue Collectability ↑ → Sales of Platform ↑ → Investment into Platform ↑ → System Quality ↑ → Overall Value of Platform ↑

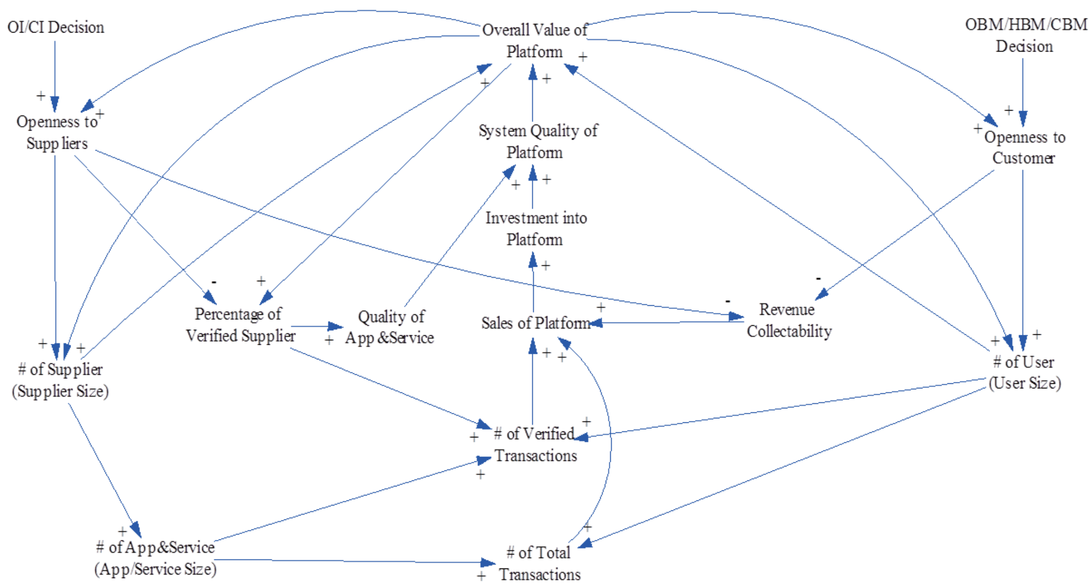
[Booking.com]

1) Advantage in # of User: OBM → Openness to Customer ↑ → # of User ↑ → Overall Value of Platform ↑

2) Disadvantage in Revenue Collectability: OBM → Revenue Collectability ↓ → Sales of Platform ↓ → Investment into Platform ↓ → System Quality ↓ → Overall Value of Platform ↓

If a firm chooses OBM, the combined impact of “advantage in # of user” and “disadvantage in revenue collectability” to “overall value of platform” can differ in accordance with the size of the “coefficient.” If the coefficient (i.e., impact) of “openness to customer” to “# of user” is greater than (i.e., impact) “revenue collectability,” the OBM will be superior to HBM/CBM. However, if the relative coefficient size (i.e., impact) is adverse, HBM/CBM will be superior to OBM. Recently, at Hotels.com, we observed the decreasing # of users of Hotels.com and the increasing # of users of Booking.com, as well as the overall value of platform of Hotels.com ↓. In this case, it means that OBM may be superior → i.e., the coefficient (i.e., impact) of “openness to customer” to “# of user” is greater than “revenue collectability.”

3.2. Revised causal model of BM and OI platform dynamics



<Figure 3> Revised causal model of BM and OI platform dynamics

If we assume the aforementioned, where a platform has greater overall value, there is a great tendency to open to suppliers and customers. As such, we can have a revised SD causal model as shown in <Figure 3>. Such tendency can arise from 1) its confidence from its success, as well as from 2) its intention to grow more and dominate the entire industry or market. With such a tendency and greater overall value, the platform will have more openness to suppliers and customers. Thus, we can have meaningful reinforcing loops and balancing loops as shown in the revised causal model in <Figure 3>.

If we look into the loops of the revised SD causal model from the supplier side, there are two different loops such as reinforcing loops and balancing loops.

A) Reinforcing Loops → (Advantage of OI) "Faster System Growth"

(R1) Openness to Supplier↑ → # of Supplier ↑ → Overall Value of Platform ↑ → Openness of Supplier ↑

(R2) Openness to Supplier ↑ → # of Supplier ↑ → # of App and Service ↑ → # of Total Transactions ↑ → Sales of Platform ↑ → Investment into Platform ↑ → System Quality of Platform ↑ → Overall Value of Platform ↑ → Openness of Supplier ↑

B) Balancing Loops → (Disadvantage of OI) "Damaged Supplier Quality"

(B1) Openness to Supplier ↑ → Percentage of Verified Suppliers ↓ → Quality of App and Service ↓ → System Quality of Platform ↓ → Overall Value of Platform ↓ → Openness of Supplier ↓

(B2) Openness to Supplier ↑ → Percentage of Verified Suppliers ↓ → # of Verified Transactions ↓ → Sales of Platform ↓ → Investment into Platform ↓ → System Quality of Platform ↓ → Overall Value of Platform ↓ → Openness of Supplier ↓

If we look into the loops of the revised SD causal model from the user side, there are also two different loops such as reinforcing loops and balancing loops.

A) Reinforcing Loops → (Advantage of OBM) "Faster System Growth"

(R3) Openness to Customer ↑ → # of User ↑ → Overall Value of Platform ↑ → Openness of Customer ↑

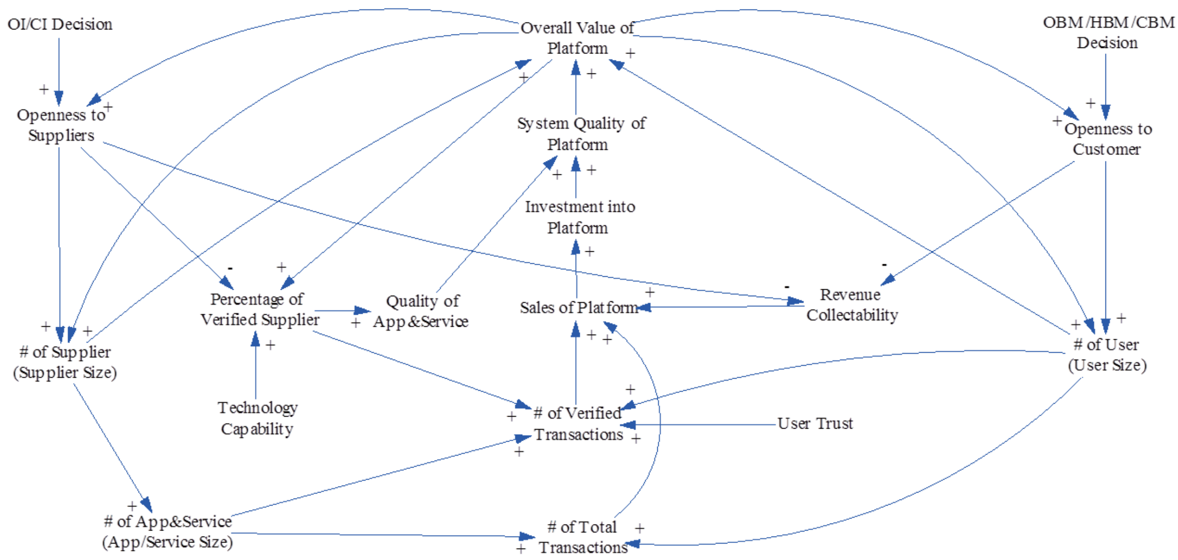
(R4) Openness to Customer ↑ → # of User ↑ → # of Total Transactions ↑ → Sales of Platform ↑ → Investment into Platform ↑ → System Quality of Platform ↑ → Overall Value of Platform ↑ →

Openness of Customer ↑

B) Balancing Loops → (Disadvantage of OBM) “Damaged Revenue Collectability”

(B3) Openness to Customer ↑ → Revenue Collectability ↓ → Sales of Platform ↓ → Investment into Platform ↓ → System Quality of Platform ↓ → Overall Value of Platform ↓ → Openness of Customer ↓

3.3. Final causal model of BM and OI platform dynamics



<Figure 4> Final causal model of BM and OI platform dynamics

<Figure 4> shows that the industry’s characteristics are included in the platform. As a platform, we expect that hardware, software, and service will have different industry characteristics: a) hardware: 1) car, 2) computer and so on; b) software: 1) OS, 2) app market and so on; and c) service: 1) hotel reservation, 2) trip reservation, 3) air ticket reservation, and so on.

In particular, we anticipate the importance of “technology capability” and “user trust” will be different, in accordance with the industry characteristics, including confirmation in the App Store and hotel reservation platforms of the Korean market through intensive interviews, which are shown in <Appendix 1>. “Technology capability” influences the “supply side” and “quality of platform,” thus it will be more important in the hardware industry. In the hardware industry, technology takes more time to develop and is harder to copy. “User trust” influences “user side” and “sales of platform,” thus it will be more important in the service industry. In the service industry, quality cannot be directly observed until a user uses it. As such, the other user’s experience and the user’s trust from using it will be more important than anything else.

We can see the relation between technology capability and platform industry in <Figure 4>. Technology capability is an important factor that influences a percentage of the verified supplier, and eventually, the overall value of the platform. With more technology capability, a platform can technologically and deeply support more suppliers → the percentage of verified suppliers will increase → quality of app and service increase → it will finally increase the overall value of platform. Moreover, technology capability will be more important in "hardware" than "software" and "service" because in hardware, it takes more time to build such technological capability and is harder to copy. The sequencing of the technology capability's importance between industries is as follows:

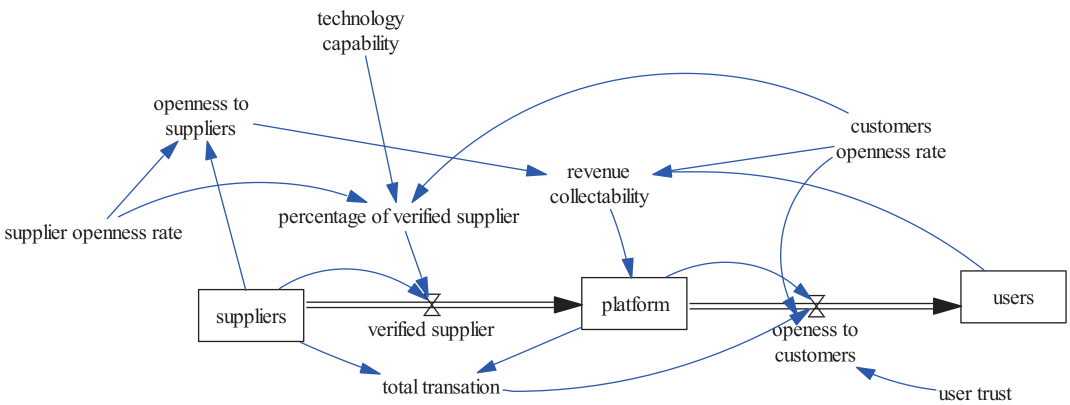
Hardware > Software (App Market etc.) > Service (Hotel Reservation, etc.). This sequencing was confirmed with the Korean market by intensive interviews, which are shown in <Appendix 1>.

We can see the relation between user trust and its influence on the platform in <Figure 4>. User trust is an important factor that influences the "# of verified transaction" and platform sales. With more user trust, the more willing a user will be to buy a more verified transaction that requires more payment → sales of platform will increase → overall value of platform increases. User trust will be more important for services than software and hardware. It is because in hardware, quality can be observed more easily than software and service. In the service, a user cannot directly observe the quality before he/she uses it. As such, the trust and opinion of another user is more important over anything else. Sequencing the importance of user trust between industries is as follows: Service > Software > Hardware. This sequencing was also confirmed within the Korean market through intensive interviews <Appendix 1>.

4. System dynamics model building and pure simulation

4.1. System dynamics model building

We begin with the model shown in <Figure 2>, which was modified in accordance with <Figure 3> and set up in accordance with <Figure 4>. The system dynamics model in <Figure 5> follows the three-step causal loop model of this research.



<Figure 5> System dynamics model

4.2 Simulation of platform business model without considering industry characteristics

4.2.1. Comparison between Apple's App Store and Google Play (Android market) in the Korean market

First, if we compare the supplier's openness rate and the customers' openness rate in the industry within the Korean market, they are as shown in <Table 1>.

<Table 1>. Openness of app store platforms in the Korean market

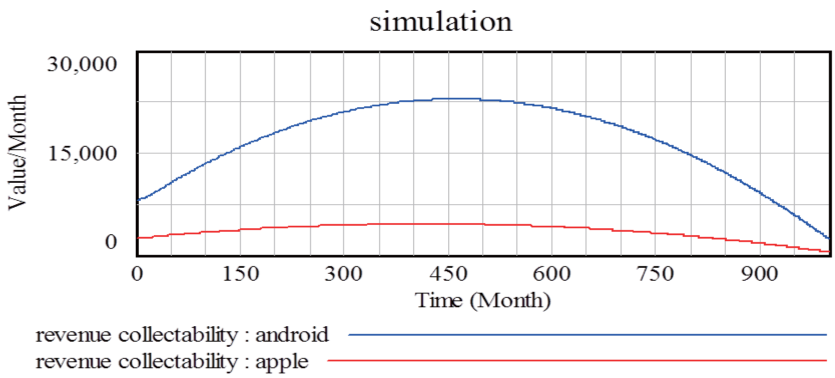
Platform firm	Supplier openness rate	Customers' rate
Apple's App Store	0.5 (iOS codes are half-opened to App development firms. Six interviewee firms agreed without exception.)	0.5 (All iOS paying apps are paid to Apple and transferred to app development firms. Six interviewee firms have the same opinion.)
Google Play (Android market)	0.9 (Android codes are open enough to app development firms. Six interviewee firms agreed without exception.)	0.9 (Most Android apps are free apps or have an app payment system that offers apps through some payment app policy similar to Apple's App Store.)

Apple supplier, customer, technology (Apple: 0.5, 0.5); (Android: 0.9, 0.9)

Apple acknowledges the passive iOS modification of developers, but only for the essentials, while Google opens the Android OS source to app developers and considerably acknowledges the free right to modify it. As such, the supplier's open innovation level is 0.5 for Apple, while it is 0.9 for Google.

Apple receives all the rewards for apps and subsequently delivers it to developers with the commission deducted. As such, the customer open innovation is only 0.5. On the other hand, most Android apps are provided for free and most of the rewards for app development are directly transferred to the app developers by allowing in-app purchase and other similar features. Thus, the open business model, i.e., customer open innovation level, is 0.9.

Second, <Figure 6> shows the simulation result of an interview on both platform businesses within the Korean market without considering the industry's characteristics.



<Figure 6> Simulation results of two app platform firms in Korea without considering the industry.

<Figure 6> shows that the Android market maintains a higher revenue collectability in paid app revenue or app development, as well as sales revenue, compared with the App Store. In the interview result of <Appendix 1>, the Android market has a bigger app development volume and distribution in Korea, while the App Store has more paid apps and higher app revenue. Therefore, this simulation has no practical feasibility.

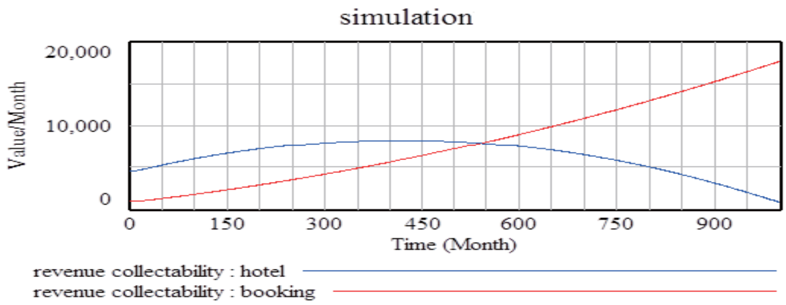
4.2.2. Comparison between Hotels.com and Booking.com in the Korean Market

First, if we compare the supplier's openness rate and the customers' openness rate in the hotel reservation platform within the Korea market, they are as shown in <Table 2>. Hotels.com allows hotels (customers) to develop a system, including its own reservation system, while Booking.com does not. Thus, the supplier's open innovation is 0.9 for Hotels.com, while it is 0.1 for Booking.com (see <Table 2>). Hotels.com receives the hotel lodging charge payment and then transfers it to the hotels with the commission deducted, while Booking.com lets hotels receive the payment and have them pay the commission by themselves. As such, the openness of their open business model, i.e., customer open innovation, is 0.5 for the former, while the highest, which is 0.9, goes to the latter.

<Table 2> Openness of hotel reservation platforms in the Korean market

Platform firm	Supplier openness rate	Customers' rate
Hotels.com	0.9 (Hotels.com codes are fully open to connected hotels. Four big interviewee hotels agreed without exception.)	0.5 (Hotel fees are paid at Hotels.com and transferred to hotels. Six interviewee hotels agreed.)
Booking.com	0.1 (Booking.com codes are not open to connected hotels. Four big interviewee hotels agreed without exception.)	0.9 (All hotel fees are directly paid to hotels, and recently, some portions are transferred to Booking.com by hotels. Six interviewee hotels agreed.)

Second, <Figure 7> shows the simulation result of the interview on both platform businesses in the Korean market without considering the industrial characteristics.



<Figure 7> Simulation results of two hotel reservation platform firms in Korea without considering the industry

In the simulation result of <Figure 7>, Hotels.com took the lead against Booking.com in the beginning, but Booking.com began to rapidly take over in a certain period without considering the industrial characteristics. It considerably matches the interview results of Korean hotels in <Appendix 1>. Thus, it is practically feasible. Hotels.com has maintained its dominance among Korean hotels as a global hotel reservation platform, but Hotels.com's market share has continuously grown and even overtook in some areas.

5. Advanced simulation including industry characteristics and additional simulation

5.1. App store platform industry of Korea

5.1.1. Industrial characteristic elements of Apple's App Store and Google Play (Android market)

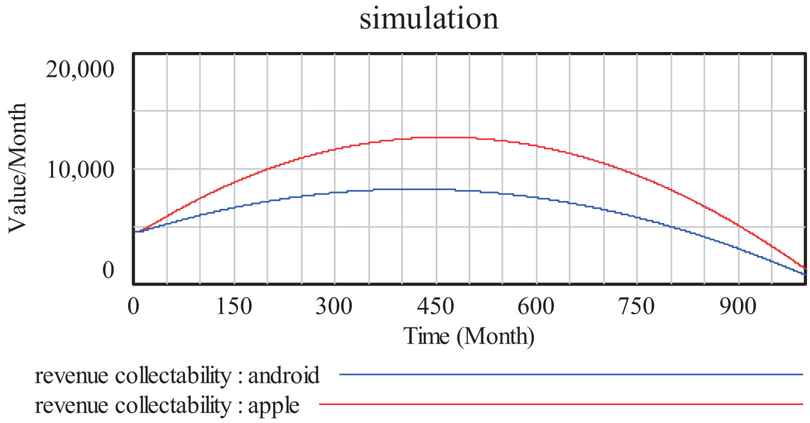
First, both application platform business models are most affected by suitable app development capabilities than others. It is believed that Apple's App Store requires a higher technology capability than Android given that Apple uses Objective C, and takes 2–3 weeks of preliminary assessment for uploading the apps to the platform in the Korean market. There are relatively many Android app Java-based developers and little preliminary assessment for uploading applications. As such, the Android platform requires lower technology capability than the Apple platform. In Korea, it is common for Android developers to develop Apple apps as hybrid ones, reflecting the fact that the Apple platform requires a higher technological capability.

Second, the trust of users on the technical level of applications is the key in regards to the consumption of paid applications. For instance, users have a high trust on the technical level of paid applications from Apple's App Store, thus their paid applications are widely consumed. On the other hand, Android app stores have low user trust on the technical level of applications, so the consumption of free applications prevails. Therefore, the technical level of an app store platform business model has the key role in deciding the capability and revenue of engaged businesses.

5.1.2. Simulation result of app store platform business model in consideration of the industrial characteristic elements

According to the focused interview, which is shown in <Appendix 1>, the technological capability level of the Apple app platform business model is high (0.9) in the Korean market, while it is still 0.5 for Android, even though it has significantly caught up. In a simulation that took this situation in consideration, the revenue collectability was higher for Apple than Android, as shown in <Figure 8>. Therefore, the result of the simulation model has practical feasibility in consideration of the industrial characteristics.

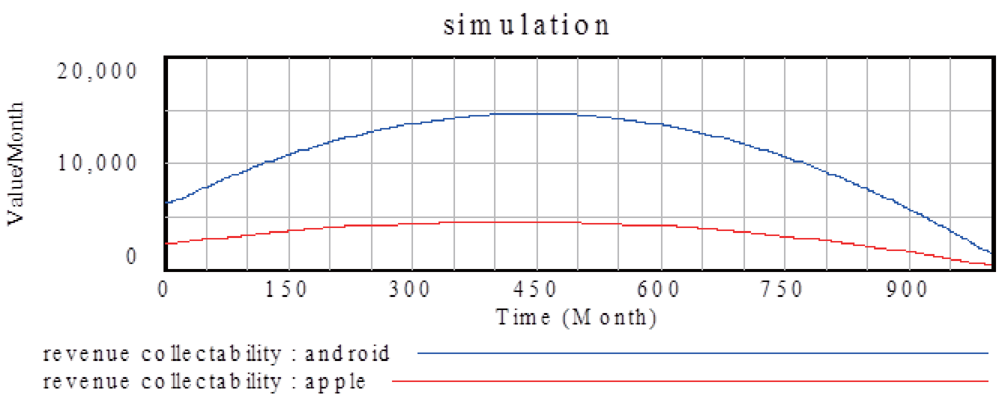
<Figure 8> Simulation results of two app platform firms in Korea with consideration of industry



5.1.3 Additional findings of simulation in consideration of industrial characteristic elements

The above is a simulation wherein the Android platform business directly receives the revenue made by the applications or takes more of the app sales revenue (for paid ones) and then transfers 80% of it to the developers later in order to reduce the customer open innovation rate of Android. In other words, the customer's open rate was reduced from 0.9 to 0.7 for another simulation. The results show that the Android app store may take over Apple's App Store for revenue collectivity (see <Figure 9>).

Thus, a business strategy to reduce some of the openness of the Android's open business model will lead to the increased profit of platform businesses in Korea. It is important to highlight the strategy that the Google Play platform recently considered and tried or practically reinforced the limitations with regard to in-app purchases. This new attempt will be revealed as a result of additional simulation.



<Figure 9> Additional simulation result in the App Store platform in the Korean market

5.2. Hotel reservation platform industry of Korea

5.2.1. Industrial characteristic elements of the Hotels.com and Booking.com platform

First, it is more likely for well-known and reputable hotels to be reserved through hotel reservation platforms. Seoul-based hotels are more well-known because they have a high domestic and overseas access through the platforms. That is, Seoul-based hotels are more well-known than Daegu-based ones, so they have a higher likelihood of being booked through the platforms. Starting in Asia, Hotels.com has introduced Korean hotels to its domestic and overseas users.

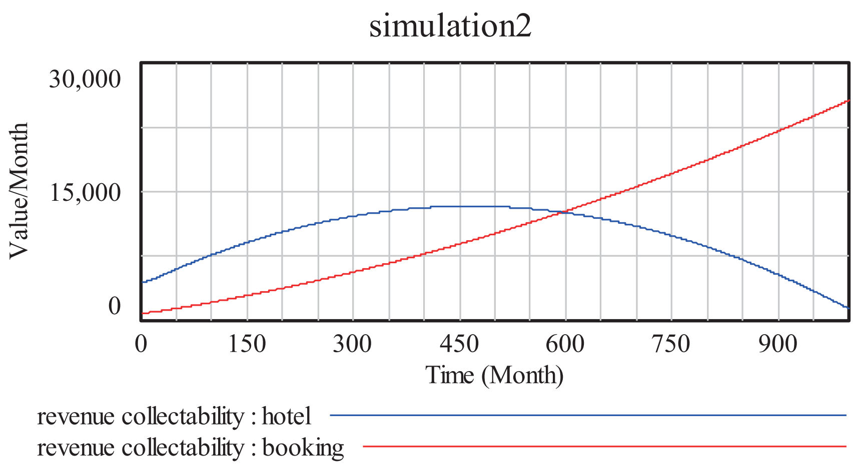
Second, those hotel reservation platforms that create many well-known promotions to users have a higher user trust because their hotels are recognized more easily. Hotels.com is making more advertisements and reinforces promotion, including one free night for those who reserve over 10 nights. Hotels.com is retaining users for longer periods through improved trust.

By examining the industrial characteristic elements of both hotel reservation platform business models, it can be seen that a higher user trust leads to more users. In fact, Hotels.com a has higher openness of supplier open innovation as it directly receives room charges and then transfers the revenue to hotels with the commission deducted. As such, customer open innovation is somewhat low, which is a very hotel-friendly characteristic. Hotels may reduce the risk of canceled reservations because the platform business receives the room charge in advance. Moreover, it is very convenient for the hotel that the platform takes all the required actions and calculations and simply transfers the payment with the commission deducted. Also, the SW system of the platform is open and well-connected to the accommodation system of hotels, which results in a higher convenience for hotels.

On the other hand, Booking.com has a somewhat low openness of supplier open innovation. As such, the platform's SW system is rarely open to hotels, while the users only make reservations through the platform and pay upon arrival, making it a very user-friendly system. It is convenient for users to register at the site and subsequently pay the charge. Therefore, users increasingly prefer the Booking.com platform as they become familiar with it. The increasing usage of Booking.com in Seoul, Gangbuk, Gangnam, and Daegu is proof of such. However, the customer trust improvement of Hotels.com, through promotion, has an effect on user retainment. As such, the users are maintained and even the number increases as Hotels.com reinforces promotion. Therefore, the customer's trust of Hotels.com is very high (0.9), while Booking.com is relatively low (0.5) because the platform is not sufficiently known in Daegu-based or small hotels (see <appendix 1>).

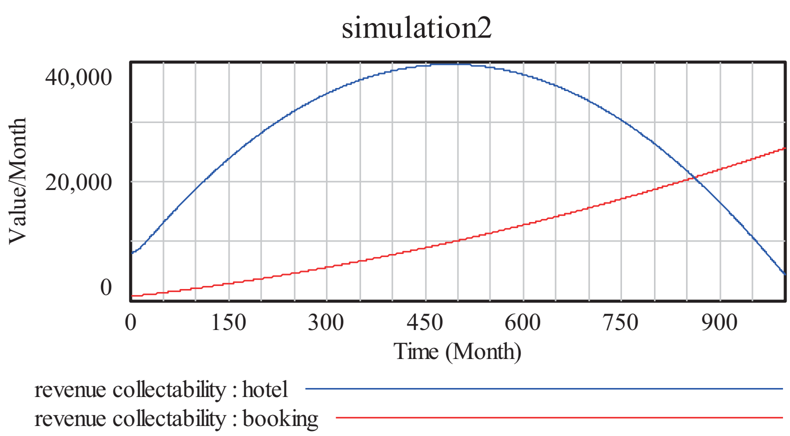
5.2.2. Simulation result of Hotels.com and Booking.com platform business models in consideration of the industrial characteristics

<Figure 10> Simulation results including industry characteristics of hotel bookings in the Korean market



<Figure 10> shows the simulation result wherein Hotels.com would have long been chased by Booking.com after a certain time and then taken over by it. This situation is far more feasible in the Korean market.

5.2.3. Additional finding of a simulation result for the industry in consideration of the industrial characteristic elements



<Figure 11> Additional simulation in the hotel reservation platform within the Korean Market

As shown in <Figure 11>, if customer open innovation is reinforced to the same level as Booking.com (0.9), Hotels.com would maintain its superiority for a considerable period. Currently, in the Korean market, Hotels.com is introducing a new sales strategy to far reduce the commission if existing or new hotel customers, who renew or make new contracts, decide to receive a room charge upon the users' arrival at the hotels. The new sales strategy of Hotel.com matches the additional simulation result of this research.

6. Conclusion

6.1. Summary

First, both app store platforms and hotel reservation platforms have the characteristics of a platform business, even though they show some differences in supplier open innovation and customer open innovation.

Second, the platform business has very strong dynamics for a certain period if both suppliers and customers have open platforms, which are connected through the casual loop of a feedback loop. That is, strong dynamics can lead to a difference in revenue collectivity if some elements are changed in the additional simulation. In particular, the App Store platform needs to concentrate on the reduced customer open innovation rate of the Android market in the future. On the other hand, the hotel reservation platform needs to focus on the strategic change of Hotels.com with regard to payment upon arrival.

Third, the platform business has some industrial characteristic elements that have a continuous and gradual effect through the feedback loop. The technology capability of the app store industry or user trust of the hotel booking industry is an example of this effect.

6.2. Implication

First, there can be multiple platforms with different characteristics and levels from the suppliers to the customers in the platform business. That is, a single business can develop a business model with several platforms. Thus, the practice or analysis of a platform business needs to simultaneously take in account the characteristics, level, and number of platforms.

Second, the platform business needs to focus on quick and dynamic changes through the dynamics' structure. That is, the platform business requires an enterprise strategy that takes in consideration the structure and conditions of dynamic change over time, as well as the result, instead of taking a static approach.

Third, it is essential for the platform business, in terms of the dynamics, to find platform elements, industrial characteristic elements, and other additional ones that compose the dynamics, as well as to understand their structure on the feedback loop, in order to establish an enterprise strategy. The platform business needs to simultaneously understand the components, including the platform and dynamic relation structure between them.

6.3 Additional research goal

First, this research analyzed two limited businesses of the app store and hotel reservation platforms for the Korean market. Additional and comprehensive follow-up research is needed for having a sufficient budget that will target major players of certain industries within the massive global market.

Second, different platform businesses are recently and explosively emerging all over the world. It is necessary to understand the major platform elements of the platform business by industry, as well as to identify the dynamic relation structure between them for a comprehensive research on the platform business.

Third, follow-up research is needed on the open innovation analysis of the platform business in order to identify the characteristics of open innovation for platform businesses where the supplier's open innovation platform and open business model platform are representatives in terms of the supplier and customer, respectively.

Acknowledgement

This work was supported by the DGIST R&D Program of the Ministry of Science, ICT, & Future Planning.

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<Appendix 1>

Interview lists and half-structured questionnaire

1) Interview lists

Industry	Interview date	Firm	Interviewee	Firm location	Home page
App development firms	2015.05.06	Busang Systems	Song JuneWoo	Daegu	www.busang-sysems.com
	2015.05.13	Neuron Works	Sin Sun	Daegu	www.facebook.com/heyyosunny
	2015.05.13	AR Media Works	Mun SukHyeon	Daegu	www.armedia.co.kr

	2015.05.13	Talk Talk Golf	Lee BaeHee	Daegu	www.talktalkgolf.com
	2015.05.14	Fusion Soft	You JongWon	Daegu	www.fusionsoft.co.kr
	2015.05.17	Whale Soft	Kim MinSu	Daegu	www.whalesoft.co.kr
Hotels	2015.04.29	Daegu Grand Hotel	Choi JunGeun	Daegu	www.daegugrand.co.kr
	2015.05.14	New Daegu Hotel	Cheai JaeYoung Jung SeoungHaw	Daegu	www.taeguhotel.co.kr
	2015.05.15	Young Dong Hotel	No YeunJong	Seoul	www.youngdonghotel.co.kr
	2015.05.15	Hotel Inter-Burgo	Han GiSu	Seoul	www.ibhote.com
	2015.05.18	GongGam Guest House	Kim YoungHee	Daegu	blog.naver.com/empathy215
	2015.05.19	IBIS Seoul Myeongdong	Ryu HeJung Kim YoungHen	Seoul	www.**ibis**.com/**Myeong-Dong**

2) Half-structured questionnaire

<Hotel interview>

- Introduce to us the booking channels, situation, and volumes of your hotel.
- Explain to us your usage of Hotels.com and Booking.com.
- Explain to us the openness of Hotels.com and Booking.com's system.
  - How freely can you use the system codes of Hotels.com and Booking.com to connect with your own hotel system or to customize it for your own usage?
- Explain to us the relations of Hotels.com, your hotel, and the customer.
- Explain to us the relations of Booking.com, your hotel, and the customer.
- Explain to us the changing trends of total booking, usage of Hotels.com, and usage of Booking.com in your hotel.
- Explain to us the special characteristics, strengths, and weaknesses of Hotels.com.
- Explain to us the special characteristics, strengths, and weaknesses of Booking.com.
- What is your opinion on the future of Hotels.com and Booking.com?

<App development firm interview>

- Introduce to us your firm's development history of Google Android apps and Apple apps.
- Explain to us your history, situation, and ability of developing free and paid Apple app/s.
- Explain to us your history, situation, and ability of developing free and paid Android app/s.

- What kinds of special characteristics, strengths, and weaknesses did you find when you developed and uploaded your Apple app?
- What kinds of special characteristics, strengths, and weaknesses did you find when you developed and uploaded your Android app?
- Did you see any changing trends in Apple's App Store and Google Play's system and policy?
- What is your opinion on the future of Apple's App Store and Google Play?

Autonomous learning model in closed and open innovation condition

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Abstract

In the previous paper, we build up the interaction model between direct and autonomous learning (IMBDAL) from the human cognitive process in closed and open innovation condition. This process is different from the general machine learning processes where agents use data to create direct knowledge to maximize their utilities by predefined inference techniques. Whereas autonomous learning (AL) produces lots of indirect knowledge, say hypotheses, from recombining and extending the knowledge of direct learning (DL). These hypotheses are converted to confirmed knowledge or discarded as agents are getting more data by interacting with their environments. This paper examines this indirect learning model and its usefulness.

Key words: autonomous learning, open innovation, machine learning

Analyze Network Property of Patent Based on Citation

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ABSTRACT
In this paper, we construct the patent network based on the citing-cited relations between patents and analyze the properties of patent network from January 1976 to December 2005. We find that the quantities to understand the patent network in terms of complex network approach change over time. In particular, the average shortest path length and betweenness centrality shows a positive relation with time, whereas the average closed centrality decreases.

Keywords: Patent, complex network, technology innovation

1. Introduction

Patent has been an inseparable factor to individual companies in competitive environment like these days. Innovative knowledge that the company had been developed determines its future economic growth and prosperity. (Saviotti et al. 2003, 2005; Saviotti 2005). In other words, the sustainability of company can be threatened without patent that protects the property of intelligent knowledge. For example, there was a patent legal controversy between Apple and Samsung galaxy because of the infringement of patent in smart phone technology. Indeed, it makes the fluctuation of each stock price according to the progress of legal battle.

Patent is cohesion of novel knowledge. Knowledge can be transmitted to others and expanded (Nonaka et al. 1995). Likewise, the development of patent is possible through the citation each other. When the patent applicants claim the patentability of their inventions, they have to list related patents of which they consider. And patent examiners look for the most closely related patents in an attempt to evaluate the eligibility of achieving patent. When it is decided, the previous patent chosen is cited by the new patent. In previous literature, Patent citation data was used to analyze the relationship between innovation and the patent system. (Narin 1994; Milman 1994; Meyer 2001; Kostoff and Schaller 2001; Debackere et al. 2002; Murray 2002; Verbeek et al. 2002) Furthermore, it was also used to examine knowledge flows and spillovers (Duguet and MacGarvie 2005; Strumsky et al. 2005; Fleming et al. 2006; Sorenson et al. 2006). From these studies, it can be concluded that vigorous citing-cited patent activities will form very intricate network structure, and it will be a critical source of emerging of a new patent. In this regard, it needs to investigate the network structure of patent citation network and its properties, and found out the desirable direction of development of it.

The main objective of this study is applying complex network methodologies to patent citation network of United States and examining its network properties. Complex network methods has gained lots of attentions and adopted to many other fields that composed of interconnections among agents such as SNS network and channel of epidemic diffusion. In this paper, the U.S patent citation network is comprised of cited patent and citing one. A patent is a node in the network and the links between nodes are citations between them. Erdi et al. (2012) used the network methodology and examined the clusters of patent and gave a prediction about temporal changes of structure of the clusters. Moreover, Hung et al. (2010) regarded the citation network as a 'small world' and investigate the network properties with statistical approaches.

This paper contributes to the literature as follows. First, we propose an alternative method to construct the patent network according to citing-cited relations.

This paper is organized as follows: Section 2 briefly describes the data used. Section 3 presents a novel method proposed in this paper. Section 4 presents the empirical results of the patent network properties in terms of the complex network approach. Finally, Section 5 concludes the paper.

2. DATA

We use patent data NBER Patent Data Project provides[1]. The data contains information of patents registered from 1976 to 2005 in US Patent office.

[1] NBER Patent Data Project , https://sites.google.com/site/patentdataproject/Home

We summarize statistics of patent data we used in Table 1. All patents are classified into 6 HJT categories such as Chemical, Computers and Communications, Drugs and Medical, Electrical and Electronic, Mechanical, and Others. Each HJT category is classified into HJT sub-category.

The total count of patent is 4,855,968. All cited citation count is 35,623,107. And average number of cited citation per patent is 7.72. Total number of intra cited citations per patent and average number of self-citations per patent are 21,842,492 and 5.91, respectively.

3. Methods

3.1 Generating Citing-Cited network

We generate citing-cited network of patent. Node indicates patent. We classify patent networks into citing and cited network. When one patent cites other patent in citing network, link between these patents are generated. In the same manner, when one patent is cited by other patents in cited network, these patents are connected by link each other.

To investigate the non-trivial properties between patents that shares common patent, we measure the similarity between citing and cited network.

We define similarity between two patents P_i^{citing} and P_j^{citing} in citing network, s_{ij}^{citing}.

$$s_{ij}^{citing} = s(P_i^{citing}, P_j^{citing}) = 2\frac{N_{P_i^{citing} \cap P_j^{citing}}}{N_{P_i^{citing}} + N_{P_j^{citing}}}$$

where $N_{P_i^{citing}}$, $N_{P_j^{citing}}$, and $N_{P_i^{citing} \cap P_i^{citing}}$ denote the number of nodes connected with P_i^{citing}, P_j^{citing}, and both P_i^{citing} and P_j^{citing}, respectively. s_{ij}^{citing} is normalized by 1 and has value between 0 and 1. The s_{ij}^{citing} is larger, the similarity between P_i^{citing} and P_j^{citing} is bigger. When s_{ij}^{citing}=1, two patents are connected by the same patents in citing network. Otherwise, when s_{ij}^{citing}= 0, there is no common link shared by two patents P_i^{citing} and P_j^{citing}.

Using s_{ij}^{citing}, we define binary closeness between P_i^{citing} and P_j^{citing}, $\mathrm{d}_{\mathrm{ij}}^{\mathrm{binary}}$.

$$\begin{aligned} \mathrm{d}_{\mathrm{ij}}^{\mathrm{binary}} &= 1, \text{ if } \mathrm{s}_{ij} \geq \theta \\ &= 0, \text{ otherwise} \end{aligned}$$

θ denotes threshold value to connect between P_i^{citing} and P_j^{citing} using binary closeness.

3.2 Measuring properties of network.

3.2.1 Degree

Degree of a node i is the number of links connected with i. Degree provide the strength of connectivity of node. The degree distribution of network shows intrinsic property of network. Particularly, in scale-free network, degree distribution follows power-law distribution ($P(x) \sim x^{-\alpha}$) and there exists large degree component called "hub"(Baraba´si and Albert (1999)). Generally, hub has a role of spreading information in network and scale-free network is vulnerable when hub is attacked.

3.2.2 Clustering Coefficient

Clustering coefficient measures the fraction of a heightened number of triangles in the network. In social network, triangle means the triple of nodes connected by friend and friend of friend. This clustering coefficient C for undirected network is quantified by (Watts and Strogatz (1998)):

$$\mathrm{C}=\frac{1}{n}\sum_{i}\mathrm{C}_i$$

$$\mathrm{C}_i=\frac{\text{number of triangles connected to node i}}{\text{number of triples centered on node i}}$$

where C_i and n denote the clustering coefficient of node i and the size of network, respectively. The clustering coefficient C of network is calculated by the average value of clustering coefficient of all nodes.

Clustering coefficient measures the degree of density of ties between nodes. Particularly, in social network, high clustering coefficient implies that there exists high density of ties between persons.

3.2.3 Shortest Path Length

The shortest path length between two nodes means that geodesic distance between these nodes. Shortest path length of network is the average value of shortest path of all pairs of nodes in network. The shortest path length l for undirected network is given by the expression:

$$l=\frac{1}{n(n+1)/2}\sum_{i\geq j}d_{ij}$$

where d_{ij} denotes the shortest path length or geodesic distance between node i and j.

Shortest path length measures the distance of spreading information in network. The shortest path is shorter, the distance of spreading information is shorter.

3.2.4 Betweenness centrality

Betweenness centrality is one kind of indicator of a node's centrality in a network. It is calculated by the number of geodesic paths of all each nodes between other nodes pass through each node (Freeman (1977)). Betweenness centrality of network is measured by the average value of betweenness centrality of all nodes.

Betweenness centrality of a node i is expressed by the formula:

$$BC(i)=\sum_{j\neq i\neq t}\frac{\sigma_{jt}(i)}{\sigma_{jt}}$$

where σ_{jt} denotes the total number of shortest path from j and t and $\sigma_{jt}(i)$ denotes the number of shortest paths that run through i.

A node with high betweenness centrality has a large influence on the transfer information through the network. In particular, betweenness centrality of hubs is measured largely in network.

3.2.5 Closeness centrality

Closeness centrality or Harmonic centrality is another indicator of a node's centrality in a network. It is calculated by the average of inverse of shortest path length of all pairs of nodes in network (Rochat (2009)). Closeness centrality measures how to close the distance between all pairs of nodes in network. Closeness centrality is given by the expression:

$$CC=\frac{1}{n(n+1)/2}\sum_{i\geq j}d_{ij}^{-1}$$

where d_{ij}^{-1} is the inverse of shortest path length between node i and j.

4. Results

We propose an alternative method to construct the patent network by using citing-cited relationship between patents. First we analyze the basic statistics of patents according to the 37 technologies and reported in Table 1.

We investigate the properties of patent networks in terms of the complex network approach, including the degree, shortest path length, clustering coefficient, closed centrality, and betweenness centrality, respectively. Fig. 1 and 2 shows the average degree value and average clustering coefficient for the network between citing patents. In Fig. 1 and 2, the average degree value and average clustering coefficient have a peak point at 1978 and shows an increasing behavior from 1986 to 2001.

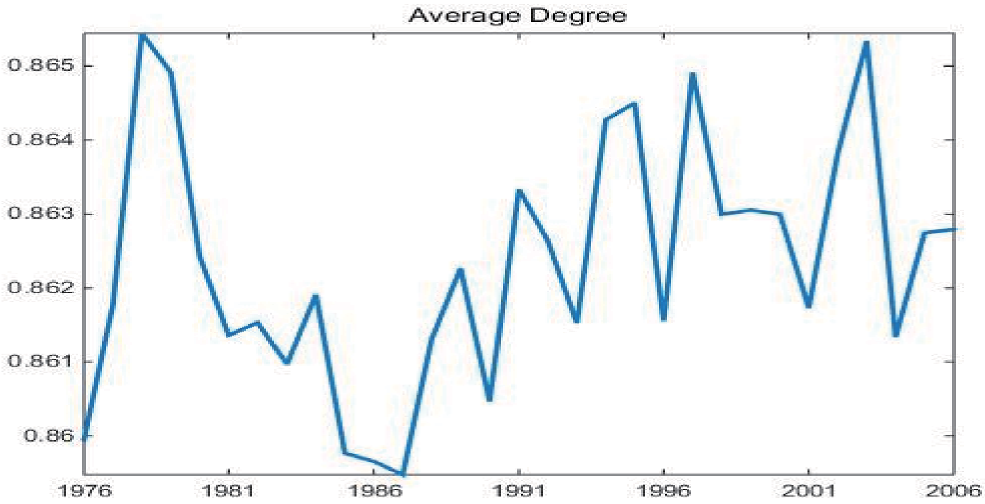

Figure 1 shows an average degree value over time.

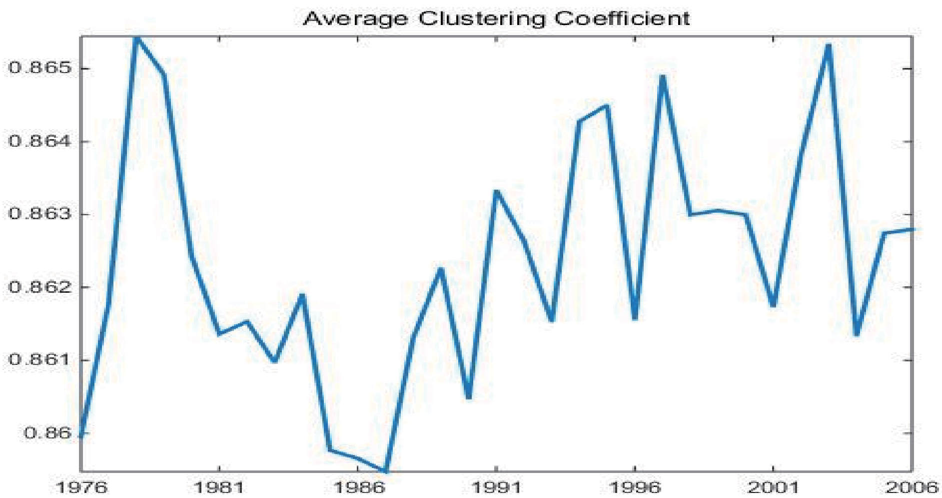

Figure 2 shows an average clustering coefficient over time.

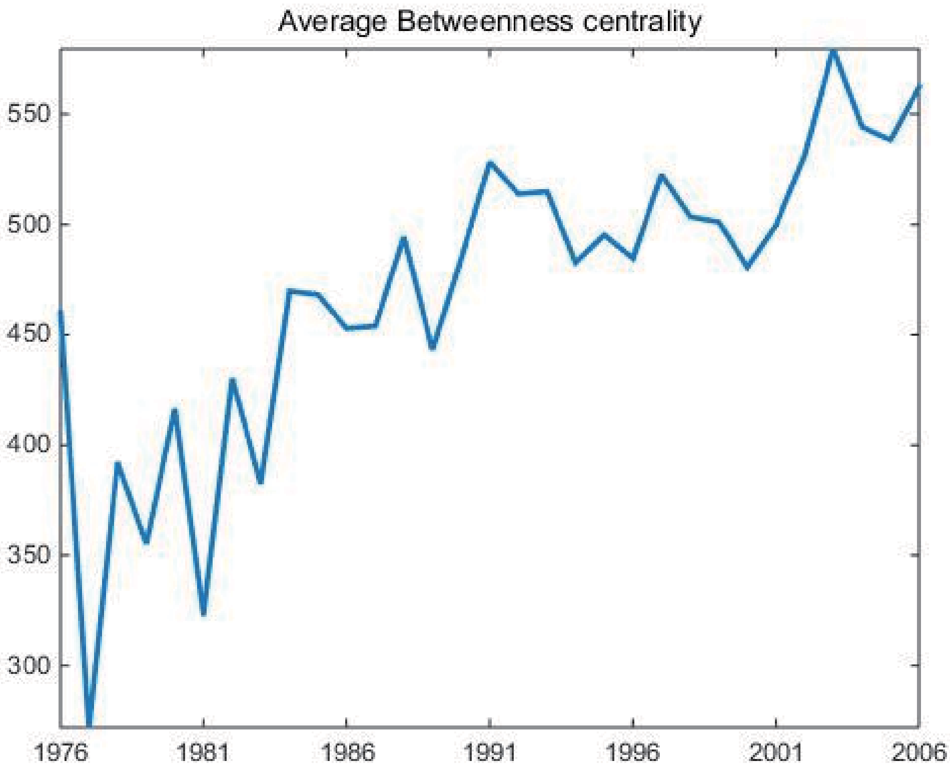

Figure 3 shows an average betweenness centrality over time

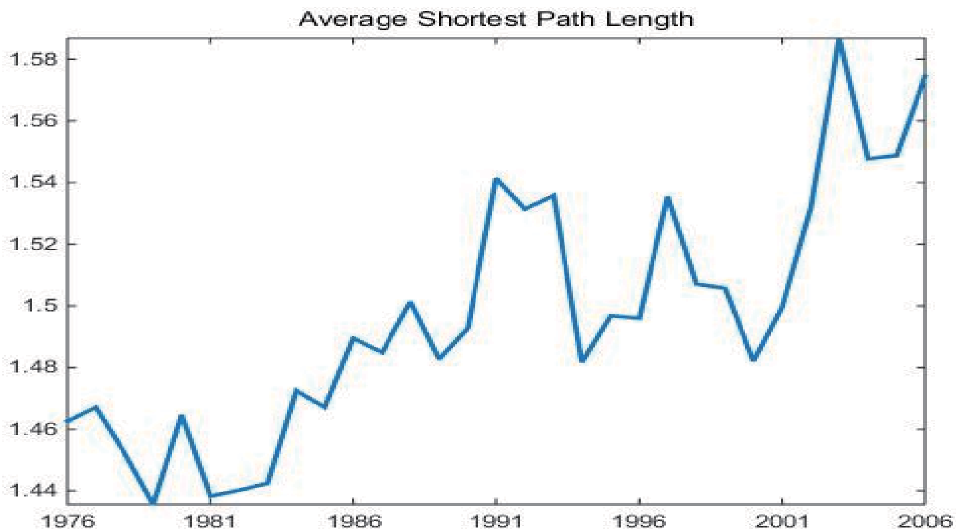

Figure 4 shows an average shortest path length over time

Fig. 3 and 4 shows the average betweenness centrality and shortest path length for the network between citing patents. In Fig. 3 and 4, both quantities have an increasing pattern over time. Based on this results, we assert that the similarity between citing patents with respective to the cited patents had weakened. In other words, recently the new patents are connected by diverse cited patent.

degree value and average betweenness coefficient for the network between citing patents. In Fig. 1 and 2, the average degree value and average clustering coefficient have a peak point at 1978 and shows an increasing behavior from 1986 to 2001.

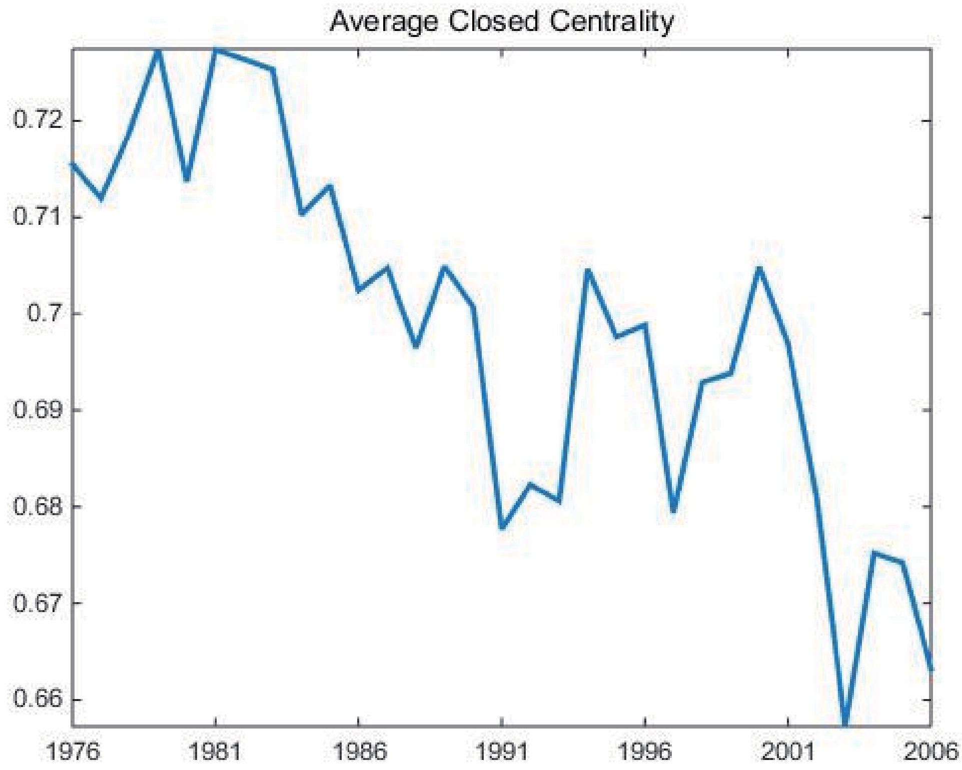

Figure 5 shows an average closed centrality over time

In Fig. 5 the average closed centrality shows a negative behavior compared to the averaged shortest path length and betweenness centrality.

5. Conclusion

In this paper, we investigated the properties of patent network based on the citing-cited relationship. We utilized the complex network approach, including degree, clustering coefficient, shortest path length, betweenness centrality, and closed centrality to quantify the properties of patent networks. We find that all quantities changes over time. Especially, the average betweenness centrality and shortest path length increase, whereas the average closed centrality decrease over time.

Acknowledgement

Following are results of a study on the "Leaders in Industry-university Cooperation" Project, supported by the Ministry of Education, Science & Technology (MEST) and the National Research Foundation of Korea (NRF).

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HJT category	HJT Sub category	Category name	Sub category name	Patent count	Frequency	Cited citation count	Cited citation per_patent	Intra cited citations per-patent	Intra citation rate	Citing to Cited citation ratio	Self-citations per patent
1	11	Chemical	Agriculture, Food, Textiles	35,402	0.73	166,072	4.69	78971	0.48	0.93	3.43
1	12		Coatings	72,688	1.50	566,077	7.79	187668	0.33	0.95	4.47
1	13		Gas	17,873	0.37	162,539	9.09	89339	0.55	1.02	6.89
1	14		Organic Compounds	165,634	3.41	735,765	4.44	279614	0.38	0.81	2.73
1	15		Resins	185,820	3.83	1,300,537	7.00	693803	0.53	0.91	4.93
1	19		Misc Chemical	470,612	9.69	3,425,375	7.28	2080717	0.61	0.97	5.09
Total or average by 1-digit tech category				**948,029**	**19.52**	**6,356,365**	**6.72**	**3,410,112**	**0.54**	**0.93**	**4.59**
2	21	Computers and Communications	Communications	278,637	5.74	2,642,073	9.48	**1809533**	0.68	0.97	8.05
2	22		Computer Hardware and Software	220,601	4.54	2,076,514	9.41	1189280	0.57	1.14	7.88
2	23		Computer Peripherals	96,233	1.98	897,414	9.33	501042	0.56	1.08	7.27
2	24		Information Storage	121,648	2.51	1,103,511	9.07	677048	0.61	0.94	7.62
2	25		Unknown	28,896	0.60	383,845	13.28	145336	0.38	1.06	11.62
Total or average by 1-digit tech category				**746,015**	**15.36**	**7,103,357**	**10.12**	**4,322,239**	**0.61**	**1.04**	**8.49**
3	31	Drugs and Medical	Drugs	429,536	8.85	2,286,368	5.32	1768359	0.77	1.13	4.27
3	32		Surgery & Med Inst.	119,746	2.47	1,919,444	16.03	**1474469**	0.77	0.98	13.52
3	33		Biotechnology	21,336	0.44	61,189	2.87	45853	0.75	1.21	2.68
3	39		Misc Drugs & Med	28,847	0.59	338,080	11.72	210212	0.62	1.05	9.82
Total or average by 1-digit tech category				**599,465**	**12.34**	**4,605,081**	**8.98**	**3,498,893**	**0.76**	**1.09**	**7.58**
4	41	Electical and Electronic	Electrical Devices	139,953	2.88	903,843	6.46	515150	0.57	0.92	4.89
4	42		Electrical Lighting	74,361	1.53	502,344	6.76	316389	0.63	0.94	5.12
4	43		Measuring & Testing	134,106	2.76	942,120	7.03	**517053**	0.55	1.01	4.66
4	44		Nuclear & X-rays	61,487	1.27	444,255	7.23	208455	0.47	0.85	4.75
4	45		Power Systems	158,493	3.26	1,260,116	7.95	733485	0.58	0.94	5.87

4	46		Semiconductor Devices	195,922	4.03	1,629,813	8.32	1250607	0.77	1.12	7.01
4	49		Misc Elec	126,009	2.59	987,681	7.84	506530	0.51	0.91	4.75
Total or average by 1-digit tech category				**890,331**	**18.33**	**6,670,172**	**7.37**	**4,047,669**	**0.61**	**0.96**	**5.29**
5	51	Mechanical	Mechanical Mat. Proc & Handling	196,317	4.04	1,254,806	6.39	691194	0.55	0.98	4.06
5	52		Metal Working	117,390	2.42	643,259	5.48	310301	0.48	1.00	3.18
5	53		Motors, Engines & Parts	151,712	3.12	880,414	5.80	597954	0.68	0.96	4.47
5	54		Optics	78,461	1.62	552,244	7.04	**325388**	0.59	1.14	4.32
5	55		Transportation	110,428	2.27	703,221	6.37	475837	0.68	0.98	4.90
5	59		Misc Mechanical	177,752	3.66	1,137,887	6.40	642704	0.56	0.97	4.42
Total or average by 1-digit tech category				**832,060**	**17.13**	**5,171,831**	**6.25**	**3,043,378**	**0.59**	**1.01**	**4.23**
6	61	Others	Agriculture, Husbandry, Food	82,851	1.71	531,618	6.42	372545	0.70	1.04	5.03
6	62		Amusement Devices	41,503	0.85	325,755	7.85	247097	0.76	1.00	6.49
6	63		Apparel & Textile	63,440	1.31	362,344	5.71	253647	0.70	0.97	4.62
6	64		Earth Working & Wells	56,188	1.16	497,121	8.85	404521	0.81	1.18	7.65
6	65		Furniture, House Fixtures	75,108	1.55	491,326	6.54	**333573**	0.68	0.99	5.35
6	66		Heating	46,525	0.96	279,608	6.01	159742	0.57	0.90	4.19
6	67		Pipes & Joints	31,497	0.65	205,418	6.52	99862	0.49	0.90	4.57
6	68		Receptacles	71,239	1.47	541,901	7.61	318385	0.59	0.93	5.81
6	69		Misc Others	371,717	7.65	2,481,120	6.67	1330829	0.54	1.00	4.13
Total or average by 1-digit tech category				**840,068**	**17.30**	**5,716,211**	**6.91**	**3,520,201**	**0.65**	**0.99**	**5.32**
Grand Total or Average				**4,855,968**	**100**	**35,623,017**	**7.72**	**21,842,492**	**0.62**	**1.00**	**5.91**

Table 1. Statistics of patent data

June 17 (Wednesday)

R# : 202 Conference Room

Special Session 10

"Daegu Techno-Park, Open Innovation and Creative City"

■ **Session Chair: YoHan Kim** (Daegu Techno Park)

- Paper 1: "Sectoral differences in convergence innovation: implications for open innovation" by **KongRae Lee(DGIST), Guktae Kim(Kyungpook University)**
- Paper 2: "Healthcare IT growth strategies for Daegu" by **JinWoo Lim (DGIST)**
- Paper 3: "The Study for Network Structure between intellectuals and urban innovation" by **HeeDae Kim(DIP), ChangYong Mun(Daejeon Metropolitan City), DukHee Lee(KAIST)**
- Paper 4: "The Case of R&D Intermediate Organizations in Daegu Technopark" by **YoHan Kim & Hyojin Kwon(Daegu Technopark)**

Sectoral differences in convergence innovation: implications for open innovation

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(Abstract)

Convergence innovation becomes a prevailing phenomenon in the modern innovation of the manufacturing industry as IT technologies began to be applied to vast areas of conventional technologies. This paper aims to measure the degree of convergence innovation and their trends at the industry level. The data set used is composed of 12 years in longitude and five industry types with 39 sub-industry sectors and comparisons of four countries having patent applications in the US: Japan, Korea, Taiwan and China. This paper measured intra-industry convergence and inter-industry convergence in the case of the Korean industries and made a convergence innovation matrix based on the results of the analysis. We hope that this study will provide a clue to exploring further the structure of convergence innovation at the meso and macro level. Innovation studies that focused on convergence innovation need to deepen their framework toward various perspectives in the future. Research performances achieved by open innovation studies and their research framework might provide many insights into the exploration and exploitation of future convergence innovation studies.

Keywords: convergence innovation, open innovation, inter-industry convergence, intra-industry convergence, convergence innovation matrix

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1. Introduction

Convergence innovation is here defined as ‘a horizontal and vertical integration of diverse technologies creating new products, processes and services’. Horizontal integration means an absorption of diverse fields of technologies for the purpose of creating new functions and products, which often broadens the scope of their technological specialization that can interact with partner companies. Vertical integration means a deepening of specific technologies connecting technological fields of forward and backward sectors for the purpose of creating new functions and products.

Modern innovations have had a strong tendency of technological convergence in which IT technology plays a central role as it has been applied to vast areas of industries, generating variety of new products and services. Not only IT technologies but also other technologies are converging or being converged at varying degrees of integration routinely creating intellectual property rights. The phenomenon of convergence innovation is likely to even deepen and widen in the future due to intense competition among firms in global markets. Particularly manufacturing firms in Asian countries have been quite active in convergence innovation leading to an industrial revolution of the world.

Looking back on the history of technological innovation as Rosenberg (1963, 1982) found, the phenomenon of convergence innovation emerged at the end of the 19 century as closely related technological problems were solved and shared among manufacturers of different types of machines. Machines confronted a similar collection of technological problems dealing with such matters as power transmission, control devices, feed mechanisms, friction reduction, and a broad array of problems connected with the properties of metals. These problems became common to the production of a wide range of commodities. These were apparently unrelated from the point of view of the nature of the final product. The uses, however, of the final product were very closely related on a technological basis. Rosenberg called this phenomenon as “technological convergence” and argued that the intensive degree of specialization which developed in the second half of the19th century owed its existence to a combination of this technological convergence.

Since the concept of 'technological convergence' appeared at the end of the 19^{th} century, similar terminologies have been developed by relatively few innovation scholars such as Kodama (1986, 1991, 1994), Kong-rae Lee, et al. (2005, 2007, 2015). They argued that convergence innovation is a fundamental phenomenon prevailing in the modern industries and that it is associated with strong leadership in a particular technology, and can be possible through concerted efforts by several technological experts. Convergence innovation contributes not only to the rapid growth of companies, but also to the gradual growth of all the companies in many industries (Kong-rae Lee and Jung-tae Hwang, 2005).

The outline of this paper is as follows. Section 2 explains research methods and data for this study. Section 3 analyzes innovation trends of the Korean industries in terms of patenting activities in the US. Section 4 investigates industry differences in making convergence innovation. Intra-industry convergence and inter-industry convergence are defined and those of the Korean industry are measured. Section 5 tries to relate convergence innovation to open innovation and implications for each other. Section 6 provides concluding remarks.

2. Research methods and data

2.1 Classification of industry types

Classification of industries based on their characteristics of innovation has been often used for analyzing innovation issues. A number of innovation studies (Pavitt, 1984, 1986, 1991; OECD, 1993; Tidd, et al, 2001) have shown similar and persistent differences amongst industries in the sources and direction of technological innovation. The four types of industrial taxonomy made by Pavitt (1984) have been well known and have applied to innovation studies. Tidd, et al. (2001) developed Pavitt's taxonomy and applied to the classification of firms. They classified five types of industries or firms (supplier dominated, scale-intensive, science based, information intensive, specialized suppliers) based upon technological trajectories which were originally made by Pavitt.

We adopted Tidd's typology on the types of firms and applied it to classification of industry types. They are supplier dominated, information intensive, specialized suppliers, scale intensive, and science based. This typology deems to be useful to understand how much there has been convergence within an industry type which can be called as intra-industry convergence or between industry types which can be called as inter-industry convergence. Convergence trends in those five industry types may reveal many implications on the innovation of Korean industries.

There is one thing worth mentioning regarding industrial classification. Traditional concept of distinction between firm and industry is in fact ambiguous since some of large firms run their business across many industrial sectors. For instance, Samsung Electronics Co. has operated its business across many industrial sectors: semiconductors, information, mobile telecommunications, displays, home appliances, and digital media. Some scholars like Fujimoto (2007) equally treated firms and industries in innovation research. He argued that the lowest level of micro unit analysis is not firm but factory. This paper hereafter adopts the typology of five industry types by which firms and specific industries are grouped and analyzed as shown in Table 1.

Table 1: Classification of products and services by industry types

Types	Specific products and services
Supplier dominated (Sd)	food processing (a beverage, food stuff and cigarettes etc.), textiles, metal products, glass and ceramics, non-ferrous metal, lighting instruments etc.
Information intensive (Ii)	audio instruments, telecom instruments, office instruments, other services etc.
Specialized suppliers (Ss)	engine, agricultural machinery, construction & mine machinery, machine tools, special industrial machinery, general industrial machinery, service industrial machinery, transmission instruments, electrical industrial machinery, home appliances, electronic parts, weaponry, shipbuilding, railroad equipment etc.
Scale intensive (Si)	petro chemicals, inorganic & organic chemicals, paint, rubbers, plastics, iron & steels, TV, automobiles, other transportation equipment, etc.
Science based (Sb)	pharmaceuticals, oiled & cosmetics, agro chemicals, other chemicals, precision instruments, aerospace and aircrafts

2.2 Data

US patent statistics have been used for a proxy of innovation. It well represents an upstream part of innovation cycle that includes such an invention as new ideas, prototypes of new products, new processes, and designs. It is, however, not able to account for the degree of utilizations, industrial difference of propensity to patent, and some kinds of innovation results such as software, trade secrets, know-how associated with production processes. This paper supposes that those industries having high US patent shares have a leading position especially in the upstream part of the innovation cycle.

The time horizon of the data is 12 years from 2001 to 2012. The data set is composed of 12 years in longitude and five industry types with 39 sub-industry sectors. It has also drawn that of four countries having patent applications in the US: Japan, Korea, Taiwan and China. Our data set has three dimensions such as sectoral, time series and countries. This data enabled us to adopt a comprehensive archival analysis for discovering sectoral differences in convergence innovation.

2.3 Method to measure CIs

Method to measure the degree of convergence innovation (CI) is to calculate the percentage of patents with more than one USPTC class citations in technology fields out of total number of patents in an industry. Two types of convergence innovation can be measured. The one is intra-industry convergence, in which technologies converge within an industry sector; the other is inter-industry convergence in which a technology converge to other technology fields which belong to other industry sectors. It is assumed that frequent occurrences of patents with more than one USPTC class citations indicate a high degree of convergence innovation.

$$CI_{ijt} = \sum_{1}^{ijt} \frac{CP_{ijt}}{P_{ijt}} \quad \text{------------------------------------} \quad (1)$$

The degree of convergence innovation can be expressed as equation (1) where CP_{ijt} indicates convergence patents with more than one USPTC class citations in technology field i in industry j at time period t and P_{ijt} indicates number of patent applications in technology field i in industry j. Convergence patent is defined as patents with more than one USPC class citations. CI_{ijt} is a converted percentage index representing the degree of convergence innovation in technology field i, in industry j and at time period t. Time period is here 12 years from 2001 to 2012. Intra-industry CI is obtained by limiting j to a specific so as to measure CI within the industry. Inter-industry CI is obtained by counting convergence patents that hold more than one USPTC class citations pending on two industries (j). In calculating the inter-industry CI, we made 10 pairs of industries (Sd-Ii, Sd-Ss, Sd-Si, Sd-Sb, Ii-Si, Ii-Si, Ii-Sb, Ss-Si, Ss-Sb, and Si-Sb).

3. Innovation trends of Korea by industrial types

The results of US patent analysis by five industry types revealed that the specialized suppliers of Korea took the largest share of US patents. The industry includes engine, agricultural machinery, construction & mine machinery, machine tools, various industrial machinery, electrical machinery, home appliances, electronic parts, weaponry, shipbuilding, railroad equipment etc. In 2001, its US patent share was 6.1 percent, which was increased to 14.7 percent in 2012. The information-intensive industry such as audio instruments, telecom instruments, office instruments, etc. followed the specialized suppliers, accounting for 3.5 percent of US patents in 2001, which was also substantially increased to 6.9 percent in 2012. These two types of industries have actually led the innovation of Korean industries and the growth of the Korean economy. On average, the Korean industries took 8.5 percent of total US patents in 2012, which has been continuously increasing.

Except for the two industries, other three types of industries have shown rather a stagnation trend in patenting activities in the United States or slightly declining over the last twelve years as seen in Figure 1. The science based industry such as pharmaceuticals, oiled & cosmetics, chemicals, precision instruments, aerospace and aircrafts showed almost identical patterns with that of the scale intensive industry that has been traditionally a strategic sector of Korea. The suppliers dominated industry such as food processing (a beverage, food stuff and cigarettes etc.), textiles, metal products, glass and ceramics, non-ferrous metal, lighting instruments, etc. accounted for the least position in US patent applications.

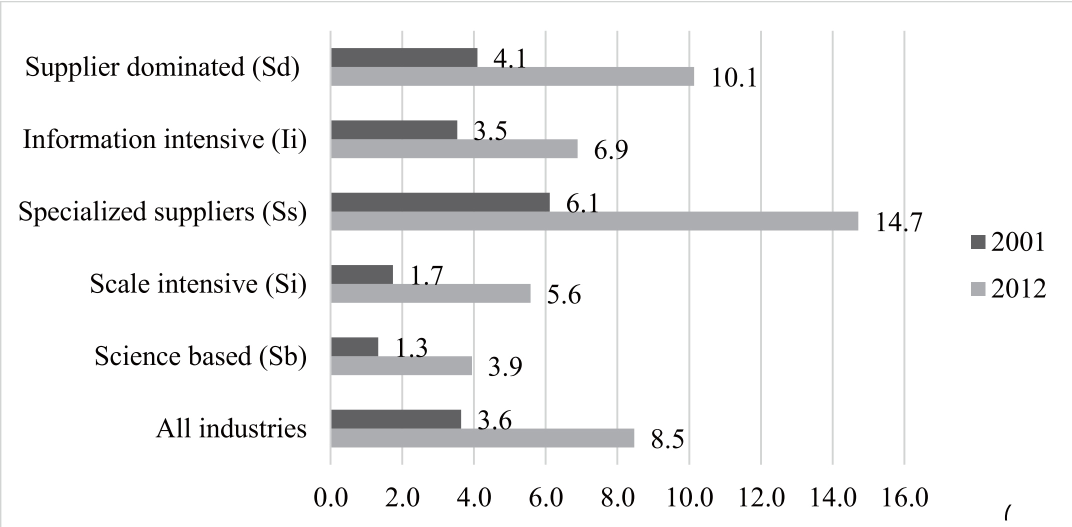
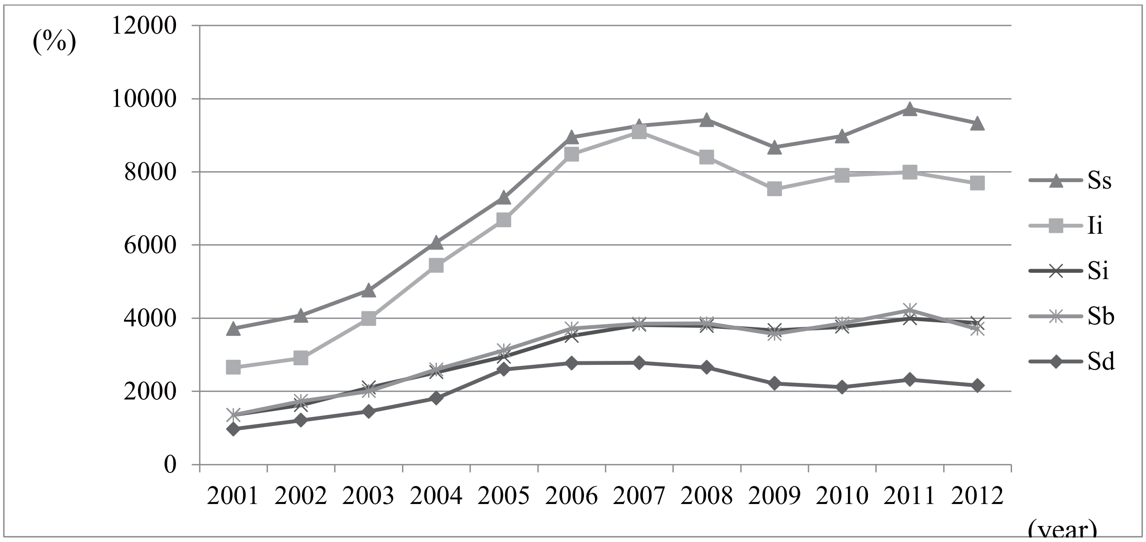


Figure 2: Changes in US patent shares of Korea by industry types

As seen in Figure 1, patenting of Korean industries in the US revealed a downturn trend from 2008 during the year the monetary crisis began in the US. Since then, it tends to recover shortly in 2010, and reveals a downturn again from 2012. The trends of patenting activities in the US are overall in accordance with economic trends of Korea. This implies that innovation trend of the Korean industry has influenced or been influence by the economic activities of Korea.

If we see the US patent shares of specific industries, it is found that the shipbuilding industry that showed the largest global export market share ironically obtained extremely low level of US patents. The industry accounted for just 0.3 percent out of US patents in 2001, which tends to decrease over time. Some managers of a shipbuilding company said that the industry keeps innovations as secret for protection rather than patenting because they are mostly associated with processes of shipbuilding which is less likely to be protected by a patent law when infringed by a third party (Lee, Kong-Rae and Rhee, Wonkyung, 2008).



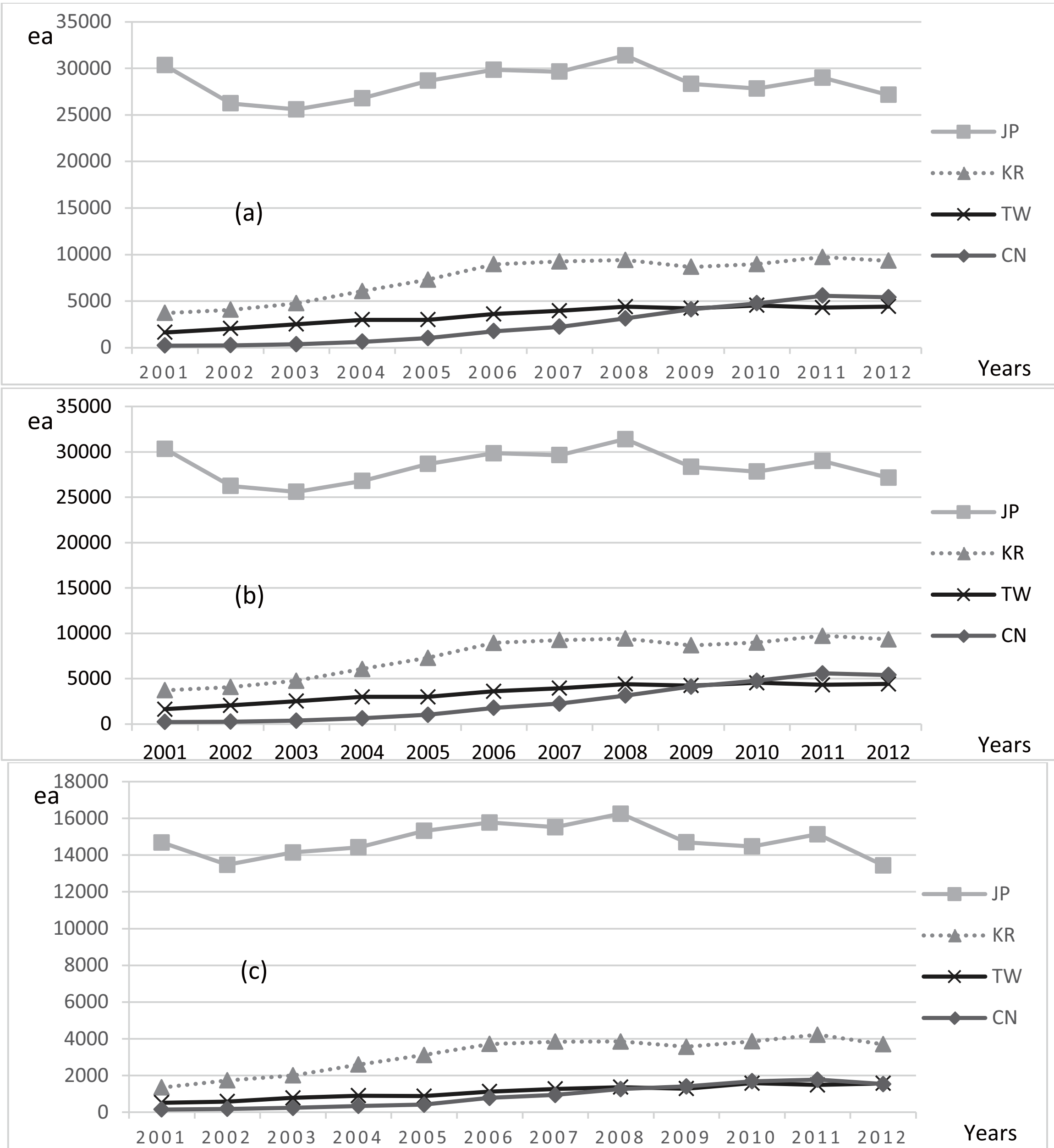
Note: symbols of graphic lines denote as follows: Ss-specialized suppliers, Ii-information intensive firms, Si-scale intensive firms, Sb-science based firms, and Sb-supplier dominated firms.

Figure 1: Patenting trends of Korea in the United States by industrial types

Comparisons of US patents among Korea, Japan, Taiwan and China may show interesting implications on their innovation activities. Let us look at three industry types: the information intensive industry, the specialized suppliers industry and the science based industry. Firstly, it is discovered that Japan showed absolutely the greatest in US patenting in terms of scale in all of three industrial sectors among four countries. However, its numbers of patent applications are somewhat decreasing; whereas those of Korea, Taiwan and China are increasing. As the results of such trends, it is expected that innovation gaps between Japan and other three countries may be narrowing over the twelve years. In fact, export performance of Japanese industries has continuously declined, while those of other three countries increased during the same period.

Second feature found in the trends is that China has caught up the scale of US patenting activities of Taiwan both in the information intensive industry and in the science based industry in 2008, and in the specialized suppliers industry in 2009, and the science based industry in 2008. Chinese catch-ups in all of the three industrial sectors imply that innovation capability and innovation performance of Chinese firms already surpassed that of Taiwan. Export market shares of China may as well have overpassed that of Taiwan too. It is surprising that Taiwan with relatively strong networks of small &

medium sized firms tends to lose its innovation base in the specialized suppliers industry in which strong small & medium sized firms hold competitive advantage. Korea seems to maintain the gap with China in US patenting. These four countries have shown an interesting game in an innovation league.



Notes: Abbreviations are as follows: JP denotes Japan, KR Korea, TW Taiwan and CN China

Figure 3: Country comparison of US patents in three industrial sectors: (a) information intensive, (b) specialized suppliers, and (c) science based

4. Industry differences in convergence innovation

According to a study on the innovation of textile machinery (Lee, Kong-rae, et al., 2015) convergence innovation takes place mainly when a firm enters into new industrial areas based on their core competence. Firms having a core competence in some technology fields tend to endeavor to make outside-in or inside-out type convergence innovation depending on market situation. When a firm loses a market in its core competence areas, the firm tries to apply them to make new products and processes, which can help enter into new markets. This is called inside-out type of convergence innovation. Conversely, a firm that gains competitive advantage in core competence areas tends to actively apply other technologies to make new products and services in its own areas and this is called outside –in type of convergence innovation.

Are the trends of such convergence innovation same or different by industrial sectors? Let us look at overall trends of convergence innovation taking place in Korea over the last twelve years before looking at the sector level trends. Figure 4 illuminates overall trends of convergence patents of Korea. At the first sight, its trend has been in line with that of total US patent. However its shares out of total patents are declining over time from 31.8 percent in 2001, 30.6 percent in 2008, and 26.9 percent in 2012. These trends imply that convergence innovation of the Korea industry has not been much changed at all. Does it really so? Looking at the trends at the meso level may help answer this question.

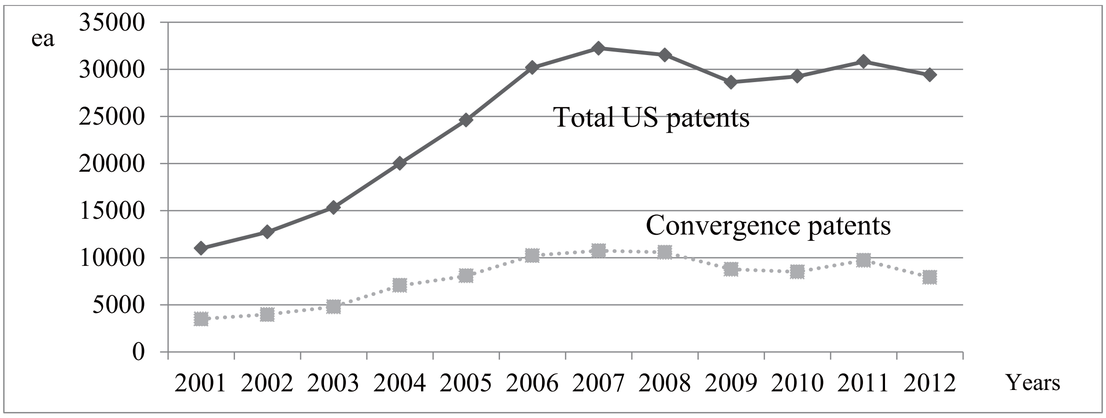
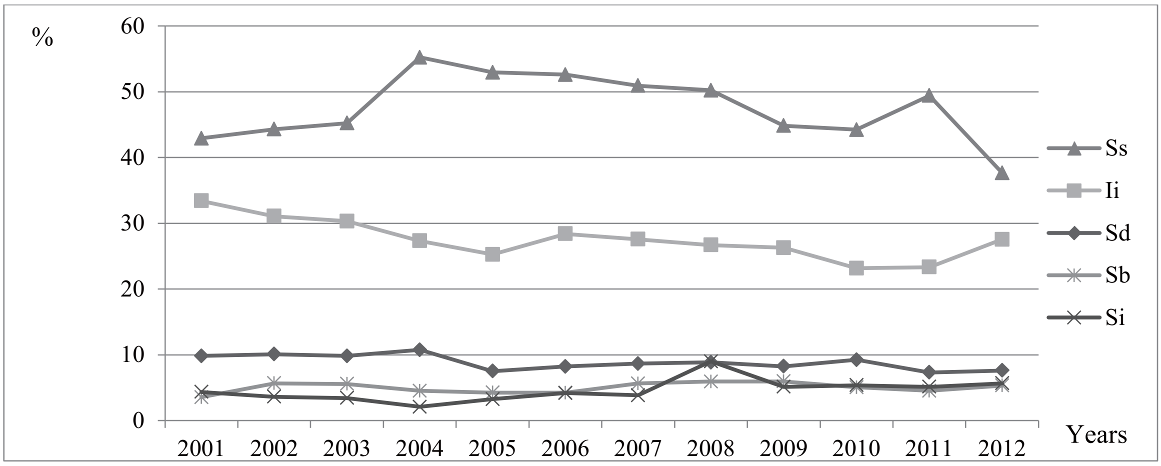


Figure 4: Trends of convergence patents of Korea in the United States

In order to scrutinize the trends of convergence innovation at the meso level, we calculated two kinds of convergence as previously mentioned: intra-industry convergence, and inter-industry convergence. Intra-industry convergence is defined as the percentage share of convergence patents with more than one IPC class citations in technology fields within an industry sector. As the results of calculating intra-industry convergence, we obtained graphical results as shown in Figure 5. Surprisingly the specialized suppliers sector has taken the greatest degrees of intra-convergence innovation fluctuating from 40 percent to 50 percent out of total patents. It implies that diverse machinery has been rapidly innovating by converging outside technologies, particularly IT technology or being converged.



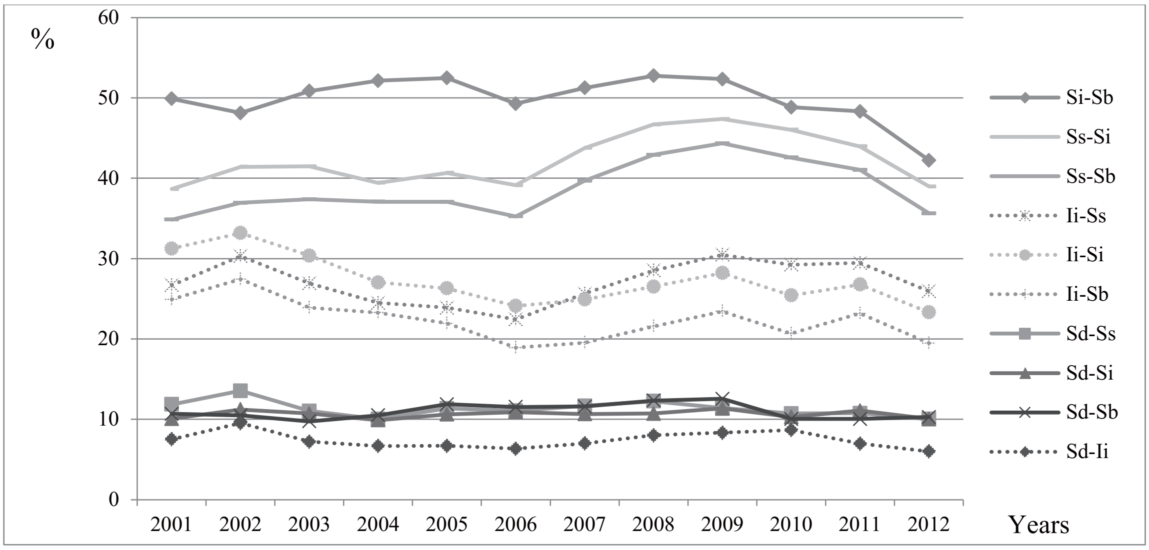
Note: symbols of graphic lines denote as follows: Ss-specialized suppliers, Ii-information intensive, Si-scale intensive, Sb-science based, and Sb-supplier dominated.

Figure 5: Trends of intra-industry convergence of Korean industries

The second industry revealing high degree of convergence innovation has been taking place in the information intensive industry. We expected that this industry may have the greatest degree of convergence innovation because of exploiting technological opportunities created by the emergence of innovative information and telecommunication technology. However, the reality does not show such trends. There have been relatively active convergence innovations in the information intensive industry, but remaining around 30 percent level. Moreover, it has a rather declining tendency as shown in figure

5. The information intensive industry seems to play a role of infrastructural technology in the innovation of vast areas of the manufacturing industry due to its application to vast industrial areas.

The other three sectors such as the scale intensive, the science based, and the supplier dominated industry do not show an impressive trend. The supplier dominated industry including food processing, textiles, metal products, glass and ceramics, non-ferrous metal, lighting instruments, etc. has showed a medium degree of convergence innovation revealing around 10 percent over the period. The other two industries showed even lower than that of the supplier dominated industry with less than 10 percent. The scale intensive and the science based industry are actually important for the Korean economy to create and build up the next generation industries to increase potential growth rate of the Korean economy.



Note: symbols of graphic lines denote as follows: Ss-specialized suppliers, Ii-information intensive firms, Si-scale intensive firms, Sb-science based firms, and Sb-supplier dominated firms.

Figure 6: Trends of inter-industry convergence of Korean industries

Turing to the inter-industry convergence innovation, Figure 6 reveals the trends of inter-industry convergence of the Korean industries. The degree of inter-industry convergence is calculated as the percentage share of convergence patents with more than one IPC class citations between technology fields that belong not to own industry sector but to other industry sector. There are 10 pairs of inter-industry convergences (Si-Sb, Ss-

Si, Ss-Sb, Ii-Ss, Ii-Si, Ii-Sb, Sd-Ss, Sd-Si, Sd-Sb, and Sd-Ii) since there is the classification of five industrial sectors. As the results of calculating 10 pairs of inter-industry convergence, we obtained graphical results as shown in Figure 6**.**

The greatest inter-industry convergence appeared in the pair of Si-Sb (the scale intensive and the science based). It is assumed that the scale intensive firms like motor companies having huge scale of smart manufacturing system have actively achieved convergence innovations for equipping their competent production systems. The next is followed by the convergence innovations between the specialized suppliers and the scale intensive (Ss-Si) and between the specialized suppliers and the science based (Ss-Sb). This tendency implies that machinery industry has been a focal industry of convergence innovation adopting forward, for instance, the automobile industry as a representative scale intensive sector and backward industries, for instance the precision instrument industry as a representative science based sector.

Inter-industry convergence between the information intensive industry and other industries did not take place much. It was expected that inter-industry convergence around the information intensive industry would be higher than any other pairs of convergence innovation. However, as expected, inter-industry convergence between the suppliers dominated industry which includes most traditional industries such as food processing (a beverage, food stuff and cigarettes etc.), textiles, metal products and other industries showed the lowest degrees of convergence. They have been regarded as less innovative industries as well as technologically less adaptive to other industries. They may continue to remain such characteristics.

Table 2: Convergence innovation matrix by industrial types of Korea

	Sd	Ii	Ss	Si	Sb
Sd	8.26	7.59	11.03	10.70	11.05
Ii	7.59	25.40	28.73	26.05	21.66
Ss	11.03	28.73	45.27	44.61	41.29
Si	10.70	26.05	44.61	6.06	48.90
Sb	11.05	21.66	41.29	48.90	5.37

Notes: 1) unit of figures in each cell indicates percentage of convergence patents out of total patents and 2) symbols of industrial types are same as those described in Figure 4.

The degrees of inter-industry convergence can be expressed as a matrix form that is here called as convergence innovation matrix as seen in Table 2. Five rows and five columns represent five industrial types respectively. Each cell denotes the degree of convergence innovation among which shaded cells indicate intra-industry convergences and other cells indicate inter-industry convergences. We can see that the greatest convergence appeared in inter-industry convergences between the scale intensive industry and the science base industry, and between the scale intensive and the science based accounting for 48.9 percent of convergence patents out of total patents respectively. The highest degree of intra-industry convergence appeared within the specialized suppliers industry revealing 45.3 percent of total US patents, followed by the information intensive industry.

5. Implications for open innovation

We went through the trends and patterns of convergence innovation at the meso and macro levels. Taking convergence responding to the needs of different sources as well as the divergent market demands into account, such sources as customers, ideas and knowledge of users and suppliers, knowledge-intensive services, scientific and technological knowledge, and networks can be triggers or drivers of convergence innovation. The ability to utilize such diverse sources strategically enables a firm to make convergence innovation and gain a unique advantage which becomes a core competence of the firm.

Open innovation has been defined as ‘the use of purposive inflows and outflows of knowledge to accelerate internal innovation, and expand the markets for external use of innovation respectively’ (Chesbrough et al, 2006). A number of studies on the open innovation have been following since Chesbrough made a pioneering work on the terminology ‘open innovation’. Open innovation concept has obviously created a new paradigm of innovation studies along with the expansion of the scope and scale of innovation theories. It also embraces the benefits of openness as a means of expanding value creation for both public organizations and private firms. Then, how shall we link convergence innovation to open innovation, which must be revealing different dimensions of modern innovations?

Convergence innovation provides many implications strategically and structurally for open innovation. It has been taking place mainly by applying IT technologies to vast areas of conventional technologies. Its nature is intrinsically associated with open innovations as convergence involves interaction among diverse innovative actors and knowledge integration. As the scope of convergence innovation tends to expand, the scope of open innovation may too expand. This means that cooperation partners of firms become wider and wider as the scope of open innovation expands. Convergence innovation and open innovation require not only conventional science and technologies, but also knowledge of social and humanity science beyond science and technology. Therefore, the degree of convergence and open innovations out of entire innovations may increasingly appear as time goes by.

As convergence innovation increases, technology aggressiveness of firms is like to be stronger and stronger in the future. Firms pursuing convergence innovation necessarily require diverse sources of knowledge, which also require a more open approach to incorporate external knowledge into internal innovation. Lichtenthaler and Ernst (2009) found from the analysis of the survey results of 155 German firms that technology aggressiveness has a strong influence on a firm’s approach to open innovation. With the trend toward more convergence and open innovation, firms may have to or choose to acquire external technology and its exploitation, which means an increasing technology aggressiveness of firms.

In order to facilitate the growth of firms by applying convergence and open innovation, business strategy of firms needs to be reshaped. Chesbrough, et al (2006) argued that embedding open innovation principles into strategies and business practices plays a critical role in narrowing two types of growth gaps: the one is that within the current business and the other is those with a potential new business. When internal R&D cannot meet growth objectives, a growth gap ensues. They recommended strengthening or extending the current business by optimizing execution of the existing product pipeline to close the first type of growth gap, and identifying and developing potential new businesses in emerging technologies to close the second type of growth gap. This argument obviously implies that in addition to open innovation principles, adopting convergence innovation principles is vital to develop new businesses by application of new converging technologies.

Lastly, convergence innovation is likely to foster value capture and sustainability of firms as open innovation has made. Explanation made by Chesbrough and Appleyard (2007) implies the possibility of value creation by a convergence innovation that requires further exploration. They showed ‘open business models’ as an example of value creation in the context of open source software. They listed seven activities playing roles in the creation of open business models: support, subscription, professional services, proprietary extensions, dual license (licensing under different licenses), devices, and community source. An example of the first three activities is SugarCRM, and that of proprietary extensions and dual license is MySQL. The device model has been seen in the case of Mazu Networks on network security. The community source model entails having users with identical needs pooling their resources to address the particular needs.

6. Concluding remarks

This paper took a glimpse of the shape of convergence innovation at the sectoral level. It measured intra-industry convergence and inter-industry convergence of the Korean industries and made a convergence innovation matrix based on the results of the analysis. The specialized suppliers sector has taken the greatest degrees of intra-convergence innovation fluctuating from 40 percent to 50 percent out of total patents. It implies that machinery has been rapidly innovating by integrating outside technologies. In terms of inter-industry convergence, the greatest inter-industry convergence appeared in the pair of Si-Sb (the scale intensive and the science based), followed by the convergence between the specialized suppliers and the scale intensive (Ss-Si) and between the specialized suppliers and the science based (Ss-Sb). This tendency implies that the machinery industry has been a focal industry of convergence innovation integrating forward and backward industries.

What do the trends of convergence innovation imply for open innovation? First of all, cooperation partners of firms become wider and wider as the scope of convergence innovation expands. Convergence innovation requires not only conventional science and technologies, but also knowledge of social and humanity science beyond science and technology. Firms require a more open approach to incorporate external knowledge into internal innovation in response to widening the scope of convergence innovation. In addition to the adoption of open approach, the adoption of convergence principles will be vital to develop new businesses based on new converging technologies.

As Gassmann, et al argued (2010), one needs to adopt nine different perspectives for exploiting future convergence innovations by open innovation approach. The spatial perspective concerns with globalization of convergence innovation, for instance, sourcing diverse knowledge by locating R&D centers in talented regions. The structural perspective deals with disaggregation of value chains of industries as one adopts greater specialization due to more complex technologies. The user perspective is to incorporate diverse user knowledge into the process of convergence innovation. The supplier perspective includes the downstream side of the innovation process like early integration of suppliers' role. The leveraging perspective is to adopt business model thinking which is crucial in the commercialization of IPRs. The process perspective is to apply outside-in, inside-out and coupled type of convergence innovation. The tool perspective is to adopt a set of instruments that enables customers to create or configure their own products. The institutional perspective deals with compensation, protection, co-exploitation of convergence innovation, and so on. Lastly, the cultural perspective concerns with a mindset such as creation of community values and social norms, communication and trust relationship of stake holders, decision making of collective agents, and so on.

We hope that our findings will provide a clue to developing further theories on spatial, structure, process, institutional, and cultural aspect of convergence innovation. Innovation studies that focused on convergence innovation need to deepen their framework toward various perspectives in the future. Research performances achieved by open innovation studies and their research framework might provide many insights into the exploration and exploitation of future convergence innovation studies.

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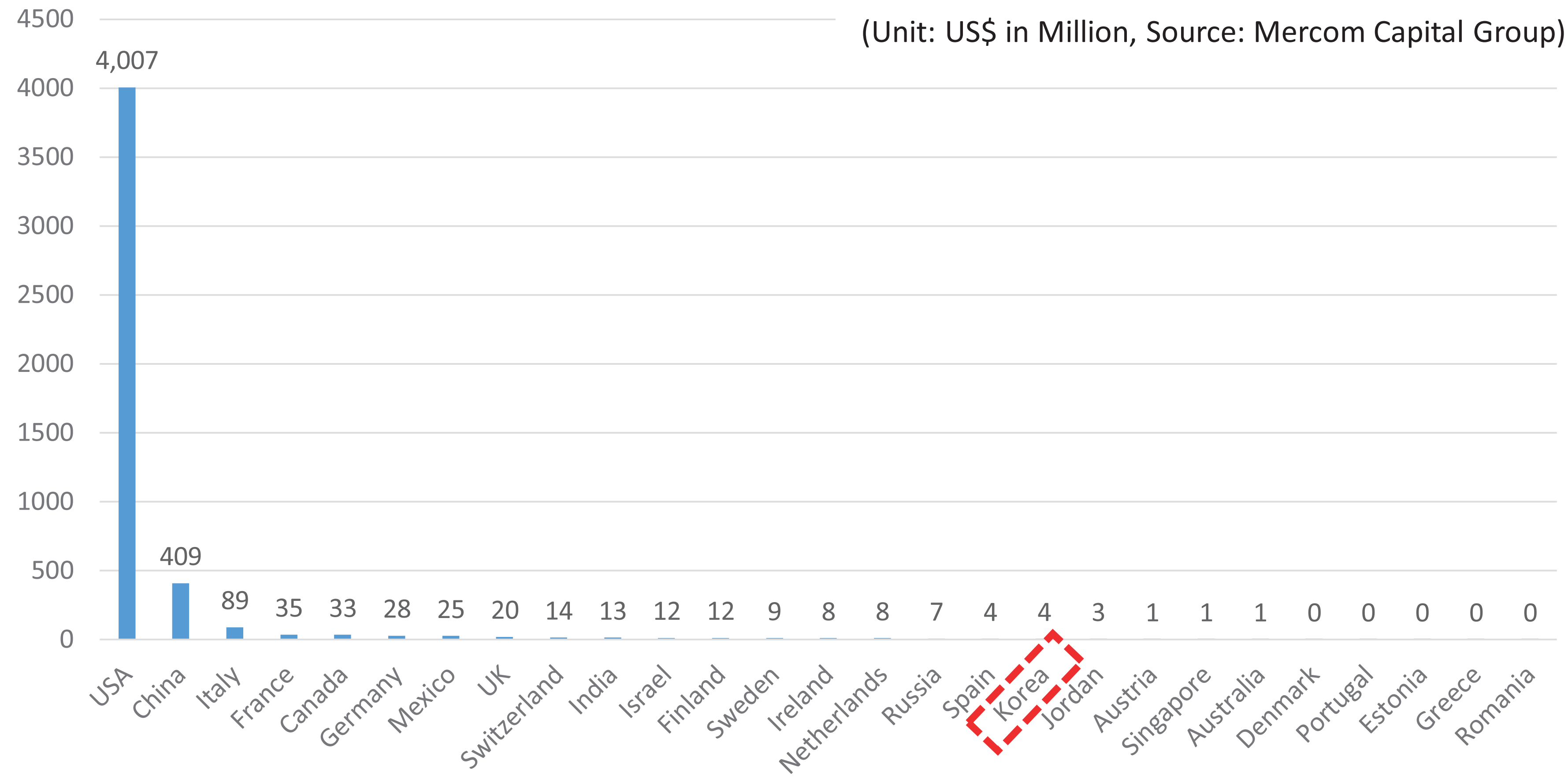
Healthcare IT growth strategies for Daegu

Jinwoo Im @ DGIST

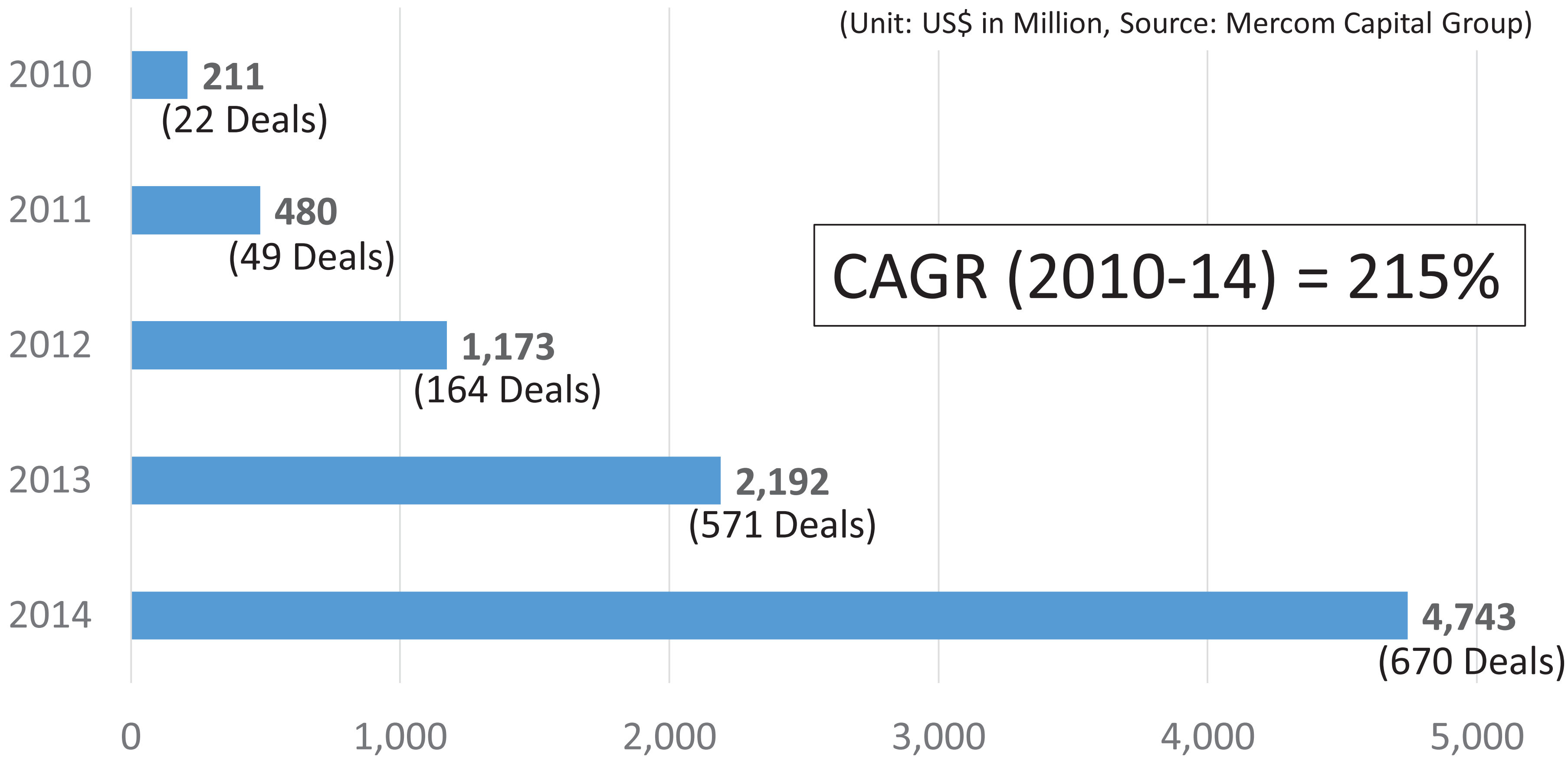
Money talks!

Korea, small fraction of Healthcare IT VC funding

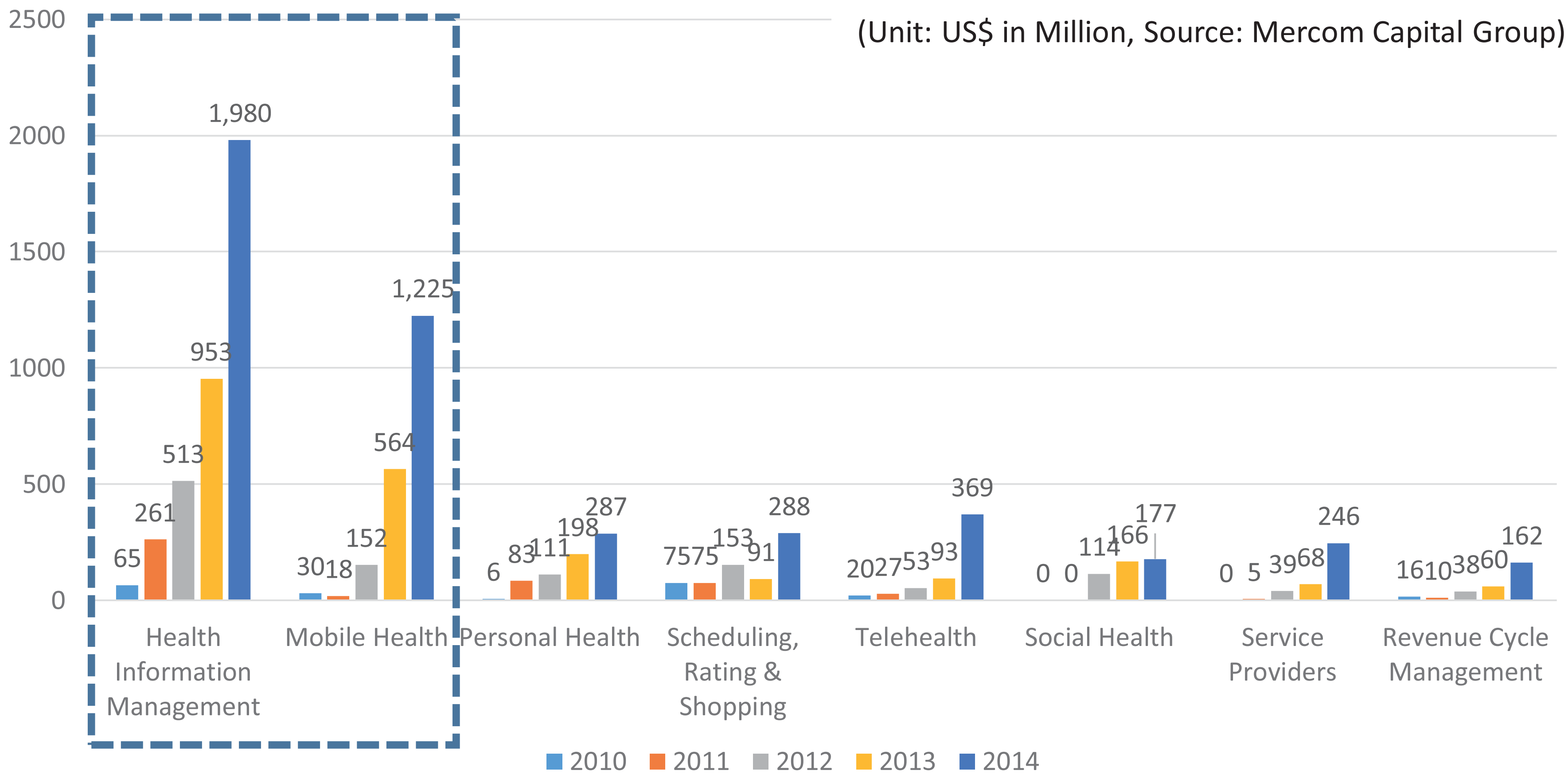
(Unit: US$ in Million, Source: Mercom Capital Group)



Healthcare IT VC funding increases rapidly

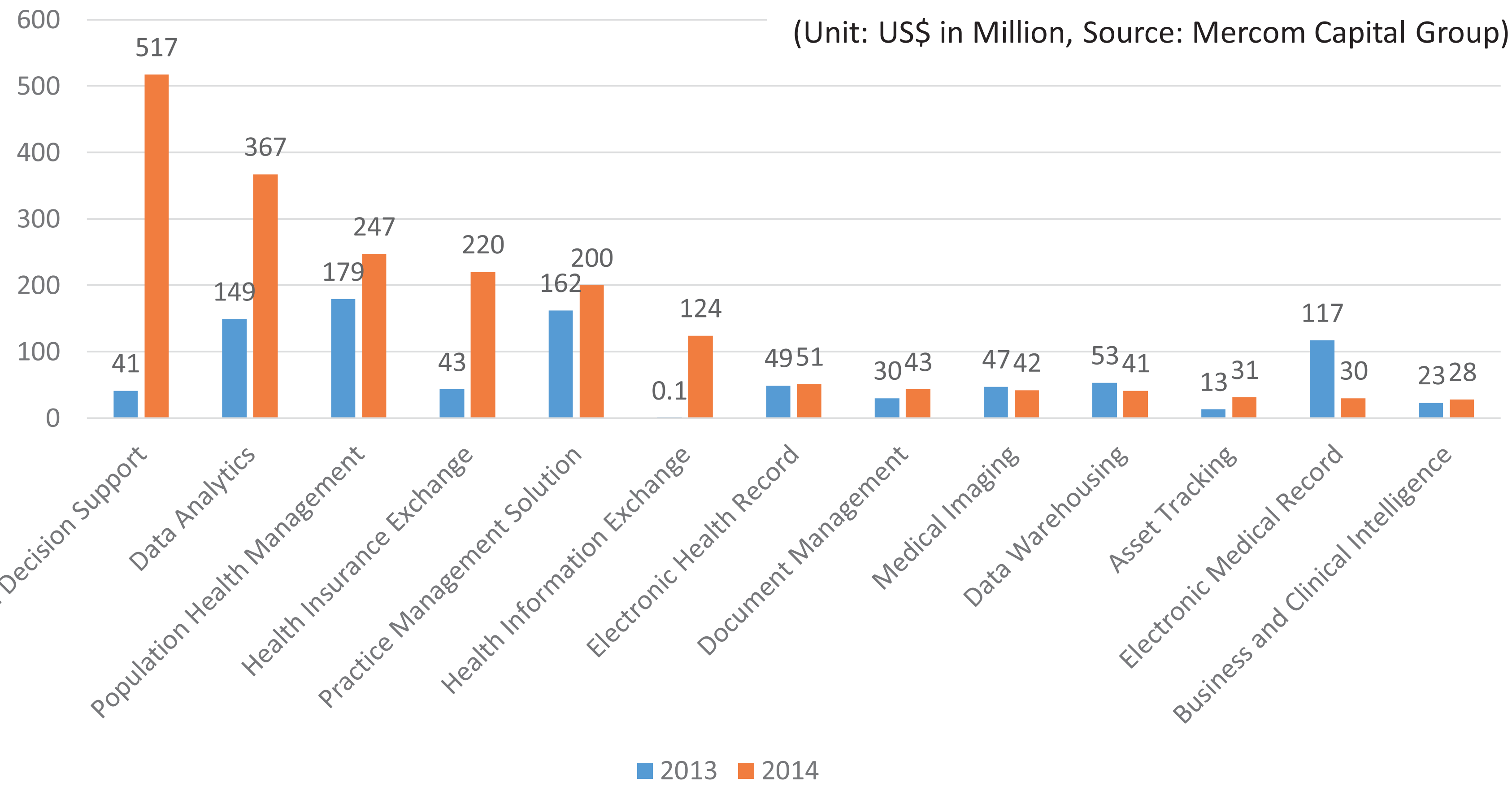


‘Health Information Management’ and ‘Mobile Health’ are dominant in VC funding

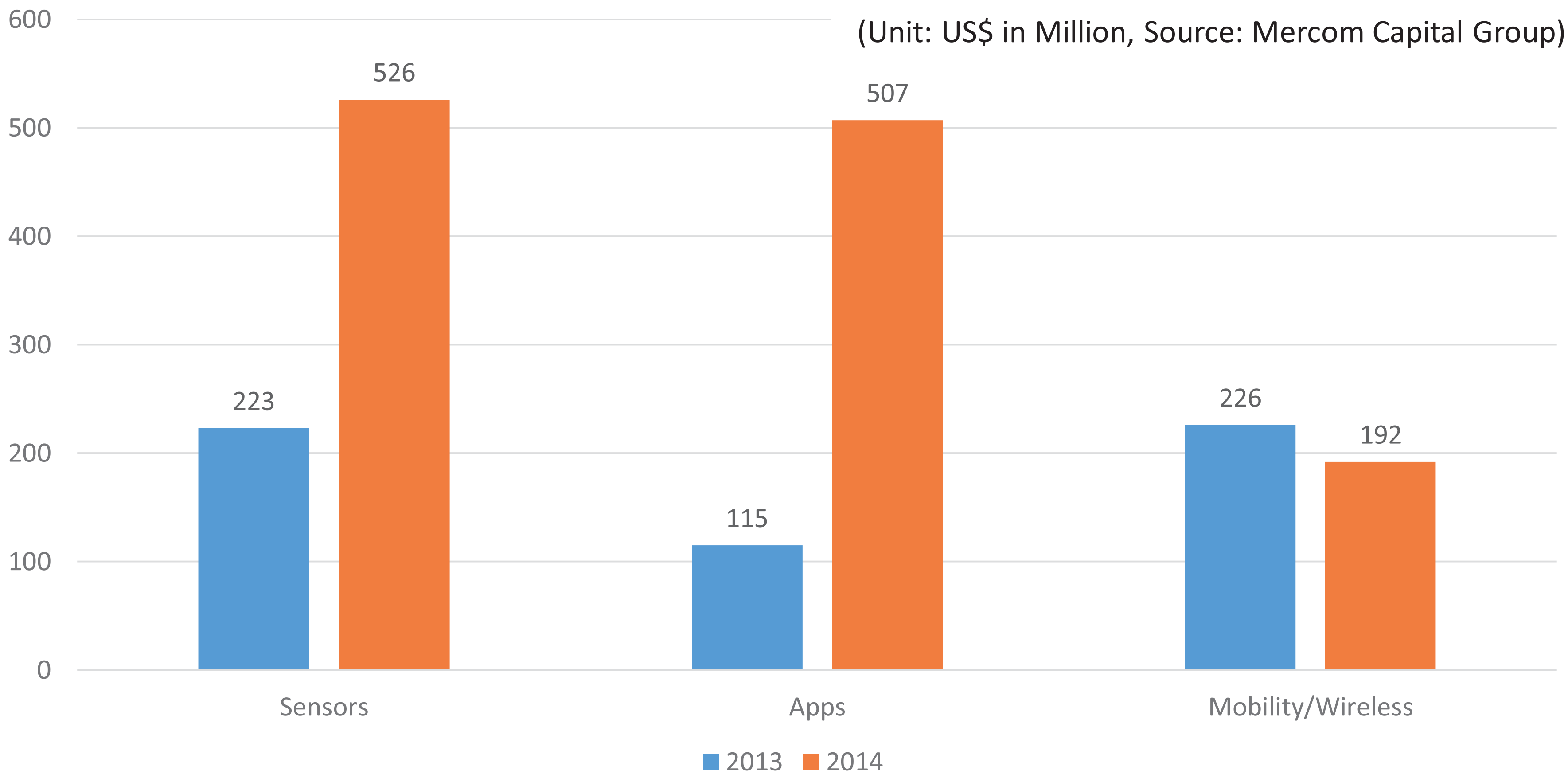


‘Clinical Decision Support’ is most funded within ‘Health Information Management’

(Unit: US$ in Million, Source: Mercom Capital Group)



‘Sensors’ and ‘Apps’ are most funded within ‘Mobile Health’



Healthcare IT – Top VC funding rounds in 2014

Company	Country	Funding type	Amount ($M)	Investors
Nant Health	USA	Series B	320	Kuwait Investment Authority (KIA), Verizon, Celgene, BlackBerry, Blackstone
	USA	Undisclosed	135	Kuwait Investment Authority, BlackBerry
Flatiron	USA	Series B	130	Google Ventures, First Round Capital, Laboratory Corporation of America
Alignment Healthcare	USA	Undisclosed	125	General Atlantic
Proteus Digital Health	USA	Undisclosed	120	Undisclosed
Guahao.com	China	Undisclosed	100	Tencent
Dedalus Healthcare Systems Group	Italy	Undisclosed	89	Hutton Collins
American Well	USA	Series C	81	Undisclosed

Healthcare IT – Top VC funding rounds in 2014

NANTHEALTH

Healthcare IT – Top VC funding rounds in 2014

FLATIRON

Healthcare IT – Top VC funding rounds in 2014

Alignment Healthcare

Healthcare IT – Top VC funding rounds in 2014

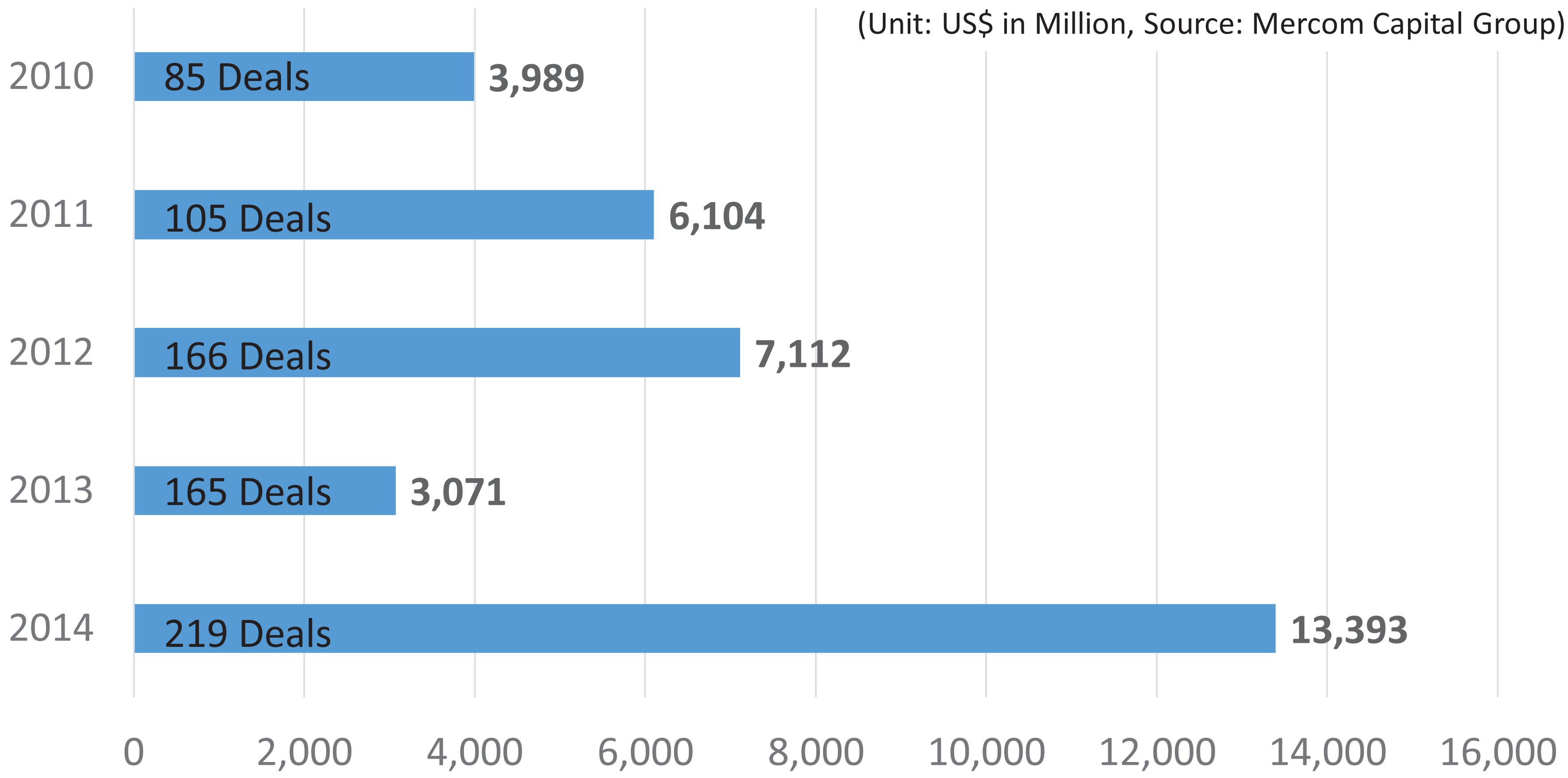
proteus®
DIGITAL HEALTH

Healthcare IT – Top VC funding rounds in 2014

Healthcare IT IPO activity in 2014

Company	Date	Amount ($M)	Country	Stock Exchange
IMS Health	4/9	1,300	USA	NYSE
Castlight Health	3/19	204.2	USA	NYSE
Everyday Health	3/27	100.1	USA	NYSE
Orion Health	11/26	97.7	New Zealand	NZX
Imprivata	1/30	86.3	USA	NYSE
Connecture	12/12	53.1	USA	NASDAQ

Healthcare IT M&A gets more active



3 implications

① Needs

② Regulation

③ Money

Thank you!

The Study for Network Structure between intellectuals and urban innovation

Hee Dae Kim(DIP), Chang Yong Mun(Daejeon Metropolitan City), Duk Hee Lee (KAIST)

Abstraction

Due to the late capitalist industry and ICT -based convergence it has accelerated this global competition. Accordingly, the inter-city competitiveness was more important than competition between countries. City failed to adapt to changes in the global era, failed to have the urban competitiveness. To become sustainable city, it is required to have creativity and dynamism within each individual city.

There are some measures of the dynamism and creativity cities. R.Florida suggested three factors in his book <The Creative Class>; Technology, Talent, and Tolerance. Also, H.S.Lee said five factors to be creative city; Variety, Innovative Identity, Talent, Activity, Livability & Leadership. To simplify these measurements Index furthermore, It can be summarized into three factors; change-making culture (Beyond the path-dependency) Human Resource (Innovative People) and the Vision from the future (Vision Provider).

The lack of these factors result in the bottom of the corresponding local budgets matched to the Government Insufficient budget is prepared through issued municipal bonds The city under this vicious circle goes to a moratorium.

To avoid this phenomenon and be sustainable city, there should be done a completely different approach to previous policies. In other words, rather than going to create the future, the police have to establish to be drawn from the future. Urban design to be attracted from future can see current problems more clearly. Then, the things to go and what to cut current will be revealed. Through functional design through a multi-party participation and urban design of the retroactive manner from the future, the city can be transformed into a sustainable one.

The Case of R&D Intermediate Organizations in Daegu Technopark

YoHan Kim & Hyojin Kwon
(Daegu Technopark)

Abstraction

대구테크노파크
정책기획단

SOItmC & KWCS 2015

The Case of R&D Intermediate Organizations in Daegu TP

June 17, 2015

Daegu Technopark Regional Innovation Agency
Creative Economy Planning Division / Director Kim YoHan
Policy Analysis Department / Senior Researcher Kwon Hyojin

Contents

Ⅰ. Background & Necessity of the Knowledge research cell group

대구테크노파크 정책기획단

1. Paradigm conversion into value creation–type R&D

In the 4th-generation R & D, creation of market-dominating products is required through overall link of strategy–innovation–R & D

1st generation	2nd generation	3rd generation	4th generation
Research-type R & D	Management-type R & D	Strategy-type R & D	Innovation-type R & D
▪ Input-centered linear model ▪ Regularize company R & D ▪ People (R & D workforce) ▪ Research & development	▪ Process-centered linear model ▪ Task management process, economic feasibility analysis ▪ Process ▪ Stage-Gate®, performance evaluation, process innovation	▪ Chain-linked model ▪ Strategic R & D, research institute – business department linkage ▪ Product (Technology portfolio) ▪ Strategic technology and technology road map; knowledge management	▪ Chain-linked model, network model ▪ Discovering new business lead by R & D ▪ Innovation-oriented 3P management ▪ Noncontinuous innovation, open innovation, creative/innovative management

Must break away from the imitation–implantation-type growth pattern and observe a creativity–development-type growth pattern

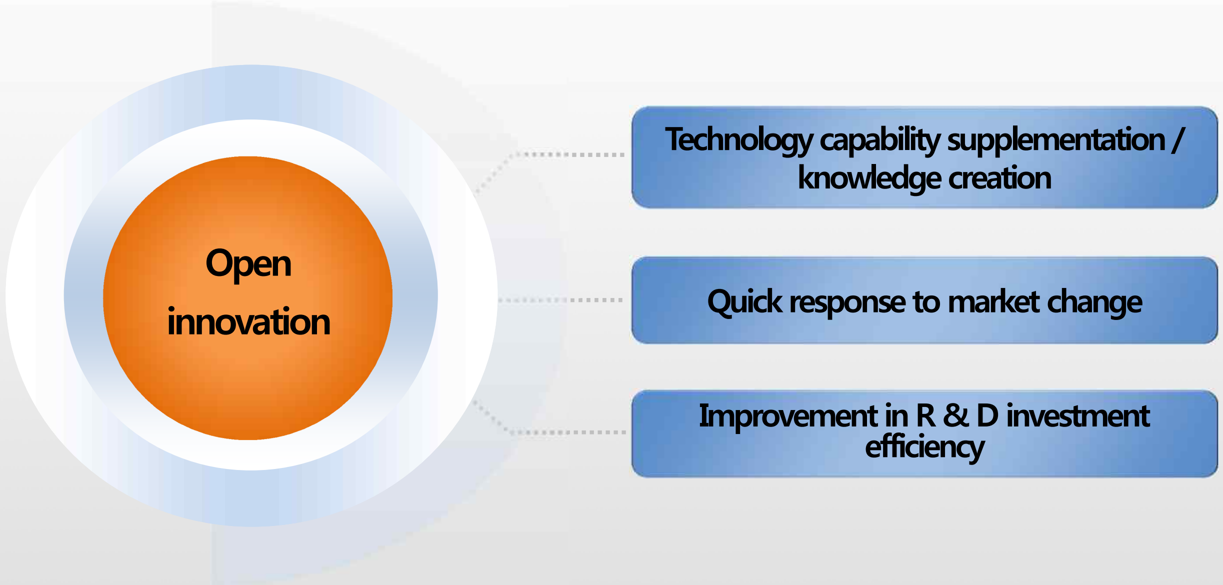
Management–efficiency-centered system		Creativity–effect-centered system
Faster, more	→	Emphasis on output quality/meaning
Emphasis on short-term/partial performance	→	Emphasis on consistent/overall performance
Manager/controller	→	Creativity/vision provider

R & D support system interacting with the market must be constructed

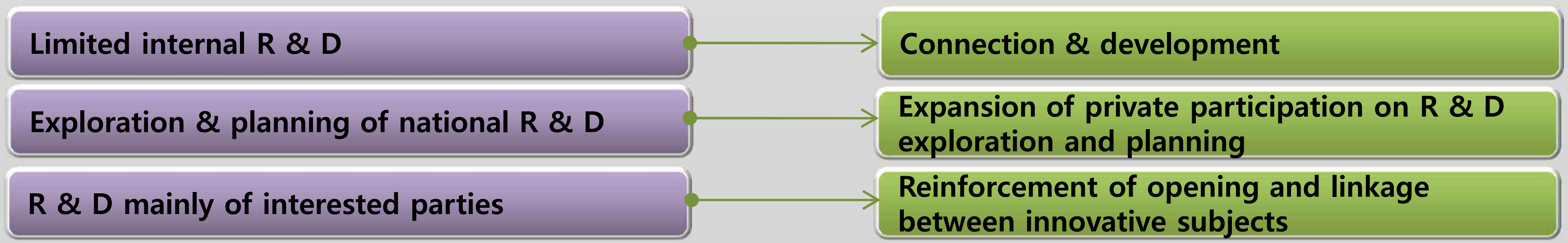
- Promoting knowledge exchange–convergence to construct a structure that can quickly link R & D performance with the market
- Private R & D support in which the company can lead in the creation of performance is required

2. Highlighting the importance of open-network R&D activity

Effectively using external resources to improve company competitiveness

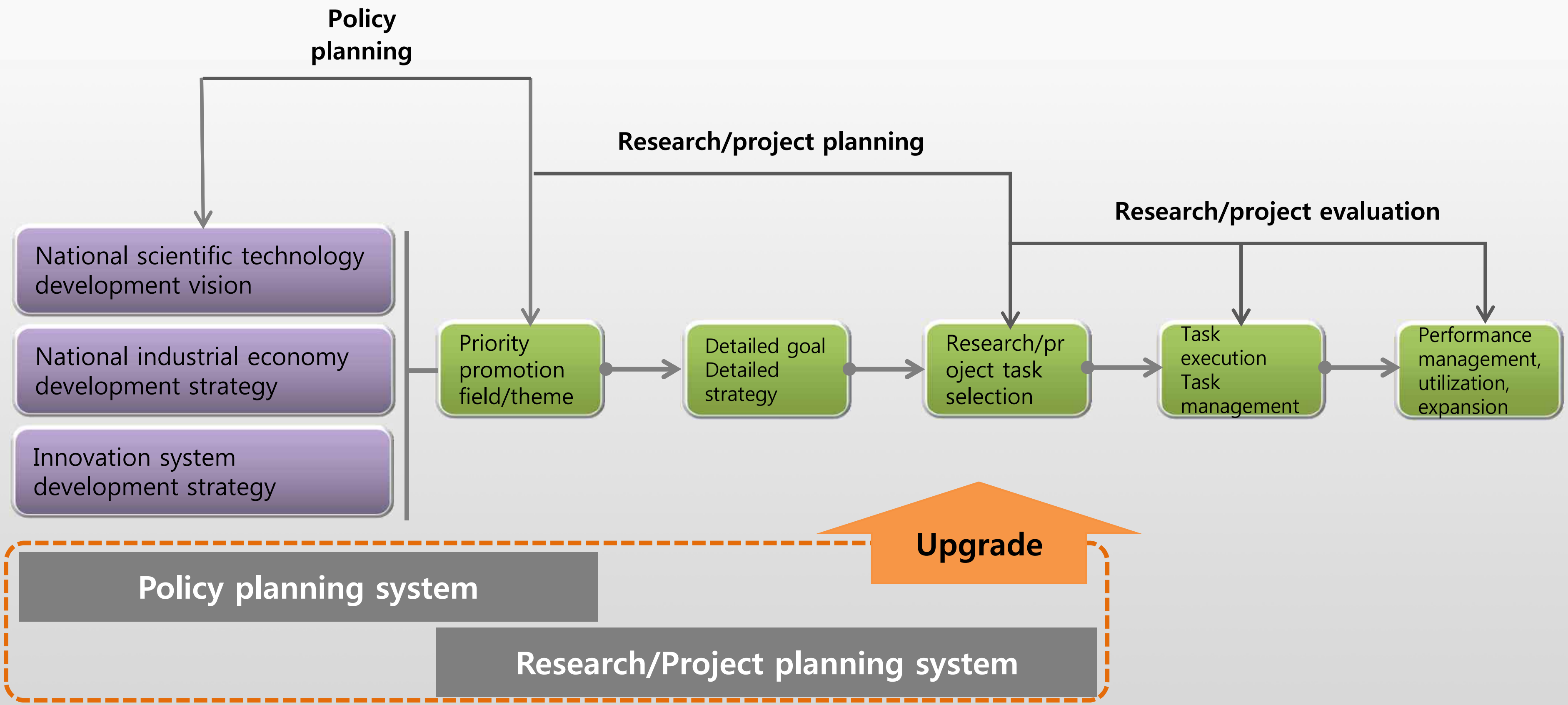


Performing effective R & D through open-network construction



3. Development direction of the innovation system (1)

Internal capability upgrade direction of the innovation system



- Joint planning of specialized road map
- International competitiveness investigation on the industry
- Faithfulness of industrial economy innovation statistics

Research evaluation system

Research system

Innovation system

3. Development direction of the innovation system (2)

Status and problems in the planning process

Beneficiary attitude / vision of both the company and the government

- Types of joint research works are stagnant and are therefore not evolving (Only seen as joint externally)
- True matching fund method by the government – Convert to the basics of private partnership (PPP)

The point of participation of the company must be preceded

- Stages that should be prioritized for company participation are policy (strategy) planning and research business (strategic technology discovery) planning stages
- The upper frame must be expanded in the overall system
- In a step-by-step perspective, the adjustment of communication with the company must be reinforced in the FRP planning

Biased technological planning to have absence in relational planning

- True planning requires not only the discovery of a technology theme, but also partner planning to enable in-depth company participation and sophistication in its joint research form on its process

4. Requirement of mechanism promoting coevolution of the research community

Cultivating various research organizations strategically to induce effective and sustainable cooperation

- "Precedence of the point of participation of the company" from the exploration–planning stage to expand the base for enterprise-oriented R & D
- In the present, because of the one-time/formal execution of joint research and cooperation, actual performance is not accomplished, and evolution and development are stagnant
- Voluntary participation by the company is low, and organic partnership is not formed

Visible Innovation Field

Invisible Innovation Field

Research community

Planning community

Exploration community

SERI.org Knowledge Hub for Creative Solutions
- SERI Forum

산업통상자원부
- Components and materials innovation research network project

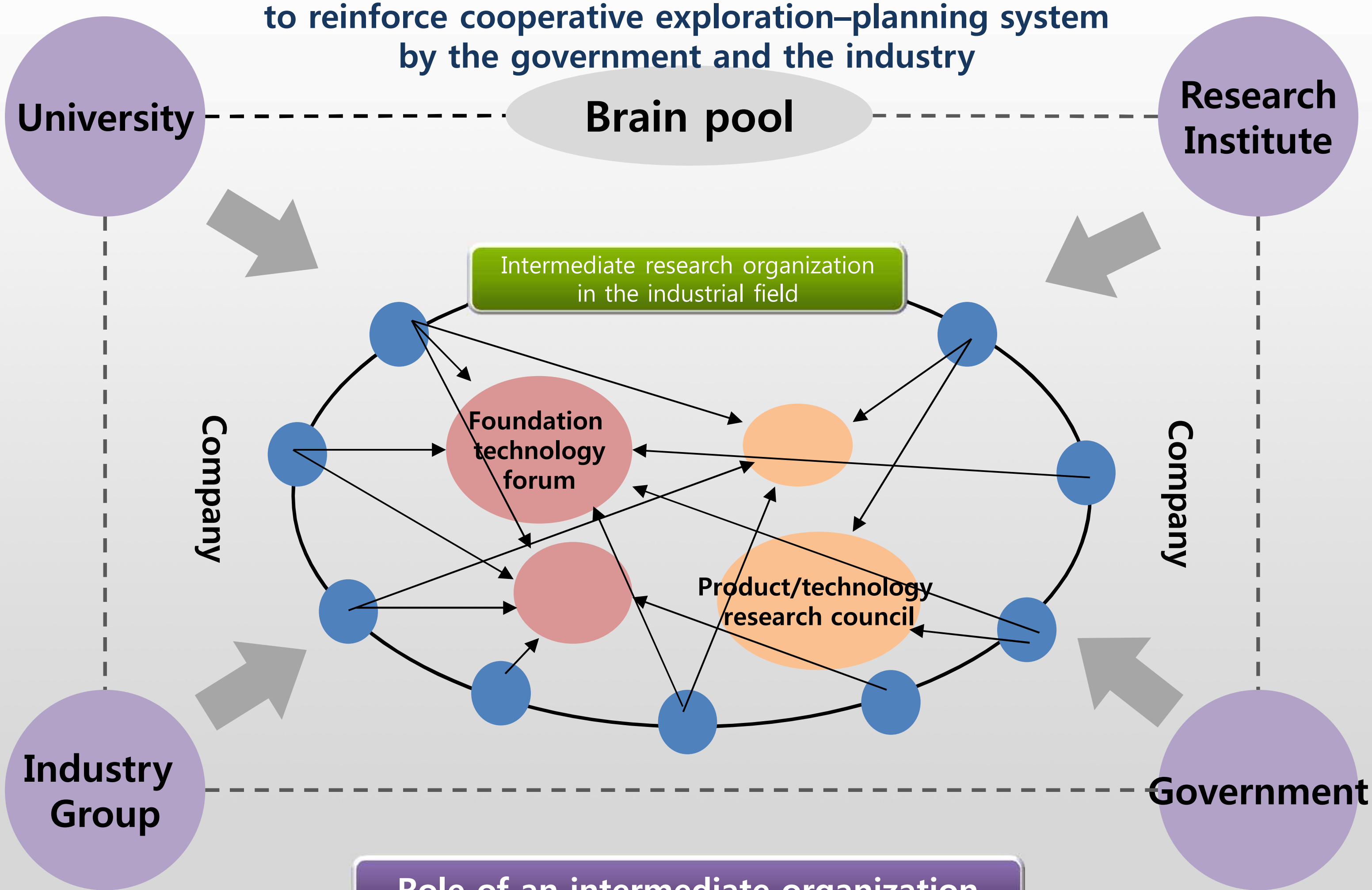
미래창조과학부 Ministry of Science, ICT and Future Planning
- Industry-University-Research Institute R&D cooperation network

중소기업청
- Technology innovative small group support project
- small & medium company technology competitiveness reinforcement partnership support project

- **Innovative resource elements are insufficient compared to advanced countries; thus, efforts of the community are now more emphasized than ever as the key to success**
- **Proactive small seed network develops gradually into a clear and strong community**
- **The company must develop its integration capability and concentration external innovative capability into core competence**

5. Technology innovation capability linkage through activation of the intermediate organization

Cultivating various R & D intermediate organization strategically to reinforce cooperative exploration–planning system by the government and the industry



Role of an intermediate organization

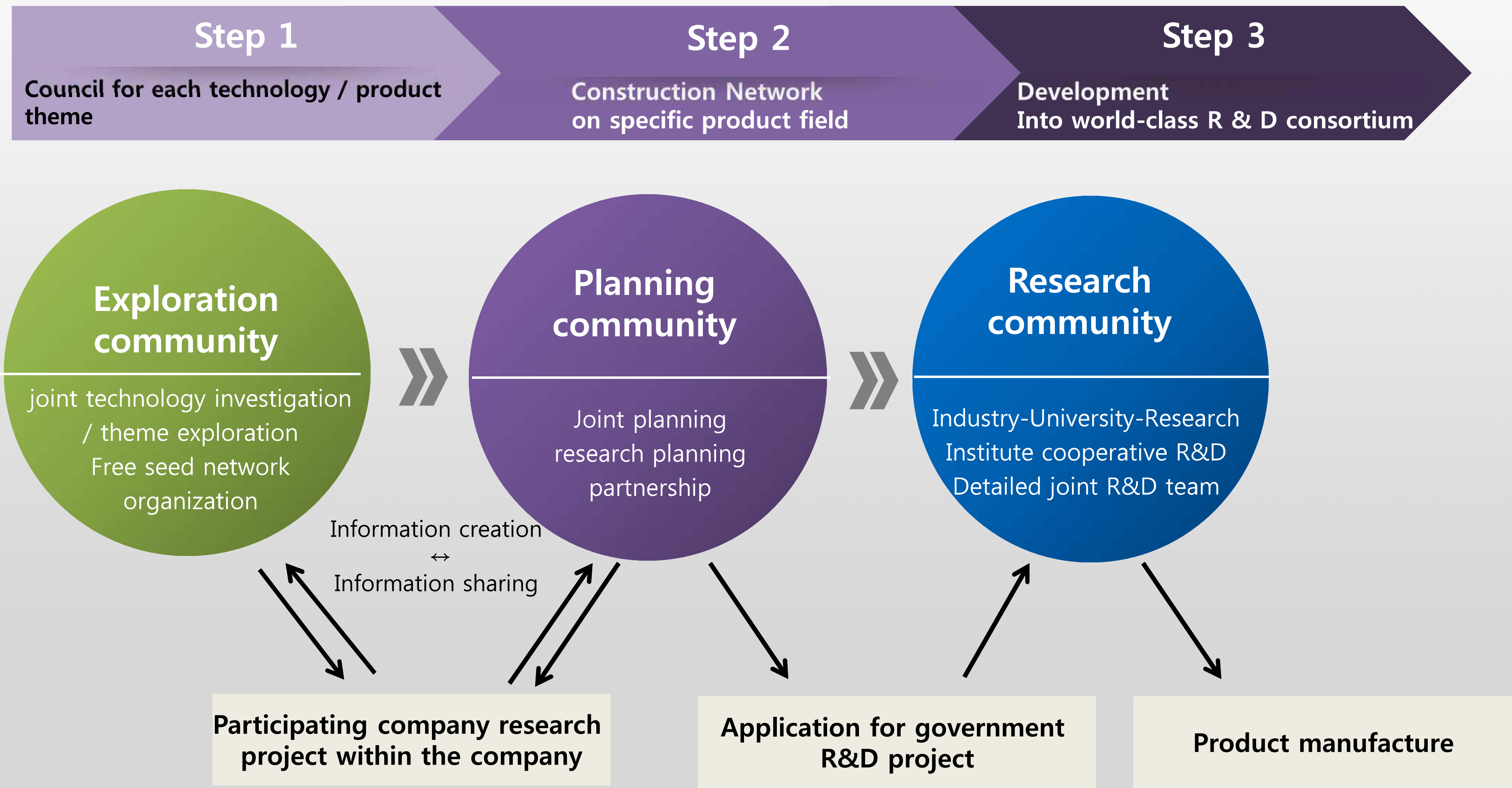
Mutual exchange and learning of technical knowledge / investigation and analysis of joint technology

Exploration and selection of joint research theme / Promotion of joint cooperation partnership

Planning of industrial promotion events / development of the government's proposal policy

6. Link between a government R&D project and an R&D intermediate organization

대구테크노파크 정책기획단 10

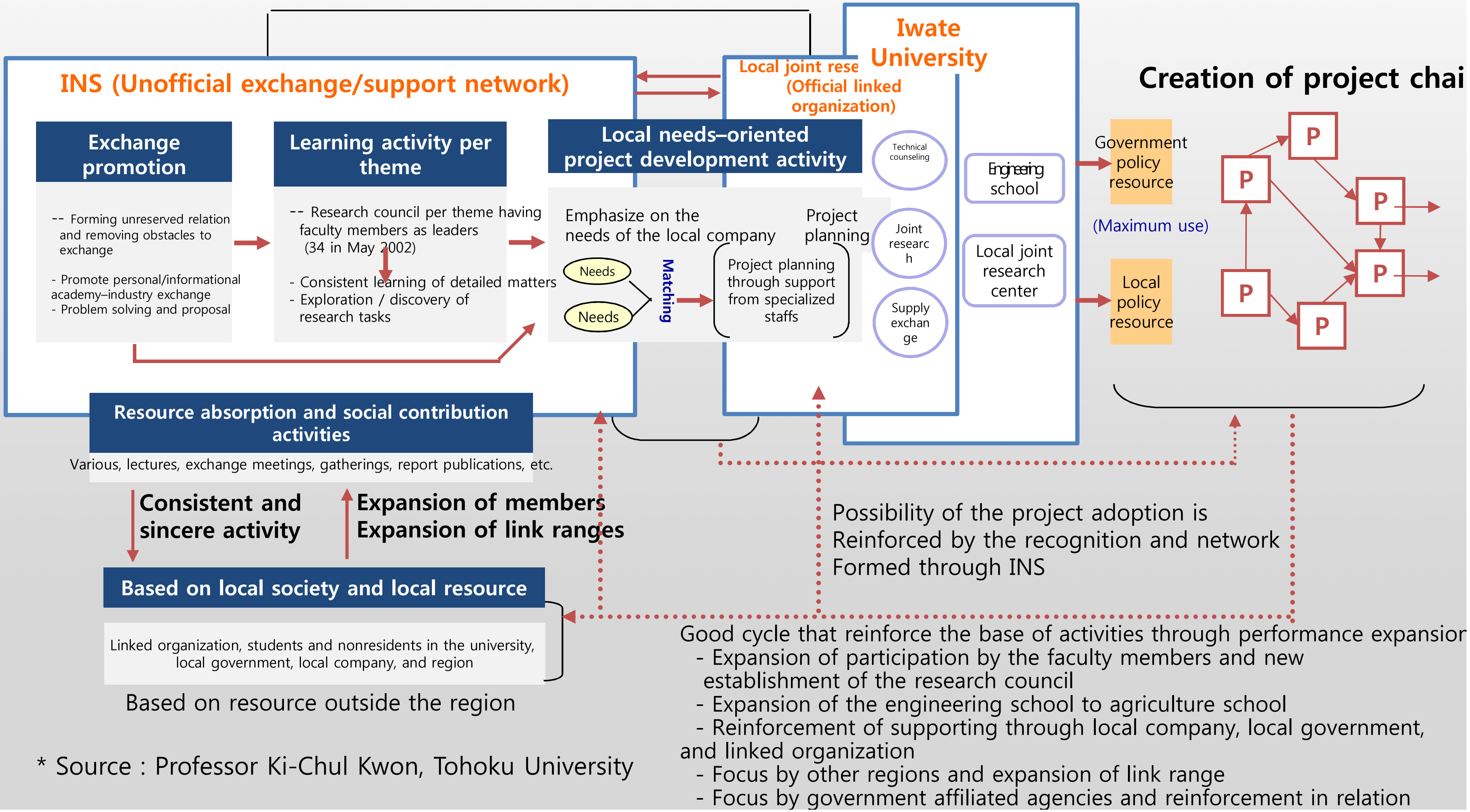


7. Foreign case study of R&D intermediate organization (1)

대구테크노파크 정책기획단

[Japan] Research planning dynamism of Iwate University

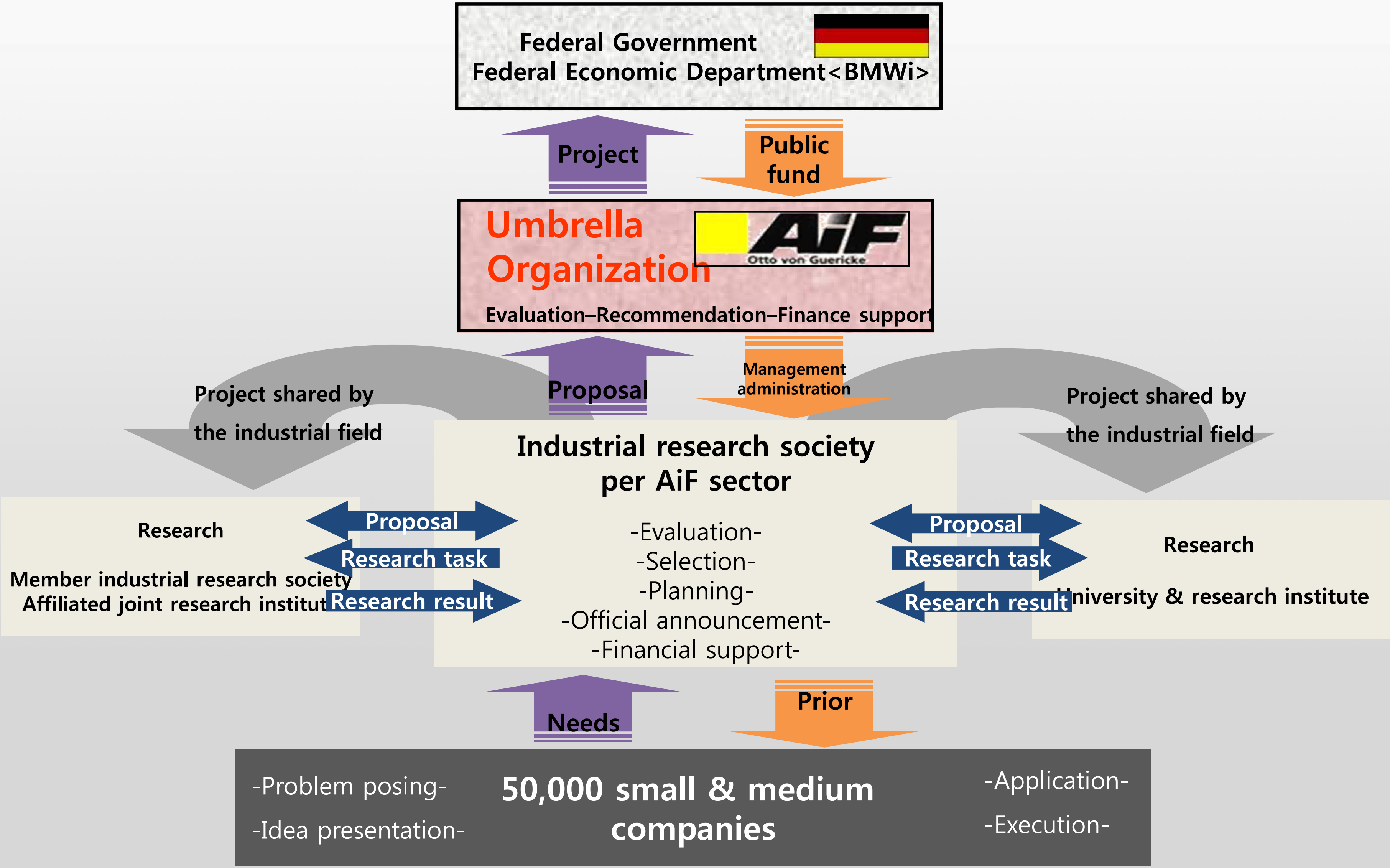
Integrated leadership performed by a few key faculty members
- Complementary operation by INS and local joint research center
- Promote academic–industry project expansion as the basic strategy



* Source : Professor Ki-Chul Kwon, Tohoku University

8. Foreign case study of R&D intermediate organization (2)

[Germany] Industry-University-Research Institute joint research lead by AIF



8. Foreign case study of R&D intermediate organization (3)

[USA] Research Joint Venture (RJV)

Establishment & composition

- **In 1984, the National Common Research Act** was enacted to establish the Research Joint Venture, and free joint venture of American companies are supported
- 861 RJC established (1984–2001)
- Approximately 6,500 companies and organizations participated to form a total of 13,000 memberships
- Organized among all industrial fields
- RJV forms are very diverse (limited company, joint company, consortium, industrial association, forum, academic–industry cooperation research institute, cooperative research contract, joint research project, etc.)

Operation

In principle, RJV is a joint cooperation form in the industry of voluntary business perspective

However, there are also many large-size RJVs established with more than 100 members for government-private joint purpose (This is an American cooperative organization method.)

- 31 RJVs
- The federal government concentrates the consignment of relevant research task to large-size RJV
- Construction of an academic–industry cooperative research system led by the industry

9. Difficulties in R&D intermediate organization activation

Relatively weak planning function	• Focus on the passive role of consigning the task and distributing funds • Insufficient function of funding through project planning
Lack of incentive for voluntary–competitive activation	• Like Germany, the system must be constructed to attract voluntary participation by their own necessity
Insufficient basic support system such as operation cost and investigation analysis activity	• The space required to perform common exploration, planning activity, and the basic funding of operational cost by the intermediate organization are insufficient • Lack support for reinforcing preliminary investigation and analysis activity for the efficient planning and exploration such as new technology change trend and market demand investigation
Lack of professional workforce (integrator)	• As the key support organization of the research planning system, a special integrator must be trained and secured for development

10. Current status of local small & medium companies

대구테크노파크 정책기획단 15

AS-IS	TO-BE	Goal
Lack of R & D task performance experience by small & medium companies	Activation of preliminary exploration and planning activity	**Discover excellent R & D task**
Weak open innovation system Lack of open innovation activity	Aim for broad innovation system including not only R & D under discussion, but also business model development and marketing	**Pursue value creating R & BD**
Insufficient innovative capability by small and medium companies	Innovative activity in the direction of creating value demanded by the market	**Create market-oriented innovation**
Knowledge ecosystem where various forms and tacit to transfer and exchange is not activated	Activation of small communities to share and learn knowledge	**Create convergent-integrated knowledge through group study**
Weak official and unofficial networking between local small and medium companies – research institutes – universities	Combination of face-to-face contact and online networking based on geographical closeness	**Construct open network in connection with Industry-University-Research Institute**

Ⅱ. Review of the Knowledge research cell group Management Project

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정책기획단

1. Concept

cell

- A small but self-sustaining, dynamic,, and actively self-proliferating research community

Concept of knowledge research cell group

- Learning community for solving company problems, discovering R&D tasks, and supporting technology commercialization by constructing network-linking companies, company-supported institutions, research institutes, and universities
- Small knowledge community with virtuous cycle of exchange – learning – processing – creation of industrial technical knowledge

Role of knowledge research cell group

- Self-learning and group study through abundant exchanges of forms and tacit knowledge between subjects participating in the knowledge cell
- Discovery and performance of the R & D task through preliminary exploration and research planning
- Idea study on technology development and technology commercialization
- Innovative activities for the solution to difficult technology, process innovation, commercialization and marketing
- Deriving bottom-up–type policy proposal

2. Project overview

Project goal

Creating an R & D climate for small and medium companies and improving the participation rate of R&D tasks by solving company difficulties through industry, university and research institute linkage, and by supporting technology commercialization

Project period and budget (Project supported by Daegu City)

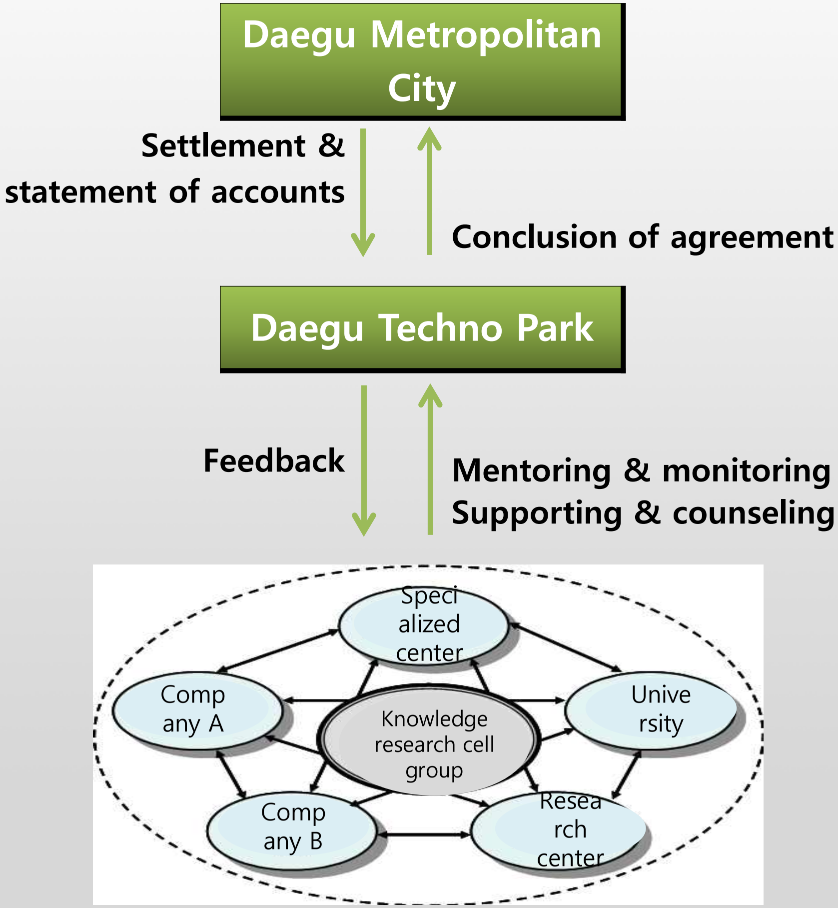
Division	Project period	Project budget (KRW 1,000)
1st year	Mar. 2005 – Feb. 2006	100,000
2nd year	Feb. 2006 – Feb. 2007	90,000
3rd year	Feb. 2007 – Dec. 2007	95,000
4th year	Jan. 2008 – Dec. 2008	95,000
Total project period	**Mar. 2005 – Dec. 2008 (4 years)**	**380,000**

Participating status

Division	Textile	Mechatronics	Live products	Mobile	Nano	Economy/ Management	Others	Total
Participating company (EA)	158	75	43	34	21	28	14	**373**
Participating workforce (No.)	184	72	51	42	44	31	12	**436**

3. Project operation system (1)

Promotion system



- Establishment of operation plan
- Designate and manage exclusive institution

- Cell group operation and management

- Group study, preliminary exploration, and research planning
- Task derivation and performance
- Find difficulties and demands
- Induce cell group DB management and activation online

3. Project operation system (2)

Operation method and procedure

Application for admission to the cell group	• Awareness of problem within the company and the necessity of external consultation • The company prepares the "Knowledge research cell group participating application form," "Status of applied company," and "cell group activity plan" to submit to the planning group
Cell group organization and management system registration	• The planning group is linked to the **optimum expert** for accomplishing the cell group target to organize the knowledge research cell group • Production and registration of the new cell group: Registration of the participating company and institution, participating workforce
Cell group operation	• Support **cost for meeting, expert consultation, and patent investigation** for accomplishing the goal • Patent and technical information investigation: Company ↔ Planning group ↔ KISTI • Appointment of management operator : For the autonomous operation of the cell group, the management operator is appointed among the participating workforce of the specialized center, company, and university from the 4th meeting
Finish and follow up on the cell group	• Identify the result according to operating the cell group to input in the management system • Follow-up management - Send feedback mail and check satisfaction level - Link with relevant forum and community / Organize follow-up cell group

3. Project operation system (3)

Linked operation of online–offline network

By operating the knowledge research cell group management system, innovative synergy is created through the online–offline combined networking promotion between the participating subjects

4. Project outcome (1)

Project output

Division	Operation			Support	
	Total	New	Accumulation	Technical advice	R & D cost support
1st year	117	117	8	226 times	6 tasks
2nd year	172	55	93	197 times	-
3rd year	201	29	9	170 times	-
4th year	220	19	110	91 times	-
Total	**-**	**220**	**220**	**684 times**	**6 tasks**

Promotion outcome

Division	Problem-solving	R & D task discovery	Product development & commercialization	Others
1st year	31 cases	25 tasks	4 cases	8 cases
2nd year	25 cases	10 tasks	2 cases	6 cases
3rd year	10 cases	2 tasks	2 cases	11 cases
4th year	1 case	9 tasks	2 cases	-
Total	**67 cases**	**46 tasks**	**10 cases**	**25 cases**

* Others: Patent application, certificate acquisition, sales increase, etc.

4. Project outcome (2)

Best Practice

Development of multilayer thin-film, high-efficient capacitor

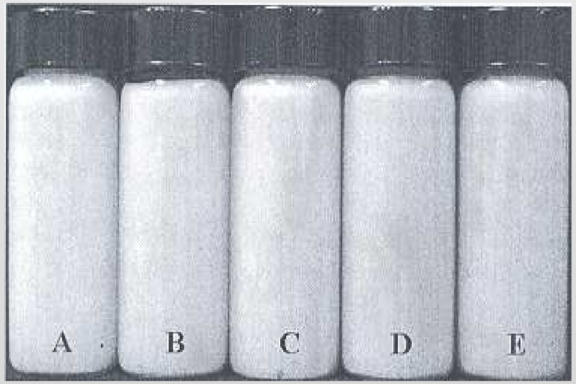
▪ **Purpose of composition**
- Development of subminiature and large-size capacitors required for small electronic device manufacture, and R & D for prototype production

▪ **Main accomplishments**
- Selected in the key technology development task in the local industrial technology development project
- Export to foreign MLCC manufacturers (Japan, Europe, Taiwan, China)
- Commercialization and patent registration on the developed system

New material & product development on oriental herb bio-functional cosmetics

▪ **Purpose of composition**
- Development of hypoallergenic, multifunctional cosmetics using natural functional materials from oriental herbs, and new biomaterial
- Existing company product and process problems are solved and the quality is improved

▪ **Main accomplishments**
- Selected in the joint technology development task in the local industrial technology development project
- Succeeded in product development and commercialization, patent registered



Subject for continuous benchmarking as the research community model

▪ Introduced in "Best Practice in Innovation Policies" published by TEKES in Finland on 2005
▪ Selected as an excellent case in the local economy field as a result of the "2005 Joint Evaluation of City and Province Government Policy" performed by the Ministry of Government Administration and Home Affairs in 2006
▪ Cell group model was spread nationally as the technology innovation community project of "2nd stage Techno Park Development Project Planning (ITEP)" in 2007

4. Project outcome (3)

Interview

Hyun Do, Head of Department, Neo Corporation

Our new project could not have started without the cell group. The difficulties we face in the textile and fashion business are linked to experts or consultation, but the cell group contributed greatly in solving these problems. We are looking forward to the development of the cell group in the future. This is because the cell group can handle almost all requirements that the company request.

Dr. Mal-Young Seo, Korea Textile Development Institute / Wan-Geun, Lee, CEO of TexNet Co., Ltd.

There is a discordance between the political demand and supply. The government is focusing only on the high-tech technology field; however, problems need to be solved in the field technology and commercialization is desperately needed.

That is why even though the field that cell group can contribute is actually small, it remains dynamic.

The specialized center and the planning group are working with us in the cell group, helping in the overall management of the company.

5. Limitations and restrictions

Gap between the ideal and reality because of the low capability of small and medium companies

The original intention on planning was to focus on discovering excellent R & D tasks; however, because of the concentration on quantitative activation and responses to various company difficulties, discovering R & D tasks through research planning and preliminary exploration was relatively poor

Limitation in support method and scale

Limited to small support methods such as costs for meeting, consultation, and patent investigation
The overall periodic and systemic support considering the management of technology (MOT), without the R & D concept

Close support of internal researchers are encountering physical limitations

Operation is stagnant because of the rapid increase of the work for internal researchers
* A total of 1 researcher operates on an average of 10 groups, and 2 groups monthly per cell group

Operational rigidity in the incentive project

Operational rigidity caused by the card system of the incentive project cost
Short-term quantitative outcome creation is not meeting its expectations

Ⅲ. Activation Method of the Knowledge research cell group

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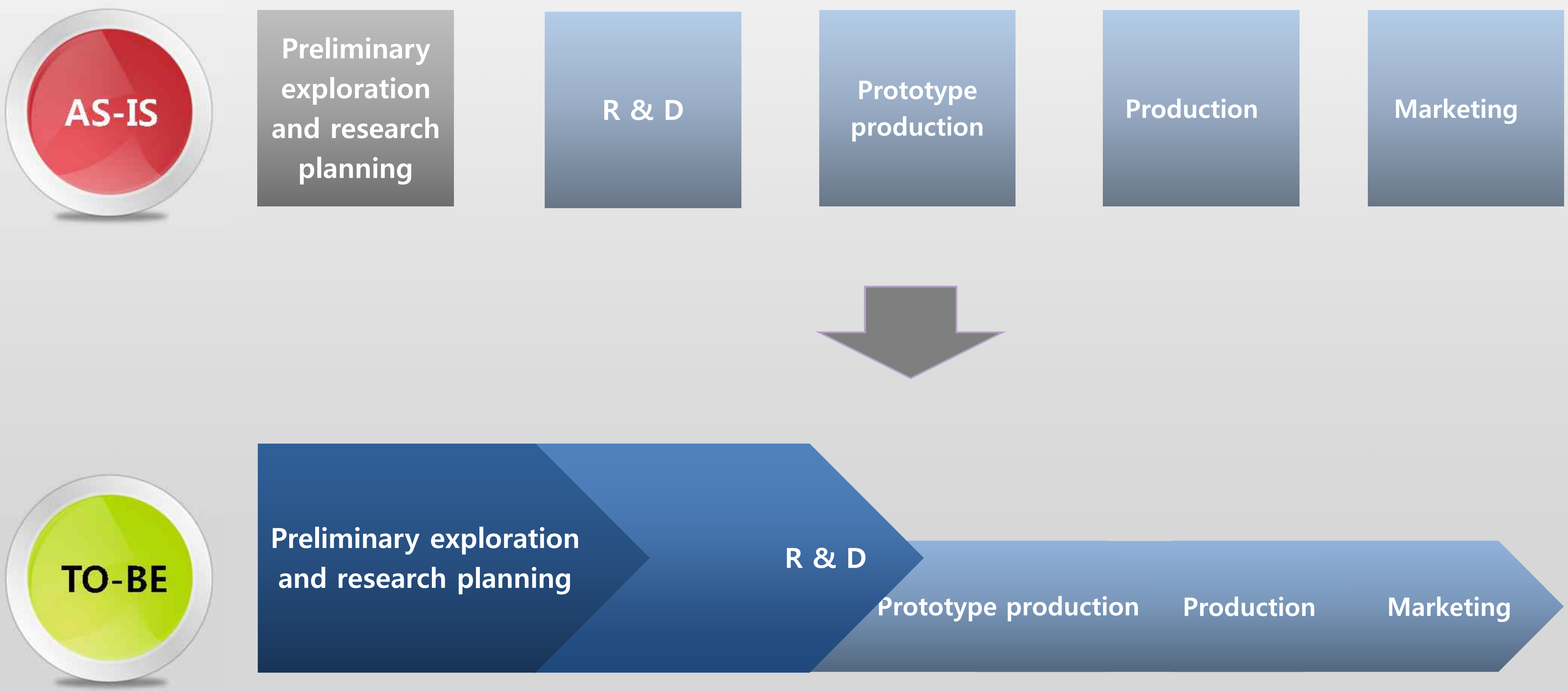
1. Future tasks (1)

Upgrade to value creating knowledge research cell grout model reinforcing the R & BD concept in the exploration and planning stage

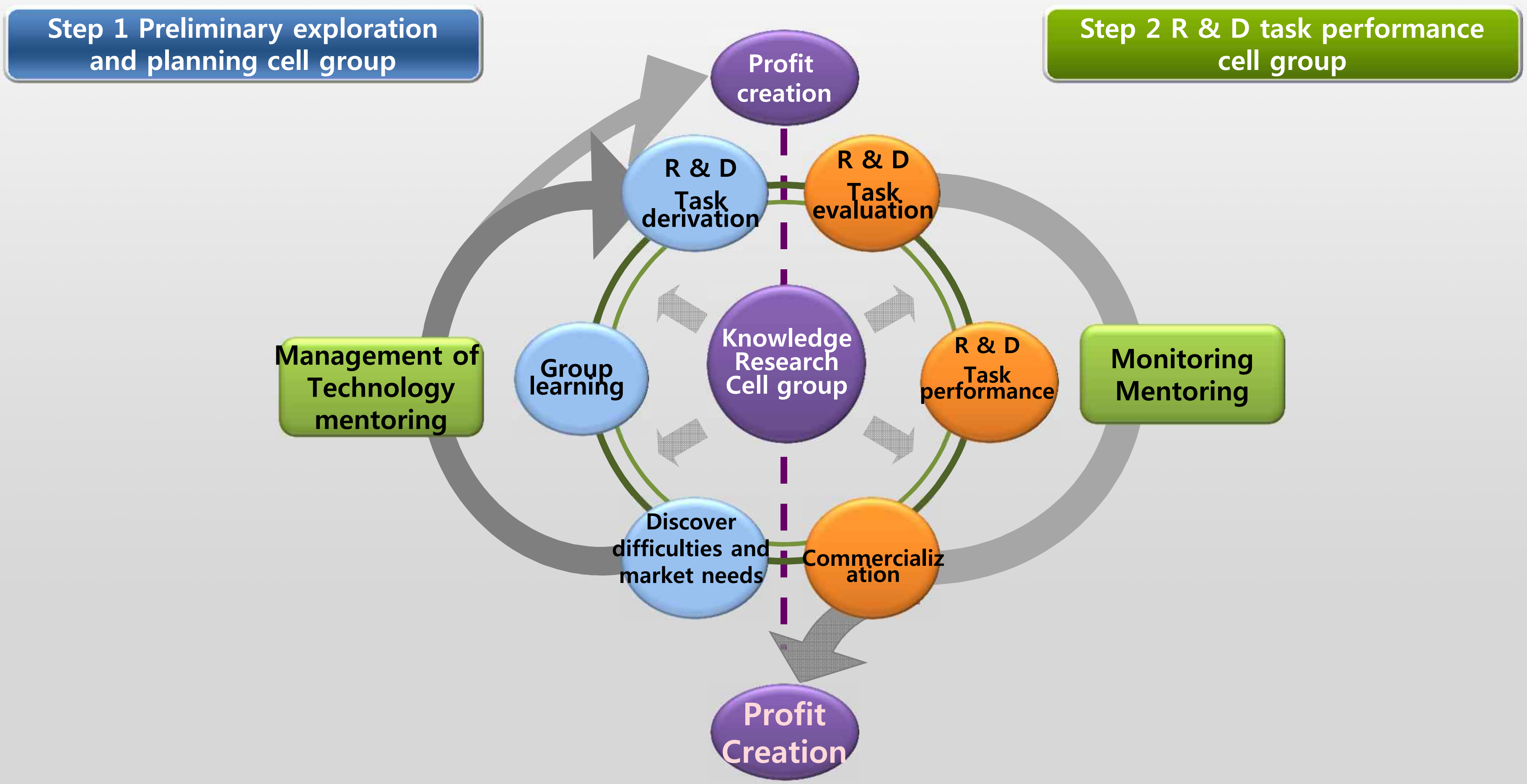
- Fragmentary/temporary R & D support and exploration and planning stages of the company support system are the blind spots of the support
- In the long-term perspective, company led **total periodically integrated R & D support model must be constructed**
- **Must be linked to various subjects** from the exploration and planning stage to compose the cell



1. Future tasks (2)

Flexible knowledge research cell group must be operated for the virtuous cycle of the joint R & D and cooperation

- Effective and sustainable cooperation must be induced through a link between cells, and the step-by-step evolution of the cell

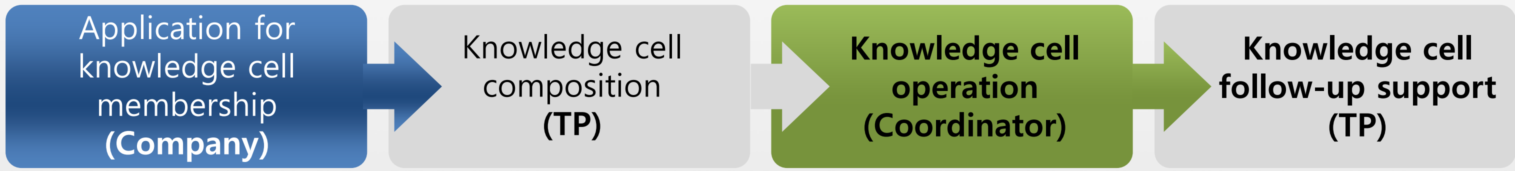


1. Future tasks (3)

Improvement of a role-sharing system for operational substantiality

- Introduction of coordinator-operating knowledge cell, and provision of incentive

* Improve closeness and solidify cooperation through close and organic information exchange between members of the R & D community and by supporting communication



System improvement and simplification of administrative procedures

- Drastic expansion of support method and volume to create actual outcome
- Simplification of complicated administrative procedures such as project cost card system and submission of complicated evidential document to improve participation rate

Link with Technology Commercialization Association on a national level to share and spread the outcome

- During the regular forum, the ideas and the business model derived as the result of knowledge cell operation are proposed, and the policy is also suggested
- Share and spread Best Practice operating knowledge cell for each region

2. Expected effect

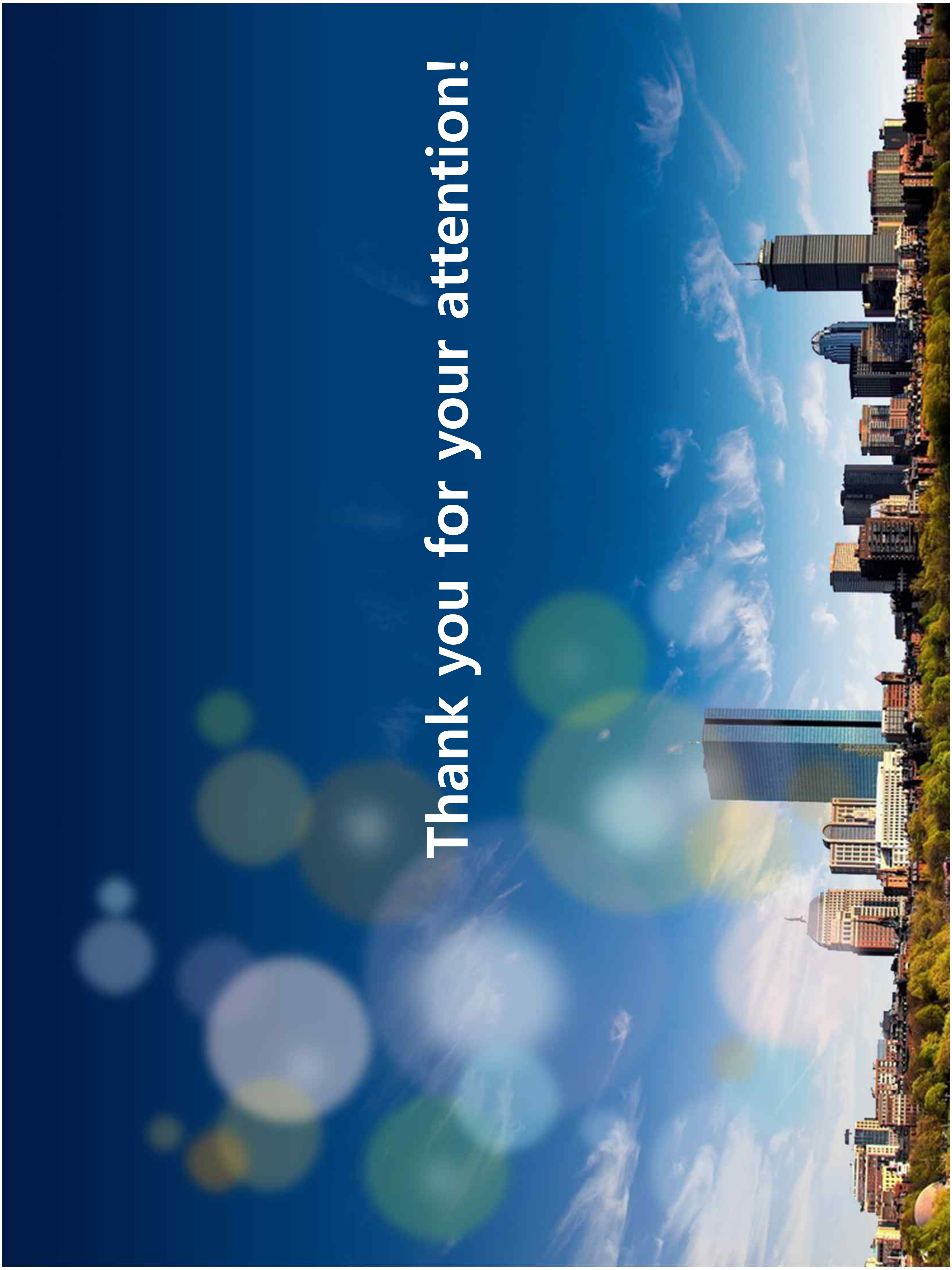
- **Constructing organic industry, academy, and research cooperation system to realize consistent technology development by small and medium companies and to enable successful technology commercialization of the newly developed product**
- **Discover creative and convergent research task through preliminary exploration and research planning activity, and activate excellent research community**
- **Open-group learning is possible through an industry, university and research learning network, and it is developed into a knowledge community to reinforce local competitiveness**

* In the cluster, the key to the success for small companies is to utilize official and unofficial networks to cooperate mutually, and to improve competitiveness (OECD, 1996)

- **Contribute to inducing change in the minds of innovative subjects, such as companies, universities, and research institutes, and create the R & D climate**

창조대구 이야기 모임
소셜 다이닝
SOCIAL DINING
도란도란
지원내용
지원신청방법
포럼 창조도시를 만드는 사람들 사무국

창조도시를 함께 만들기 위해 실행아이디어를 제안하는
창조대구 기획 모임
포커스 그룹
아자아자
공모대상
대구지역에 거주하고 있는
전문가, 기업인, 문화예술인, 청년 및 대학생, 일반시민
지원내용
1차 공모 추진일정
1 공고 6월 2일~17일
2 접수 6월 18일~19일
3 선정평가 6월 22일~26일
4 결과발표 6월 29일
5 계약
지원신청방법
포럼 창조도시를 만드는 사람들 사무국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Society of Open Innovation Technology, Market & Complexity

DGIST

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SOItmC & KCWS 2015
June 14 ~ 18, DGIST, Daegu, Korea

June 17 (Wednesday)

R# : 203 International Conference Hall

General Session 4

■ **Session Chair: KwangHo Jung (Seoul National University)**

- Paper 1: "Knowledge Cities Benchmarking: The case of Daegu, Korea" by **Prof. Blanca C. Garcia (Northern Borderlands Research College, Mexico)**
- Paper 2: "What Knowledge Activities Promote Creativity?" by **Kwangho Jung(Seoul National University), SeungHee Lee(Southern Illinois University), Jane Workman(Southern Illinois University)**
- Paper 3: "Determinants of RFID Adoption: A Meta- egression Analysis" by **Sabinne Lee(Seoul National University), Kwangho Jung(Seoul National University)**
- Paper 4: "Exploring Reasons for Illegal Use of Software: An Application of Q-Methodology" by **ChanWoo Kim(Seoul National University), Kwangho Jung(Seoul National University)**

Knowledge Cities Benchmarking and the case of Daegu , Korea.

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Keynote Abstract for KCWS 2015

One of the difficulties in creating and sustaining knowledge cities is the lack of benchmarks to identify those cities and regions that are generating knowledge-driven initiatives, triggering development and collective value. One of such benchmarks is the value-based Generic Urban Capitals System (GCS) taxonomy. The rigorous application of GCS to cities in European, Asian, North and Latin American contexts has already yielded its initial fruits, providing a deeper perspective for different urban communities through the MAKCi (Most Admired Knowledge City) application of GCS. In this paper, we are aiming to introduce the MAKCi Framework as an integrative system of capital analysis for the case of the Daegu city-region and its journey into developing its knowledge capitals. Daegu's intriguing systems of knowing are expected to emerge as a comprehensive regional meta-system articulated by the extensive knowledge-creating initiatives already in place in this Korean city, bearing a clear knowledge-based agenda.

Key words – Knowledge-City Capitals System, Social/Relational Capital, Social Norms, Borderland Knowledge Cities. Innovation Clusters, Networks, Creative Class, Brokers

Conference Theme – Open Innovation, Knowledge City & Creative Economy
Sub-themes – Knowledge-based Development

Knowledge Cities Benchmarking and the case of Daegu , Korea.

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1. Introduction

This paper aims to provide a better understanding on how leveraging knowledge triggers the construction of knowledge-based spaces of innovation in city-regions. Regional Systems of Innovation have turned relevant due to the implementation of policies at regional and state level that are concerned with the growth of specific region mobilizing players in specific areas (Chaminade and Edquist, 2010). Since the 1990s, we noticed that competitiveness and innovation is explained in the existence of innovation systems based on local and regional clusters (Porter, 1990). The regions thus seek to build and enhance their competitive advantage by multiplying, amongst other aspects, their relational capacity through networks. Network concepts to clustering for knowledge transfer conveys the idea that proximity matters. These concepts have even more impact in borderland regions that continually witness the stream of travellers and longer-term migrants, as well as the transit of goods, symbols, and technologies. It actually conveys different shapes of transactions and translations of human, cultural, intellectual, political and economic wealth from groups to networks, from consortia to clusters. In such intriguing context, enhanced definitions of social capital through clustering, networks and other institutional capacities is advanced in the first part of this paper presentation. In the second part of the paper, we will be aiming to introduce a city benchmarking framework knowns as Generic Capital System (GCS) as an integrative approach for city capital analysis. It will exemplify how some borderland cities are characterized and classified, contrasted and compared. The paper closes with a panoramic view for the case of the Daegu city-region and its journey into developing its knowledge capitals. Depicted as the "Apple City" for its high quality apple production, Daegu is also known as a "Textile City" evoking its traditional core industry, and currently focusing on fostering its fashion and high-tech industries. Through Knowledge City capital system taxonomy (used in the MAKCi Awards), some of Daegu's intriguing systems of knowing are expected to emerge as a comprehensive regional meta-system articulated by the extensive knowledge-creating initiatives already in place in this Korean city, bearing the flag of emerging knowledge-based development schemes.

2, Networks: The capital of City-regions.

Networked societies appear to be growing exponentially. According to Castells (1996), these societies derive from a network of local societies no longer defined according to a territorial principle but based on the symbolic and communicative codes that regulate those (Castells, 1996). This form of society is relational because it interlaces local societies and global society, giving rise to knowledge-based milieus in which "living where what is crucial is the quality of the relational patterns prevailing in the social spheres" (Castells, 1996, p. 15). In brief, the relational meaning of human actions in networks fully acknowledges the power to translate itself into social forms yet unknown (Castells, 1996). In this complex context, Lundvall (2001) advanced that tacit knowledge is constituted by skills and routines embodied in people and embedded in social organizations. Only experience-based learning in the form of apprenticeship or of network relationships can normally transfer it. Codification and transfer of knowledge are extremely sensitive to the prevailing social context. That is why one of the strong forms of tacit knowledge may be found in scientific knowledge, which is communicated within the scientific community and scientific networks, and expertise based on such a scientific foundation (Lundvall, 2000).

All these social capital elements on knowledge-based infrastructures are clearly sensitive to their corresponding ecosystems. Some of those milieus take the shape of ***networks***. This network metaphor designates a basic social relationship between actors. Actors in a social network can be not only persons and groups but also collectives in the form of clusters, institutions, communities or even societies (Seufert, Krogh, & Back, 1999). Networks are determined by contents (e.g., products or services, information, emotions), form (e.g., duration and closeness of the relationship) and intensity (e.g., communication frequency). Moreover, it is believed that the form and intensity of network relationships establish the network structure (Burt, 2000). Indeed, the relationships between the actors are founded on personal–organizational or technical–institutional interconnections on a long-term basis (Seufert et al., 1999). Network members' relationships stem from their individual autonomy and interdependence, their tensions between cooperation and competition as well as reciprocity and stability. Clearly, "boundaries are socially constructed by network members" (Seufert, Krogh, & Back, 2003, p. 18).

At this point, it seems important to characterize the importance of knowledge sharing and transfer in networks. The focus is on the kinds of networks that not only foster social capital but also shape learning and knowledge-generating structures, albeit intangible, as those observed in knowledge-based networks and innovation clusters. Scholars such as Nahapiet and Ghoshal (1998) and Cummings et al. (2003) have made distinctions between the structural, cognitive and relational dimensions of social capital. It is thought that structural social capital facilitates mutually beneficial collective action through established social roles and networks supplemented by rules, procedures and precedents (Hitt et al., 2002). Cognitive social capital, which includes shared norms, values, attitudes and beliefs, predisposes people toward mutually beneficial collective action (Krishna & Uphoff, 2002; Uphoff, 1999). Cognitive and structural forms of social capital are both seemingly connected and mutually reinforcing (Uphoff & Wijayaratna, 2000). As for the relational dimension of social capital, scholars have found that it increases the capacity for action, and is an aid to adaptive efficiency, creativity and learning by the degree of participation, associativity and accountability it conveys. This concept is central to the understanding of institutional dynamics, innovation and value creation and is therefore highly relevant to development contexts (Nahapiet & Ghoshal, in Cummings et al., 2003). Seemingly, knowledge-generating environments actually thrive if a cognitive networked social scaffolding sustains them (Uphoff & Wijayaratna, 2000). In this paper presentatio, some of these environments have been identified by their strong links to productive systems, in which knowledge conversion is essential (Hamdouch, 2008): hubs, clusters, cities and regions are examples of emerging knowledge environments.

3. The Knowledge city: A framework and a methodology

Clearly, another example of emerging knowledge-based environments is urban communities, cities and city-regions. Networked cities presuppose the existence of high connectivity and information management brought by the digital cities and the smart cities models. They generate living, learning and working places extensively wired and connected. They generate spaces where computer-networked environments increasingly encompass a number of versatile generic tools used for knowledge-generating communication: blogging, Yahoo Q&A postings, e-mails, Skype calls, and other instant-messaging platforms that enable people to talk to colleagues or clients abroad, or connect with family and friends anywhere in the world. Additionally, Internet-based tools such as chat rooms/radio chat broadcastings, discussion boards and wiki-based platforms within virtual communities, webinars and other learning innovations bring new levels and modes of learning and understanding, managing and making sense of knowledge through virtual interactions.

However, such rich experiential blend is directed to knowledge-based typologies such as digital city, learning city, KC, a learning city driven by knowledge production (Work Foundation, 2005); or the Ideopolis, a city of Ideas and inclusive communities. The nature of knowledge, as an intangible asset, a flow and a process, imposed a new millennial epistemological shift from matter-centered to relation-centered knowledge (Carrillo, 2002). Hence, for the purposes of this paper, value-based systems and capital dimensions are the key elements of a KC definition. A KC is a city "purposefully designed to nurture knowledge" (Edvinsson, 2002, in Dvir & Pasher, 2004, p.17). It is "a region that bases its ability to create wealth on its capacity to generate and leverage its knowledge capabilities through knowledge-based extended networks formed by enterprises and people" (Chatzkel, 2004, p.62). In another terms, a KC is one "in which its citizenship undertakes a deliberate, systematic attempt to identify and develop its capital system, with a balanced and sustainable approach" (Carrillo, 2004, p.34).

Amongst KBD approaches, a strategic framework will be advanced for the identification, valuation and systematic development of the city's traditional and knowledge capital in an integrated way (García *et al.,* 2009), which in turn will support a RIS analysis. The advanced knowledge-based framework is basically a taxonomy of urban capital that deliberately and systematically maps out all city resources—both traditional and knowledge-based required to leverage the balanced and sustainable development of contemporary urban communities. Such taxonomy is based on an assessment of a city's urban capitals system (CS) (Carrillo, 1997; 2002). The CS taxonomy has been the foundational basis of applications such as the *Most Admired Knowledge City Awards* (MAKCi), which greatly reflects how knowledge-intensive research work now depends on an extended community network to gain the necessary perspectives and paths to learn and make sense of emerging KBD initiatives.

The underlying rationale for this taxonomy is to satisfy the formal requirements of a value-production system, i.e., that it be complete, consistent and homogeneous. This taxonomy builds upon other efforts to identify and value collective individual capital in urban, national or regional levels. Known as CS, this taxonomy identifies the basic capital elements of productive systems and "meta-capitals": those other forms of capital not productive themselves but significantly leveraging the system's overall capacity. In the particular case of the RIS for Monterrey, the CS methodology will be applied in first instance to build up the analysis of the capitals system within the city. This would eventually create a complete and consistent set of indicators, within a coherent and practical framework. The key capital category dimensions used in the present exercise are:

1. Identity capital
2. Intelligence capital
3. Financial capital
4. Relational capital
5. Human Individual capital
6. Human Collective capital
7. Instrumental-material capital
8. Instrumental-knowledge capital.

The first four capital dimensions are considered "meta-capitals" as they facilitate the action of the "agent" (human) capitals and the instrumental capitals. The CS is the base criteria for the eight MAKCi Awards category dimensions that shape the consultation exercise. They constitute a generic taxonomy of urban capitals, deliberately and systematically mapped upon all the resources both traditional and knowledge-based. The CS assumes that the eight capital dimensions are required to leverage the balanced and sustainable development of contemporary urban communities. The CS framework is immersed within context, where the value-based background, history and capabilities of a city play a major role. It mirrors the city's historical antecedents and pre-existing knowledge, as well as present knowledge repositories and capital, which in turn will enhance the city's potential for development.

4. From Regional Innovation Systems to Open Innovation

On the other hand, a working definition for innovation is "a process that leads to an outcome" (and this outcome is an object or a way of doing that previously did not exist) (Shearmour, 2012). In parallel, an innovation system can be defined as a "collective of 'organizations, institutions and people that interact in the production and diffusion of new economically useful knowledge" (Lundvall, 1992, p.11). These definitions frame a number of key strategies for regional development has been identified as RIS.

Regional innovation system paradigms

RIS has been identified as the constellation of institutions at the regional level that contribute to the innovation process (Braczyk *et al.,* 2004). A RIS is clearly identified with its set of institutions, both public and private, that produces pervasive and systemic effects which encourage firms within the region to adopt common norms, expectations, values, attitudes and practices—in short, a common culture of innovation that is reinforced by the process of social learning (Wolfe, 2002). Hence, definitions of a RIS vary, but for this paper purposes, it will be defined as "the set of economic, political and institutional relationships occurring in a given geographical area which generates a collective learning process leading to the rapid diffusion of knowledge and best practice" (Nauwelaers & Reid, 1995, in Wolfe, 2002, p.6) where innovation activities takes place (Niosi, 2000).

Clearly, like any other knowledge-based environments, RIS function both on the basis of inclusion as well as exclusion, and these processes may assume sharp contours within the entire dynamism of any given system. Networks and clusters within a RIS work as bodies or entities where new knowledge and innovations can be generated and disseminated. They seem to have replaced—to a great extent—other more rigid institutions in which not so long ago knowledge was created and preserved. However, this can lead to a gloomier side of network life. It could lead to the creation of global networks, which could multiply and parcel global competition that may lead to polarization, creation of elite networks at the cost of greater exclusion of many groups. Indeed, for a number of international observers, the key problem of knowledge society will be to cope with inequality and exclusion (Hamdouch, 2008).

The literature in RIS is extensive and it has gained great recognition in developed and developing countries. Factors that influence RIS include: the presence of local public research institutions, as well as industry clusters. Venture capital, an environment conducive to business creation and infrastructure for STI. Vertical and horizontal links in the clusters. Human capital endowment. Orientation to export markets, and an active role of the State (Autio, 1998; Niosi, 2000; Cooke & Memedovic, 2003; Padilla-Perez, Vang, & Chaminade, 2009) among others. This kind of innovation systems are defined by regions of economic activities and depend largely on the emergence of intermediate organizations (Casalet, 2007) based on the work of the actors and their networks. The competitiveness and sustainability of the countries and regions seemingly depend on their ability to attract, capture, generate and exchange knowledge, eventually reflected in their value chains (Cooke *et al.,* 1997). Clearly, regions are a privileged context to develop competitive environments because of its factors of learning through interaction, geographical proximity, and the generation, use and dissemination of knowledge (Niosi, 2010). RIS's approach emphasizes the systemic dimensions, the propensity of interaction and relation between actors in innovation processes (Manley, 2008).

Open Innovation

On the other hand, the open innovation paradigm is basically a research driven generation of intellectual property. It is defined as the systematic encouragement and exploration of a wide range of internal and external sources for innovative opportunities, the integration of this exploration with firm capabilities and resources, and the exploitation of these opportunities through multiple channels (Gallagher, 2006). Open innovation is a term promoted by Henry Chesbrough (Open Innovation, 2003), at the Haas School of Business at the University of California. The concept is also related to user innovation, cumulative innovation, *know-how* trading, mass innovation and distributed innovation. According to Wikipedia, throughout the years several factors emerged that paved the way for open innovation paradigms:

- The increasing availability and mobility of skilled workers.
- The growth of the venture capital market.
- External options for ideas sitting on the shelf.
- The increasing capability of external suppliers.

These four factors have built the path for a new market of knowledge:.employees, suppliers, customers, competitors and universities are all subject to exchange knowledge. Innovation can be generated either by means of closed innovation or by open innovation paradigms (Chesborough, 2003), and the debate focuses on which paradigm will dominate in the future.

5. Emerging Typologies for KCs: Cities at the edge

In this section of the paper, the GCS/MAKCi dimensions are used to build some iconic city systems, with enough detail so that the general patterns that characterize the city would emerge, and a sample of two cities is presented. Cities would be grouped according to its intrinsic characteristics, additional to the ones yielded by the statistical data obtained during the MAKCi sample exercise. Moreover, some researchers (Honeywill, 2010, Surowiecki, 2004), have compiled a number of characteristics in creative, intelligent cities that show some key elements such as: (i) higher than average social evolution (high social intelligence), (ii) Well-developed knowledge-intensive activities and diverse clusters of such activities. (iii) embedded routines of social co-operation allowing knowledge and know-how to be acquired and adapted. (iv) Developed communication infrastructure, digital spaces, and knowledge/innovation management tools, And; (v) proven ability to innovate, manage and resolve problems that appear for the first time. Variables and indicators like these advance knowledge-based cities with strong commitment to cultural capital, innovative environments, diversity, high social intelligence and digital leadership (Honeywill, 2010, Surowiecki, 2004).

Hence, for the purposes of this chapter, a list of comparative categories, and stemming from the MAKCi Framework, eight KBD drivers have been derived as indicators of knowledge-based initiatives, through which a city can be awarded as a most admired knowledge city if the city:

1. Generates clear city branding, in which city identity is expressed.
2. Creates city future centers, and prospective studies for urban, socioeconomic and technological planning.
3. Attracts highly-intensive human capital industries, that add value to existing and future ventures, and in which knowledge workers, agents, facilitators thrive.
4. Builds citywide social ecosystems, in which connectivity, creativity and knowledge-sharing permeates (socio-political cohesion and inclusion).
5. Endorses learning and personal development in knowledge-based networks.
6. Fosters a knowledge citizenship in which partnerships, alliances, leadership, champions, trigger creativity, and so on.

7. Promotes sustainable environments.

8. Develops a culture of governance, participation and socio-political innovation.

Hence, following these criteria, instruments and tools, the following section will introduce a consolidated interpretation of the emerging MAKCI city profiles that the consultation has triggered in seven editions of the exercise in which a number of city cases have been developed. Table 5.2 shows the corresponding indicator to each of the dimensions under scrutiny.

Table 1. MAKCi Cities Typologies: Emblematic Cities, Universities and Ideopolis

MAKCi Capital Dimensions	KBD Drivers	Ideopolis: Manchester	Catalyst Cities: Bangalore
1. **Identity Capital**	1. **Clear City-Branding**.	**Core identity:** Manchester is the world's original modern city. It is a city of firsts, an 'ideopolis' – a city of ideas in the global knowledge economy and a city of action.	**Core identity:** Bangalore is nick named "India's Silicon Valley", "Fashion Capital of India", "The Pub City of India", and "The Garden City".
2. **Intelligence Capital**	2. **City Future-Centre Creation.**	Manchester: Knowledge Capital (M:KC) has a Future Center role between 2003-2011 http://www.manchesterknowledge.com/about-us/our-organisation	Bangalore has generated a series of programs to improve its infrastructure such as: The Megacity Project; the Integrated Development of Small and Medium Towns. The Swarna Jayanthi Shahari Rozgar Yojana, (SJSRY) is currently a Urban Poverty alleviation program; the Bangalore Metropolitan development Authority (BMRDA) prepares structural plans for the orderly development of Bangalore metropolitan region.
3. **Financial Capital**	3. **Highly-intensive Human Capital industries.**	Thriving pharmaceutical and biotechnology community.	Bangalore is referred to as the 'IT Capital of India' as well as the 'Biotech City'. The city plays a prominent role in international electronics, telecommunications and information technology.
4. **Relational Capital**	4. **City-wide Social Intelligence Ecosystems**	The city's diversity makes it creative and dynamic, however, the city region is still tackling the profound social and physical legacy of 40 to 50 years of industrial economic decline.	Bangalore has shifted from a traditional environment to a business and western standards life style; however, the success of this economic inequality is creating a serious threat on the social grid. An emphasis on mega-investments, bordering on a fetish, to promote a hi-tech vision seems perverse when we consider the scale and depth of poverty in the city.
5. **Human Capital (Individual Base)**	5. **Learning and Personal Development**	Manchester has one of the highest concentrations of students in Europe with three higher education institutions within a square mile radius. Universities have a significant impact on the local economy in addition to their intellectual capital assets.	Availability of a large pool of talented computer manpower, the presence of a large number of research institutions of excellence and industrial outfits specializing in electronics
6. **Human Capital (Collective Base)**	6. **Knowledge Citizenship**	'Manchester's liberal heritage has had a fundamental impact on the city, its history, its achievements, its people and its urban landscape	Lopsided development has sharply aggravated social inequality in the city.
7. **Instrumental Capital (Tangible Base)**	7. **Sustainable Environments**	As the birthplace of the industrial revolution, Manchester takes its environmental obligations very seriously and is playing its part in a new post-industrial green revolution. See www.manchesterismyplanet.com	In 2005 both the Central Government and the State Government allocated considerable portions of their annual budgets to address Bangalore's infrastructure

8. **Instrumental Capital (Intangible Base)**	8. **Culture of Governance and Socio-political Innovation**	Manchester has a long history of strong civic leadership and collaboration, which is widely regarded as being a major contributor to its economic success.	Clearly, the IT boom has its winners and losers. For Bangalore is a word not just for financial success, but growing discontentment as well. A survey conducted this year by a city-based B-school, Alliance Business Academy (ABA), found that unemployment has grown by 18 per cent in the low-income group since 2000.

MAKCi Benchmarking Dynamics

For the purposes of this paper, a first interpretation of the MAKCi Framework has been advanced so that the eight dimensions of the capitals accounted in CS are represented in the actual cities' profiles, expressed in Table 1. One of the MAKCi methodology advantages is that it offers the opportunity to develop typologies of cities, given its capacity to manage a great deal of variables to detail. It conveys the possibility to generate new knowledge based on the information provided by the city stakeholders.

As illustrated in Table 1 for two city cases, the eight identified drivers that stem from the CS consider capital indicators both simple and complex: from the existence of at least one future centre (quantitative data) to the presence of knowledge citizens, a concept involving a number of variables and dimensions that combine identity, intelligence, financial and relational capital indicators converging in the human capital (collective base) dimension of the CS, highly suitable for the purposes of this chapter. As more indicators become available, a number of characteristics have progressively been identified in the city profiles generated by MAKCi nominations, highlighting the multidimensional tapestry that constitutes the inventory exercise of a city's Capital System diagnosis (Garcia, et al., 2009), that is worth exploring in the next sections of the chapter.

Emblematic Cities: Singapore and Bilbao

In the MAKCi context, few of the cities profiled in the exercise have been as emblematic as Singapore and Bilbao, for a number of reasons. Not only are they representative of the consultation process, attracting sundry votes while also attracting intense criticism on the weaknesses of their socio-political systems. Most importantly, Singapore and Bilbao are MAKCi emblematic cities for the uniqueness of their nature and identity; their strategic geographical location; their well-built profile in aspects of their economic and technological development and the impact they have triggered in their regions and countries. Above all, they are emblematic because of their people: they both embody the miraculous power of capacity building, human resources development and qualified human capital as the source of knowledge-based development in the midst of most challenging, scarce-resourcing and severely adverse circumstances. Knowledge-based talent is a key concept for these emblematic knowledge cities. Other emblematic Knowledge Cities on the MAKCi platform are Barcelona (Spain), Holon (Israel), Ragusa (Dvrovnic, Croatia) and Ottawa (Canada).

UniverCities and Ideopolis: Austin and Manchester

These two Knowledge City categories stemming from the MAKCi exercise outline the close and ageless relationship between universities and cities. In analyzing university-city interactions, these two key social institutions are more than often put together as the engines for development, especially if working together alas not except of certain tensions (Perry, 2011). Between universities and cities, as for Knowledge and the City, a particularly important unifying principle seems to be mediation. Mediation, or the art of facilitating the development of strategic partnerships across sectors in a city (between citizens, civic authorities, private practice and academic institutions) is the triggering factor for UniverCities to flourish (Perry, 2011).

On the other hand, an Ideopolis combines the generic idea of the Knowledge City concept with that of Univercities: an Ideopolis is "is a large city, driving growth within the city-region and working with medium sized cities (or Partner Ideopolises) to play a key economic role within the wider region and at a national level" (Williams, et al., 2006, p. 9). Manchester city case illustrates this category in Table 2. An Ideopolis boasts:

- High levels of economic success;
- High levels of knowledge intensity;
- A diverse industry base including distinctive specialist niches;
- A university that has a mutually beneficial relationship with the city, leading to building industries based on research strengths, transferring knowledge to businesses and the retention of graduates;
- Strong communications infrastructure and good transport links within the city and to other cities, including air, rail and road;
- A distinctive long-term 'knowledge city' offer to investors and individuals alike, created by public and private sector leaders;
- Strategies to ensure that deprived communities also benefit from the economic success associated with knowledge (Williams et al., 2006).

Other UniverCities and/or Ideopolis on the MAKCi platform are Sheffield (UK), Nancy (France), Copenhagen (Denmark), Boston (USA) and Dublin (Ireland).

InnovaCities: Montreal and Shenzhen

Although most Knowledge City categories within the MAKCi exercise include an edge for innovation, given the tight link between innovation, learning and knowledge-generating processes, an emerging category that highlights a city's edge for innovation is worth noticing. An Innovation City profile is seemingly linked to urban communities that have earnestly sought for solutions to their sprawling suburbs, declining economic activities in their inner cities, the spread of out-of-town shopping centers, and/or grim threats to their urban environment, economic development and cultural tradition. These are cities that sought to strike a balance between focused conversion of new knowledge and socio-economic, and environment-conscious initiatives. Other InnovaCities on the MAKCi platform are Kuala Lumpur/Cyberjaya (Malaysia), Melbourne (Australia) and Hong Kong (China).

Catalyst Cities: Monterrey and Bangalore

Cities can be catalysts of knowledge and innovation: "the city is not necessarily a cradle of ideas, it is rather a conduit through which vast economic resources are channeled and so they help to bring ideas to fruition, in the shape of practical, marketable solutions" (Shearmur, 2012, S15). In the case of some they become Catalyst Cities, also known as

Breakthrough Cities because in a critical moment of their development process, “they disrupted the conventional paradigms of development” (Scheel, 2011, p.380). In some cases, cities have found through challenges, crisis, and uncertainty the key inflection moments to make a swift transition possible. By doing so, large-scale changes usually have had a positive impact throughout the city, “creating interdependent spaces in which the citizens, the social communities, the businesses and their local natural environments, moved into a harmonious and balanced regional development” (Scheel, 2011). Although not all Catalyst Cities follow the Knowledge City paradigm, the MAKCi exercise has identified a few of them, along with the initiatives that drive their societal long-term change. Bangalore illustrates this city profile in Table 5.2. A handful of drivers have been identified to characterize Catalysts Cities: infrastructure, associativity and holistic awareness, entrepreneurship, technology, spectacular successes, talent, public policies and innovation (Scheel, 2011). Other Catalyst Cities on the MAKCi platform are Curitiba (Brazil), Manizales (Colombia), and Seattle (USA).

6. A capital systems approach for knowledge systems in Daegu

Following the pattern shown for other cities, an introduction to the city benchmarking characterization of Daegu, South Korea is presented below. Please see also Appendix (MAKCi Nomination Form or MNF).

Table 1. A capital system for Daegu, South Korea: Summary

MAKCi Capital Dimensions	**KBD Drivers**	**UniverCity, InnovaCity, RenovaCity? A Typology for Daegu, South Korea.**
1. **Identity Capital**	1. **Clear City-Branding**.	**Core identity:** The city is the economic and industrial core of the Daegu-Gyeongbuk region, one of the major industrial areas in Korea. It accounted for as much as 94 percent of Korea's trade surplus in 2006. The electronics industries in Gumi and the steel industries in Pohang provided great services to that surplus. World-leading manufacturing facilities for Anycall (Samsung Mobile) and POSCO's main factories are located near the city. Daegu and its neighbouring cities were designated for the Daegu-Gyeongbuk Free Economic Zone by the central government in 2008.
2. **Intelligence Capital**	2. **City Future-Centre Creation.**	Daegu Gyeongbuk Free Economic Zone (DGFEZ) Authority decided to make 2014 the first year of a quantum jump of investment attraction. - Choice and concentration for attracting foreign direct investment based on three major target industries - The Diversification of Cooperation Institutes and the acceleration of attracting joint ventures - Creating outcomes through the strengthening of cooperation network with Seoul-based Embassies and Chambers of Commerce The DGFEZ Authority (Commissioner Choi Byung-Rok) decided to make 2014 the first year of Quantum Jump for investment attraction,
3. **Financial Capital**	3. **Highly-intensive Human Capital industries.**	It is specialized in knowledge-based service and manufacturing industries.
4. **Relational Capital**	4. **City-wide Social Intelligence Ecosystems**	Generally Daegu is known as a conservative city. As well as being the largest inland city in the country beside Seoul it has become one of the major metropolitan areas in the nation. Traditionally, Buddhism has been strong; today there are still many temples. Confucianism is also popular in Daegu, with a large academy based in the city. Neon cross-topped spires of Christian churches can also be seen in the city.

5. **Human Capital (Individual Base)**	5. **Learning and Personal Development**	In spite of economic depression, Daegu is achieving high employment. Also, KNSO announced that Daegu had the highest employment rate in 7 metropolitan cities. It attribute to growth of Techinopolice, Innovation City and Hightech Medical complex. http://globaldaegu.blogspot.mx/2015/06/beautiful-daegu-daegu-with-highest_10.html
6. **Human Capital (Collective Base)**	6. **Knowledge Citizenship**	Daegu Metropolitan City Government has begun to build its own urban regeneration strategy as a mid- to long-term plan that includes the direction of the local autonomy's regeneration policy and strategy, such as the vision, strategy and mid-long term roadmap for urban regeneration. http://english.daegu.go.kr/cms/cms.asp?Menu=521&Category=0&Key=&Keyword=&Page=1&BoardId=15178&Action=view
7. **Instrumental Capital (Tangible Base)**	7. **Sustainable Environments**	The city government currently manages 170 waterscape facilities (98 fountains, 36 wall fountains and water falls, 20 streams, 3 ponds, and 13 other facilities). As well as facilities with pools, such as Suseong Family Park and Shinseo Park, a variety of waterscape facilities can be found all across the city, including major transportation points, such as the Obong and Dusan five-way intersections, the artificial waterfall of Ayang Bridge, Sincheon, Wolgwang Waterside Park, and the fountain in Suseong Lake Park. http://english.daegu.go.kr/cms/cms.asp?Menu=521&Category=0&Key=&Keyword=&Page=1&BoardId=15256&Action=view
8. **Instrumental Capital (Intangible Base)**	8. **Culture of Governance and Socio-political Innovation**	Daegu in the 21st century is one of the most thriving metropolitan cities in the region, providing venues for some of the world's largest cultural events, such as the 2003 Summer Universiade and the 2011 IAAF World Championships. Today, the city is committed to ensuring a new, brighter future under the motto "Daegu, a Global Leader of Knowledge-Based Economy" via its systematic efforts directed at developing its knowledge industry, green growth, and education and culture. http://english.daegu.go.kr/cms/cms.asp?Menu=953

7. Discussion and Final Thoughts

Indeed, this brief account of Daegu city-region sheds some light on how a city capital system is brought about in order to leverage added-value for its communities. As we observe how the cities –and especially, borderland cities here presented become a space for transition, some insights emerged on the complex processes of collective identity building. For the cities of Bilbao, Austin, Monterrey, Manchester and Shenzhen, it emerged that at different points in their history (part of their Heritage) their citizens made room for a redefinition of what their regions would want to become. A place where "the knowledge of the world can be deconstructed (...) then reconstructed" (Pavlakovich, et. Al., 2004:31). Such collective redefinitions and decisions have seemingly affected the level of citizenship they seem to be displaying when they face the world in present times. How are those two components in their Identity directly affecting the way they interact with other cities at a more global scale? one could ask. How do those other three elements of the Identity capital of a city affect its vision, its planning of the future of its citizens, and its generations? Those are poignant questions that further knowledge-based development research is attempting to answer.

Even if deeper research is needed on how a city-identity is built and how the interplay of cities referential capitals play a part in the entire capitals system, it has become apparent that a combination of capitals and context factors are necessary for a city to move from regional innovation paradigms to open innovation future ones, under the Knowledge-city flag. By using the eight-capital GSC framework, research on KBD can thus expect to shed some light on how knowledge cities are building their KBD advantage in the competitive innovation arenas.

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Appendix - MNF
Daegu, South Korea

Name*:____________________________Email*__________________________

Affiliation*:____

*This information will remain strictly confidential, only needed for auditing purposes.
Nominated City*: ____ Daegu _____ (Country: _____South Korea_________)

City Category*: Knowledge City-Region ✓ Knowledge Metropolis ☐
*Please use one MAKCi Nomination form for each nominated city. You can nominate as many cities as you like. Please make sure you nominate each city for one category only.

17 MAKCi Questions (They are grouped together according to MAKCi Framework capital categories)	Supporting reasons and relevant information, documents and links (to be provided/posted by expert) on the MAKCi Forum
A. IDENTITY and INTELLIGENCE CAPITALS 	**1. How distinctive and well positioned is the city's identity (how valuable is the city's brand and reputation)? (1. Identity).** Daegu (Korean: [tɛgu]), (대구, 大邱, literally 'large hill') formerly spelled Taegu and officially known as the Daegu Metropolitan City, is a city in South Korea, the fourth largest after Seoul, Busan, and Incheon, and the third largest metropolitan area in the nation with over 2.5 million residents. The city is the capital and principal city of the surrounding Gyeongsangbuk-do province, although it is not legally part of the province. The two areas combined are often referred to as Daegu-Gyeongbuk, with a total population of over 5 million. Daegu is located in south-eastern Korea about 80 kilometres (50 miles) from the seacoast, near the Geumho River and its mainstream, Nakdong River in Gyeongsang-do. The Daegu basin, where the city lies, is the central plain of the Yeongnam region. In ancient times, there was a proto-country named Jinhan, to which the current Daegu area belonged. Later Daegu was part of the Silla Kingdom which unified the Korean Peninsula. During the Joseon Dynasty period, the city was the capital of Gyeongsang-do which was one of traditional eight provinces of the country. Daegu was an economic motor of Korea during the 1960s–1980s period. The humid subtropical climate of Daegu is ideal for producing high quality apples, thus the nickname, "Apple City". Daegu is also known as "Textile City". Textile used to be the pillar industry of the city. In the second half of the twentieth century, the city underwent explosive growth, and the population has increased more than tenfold since the end of the Korean War. The city was politically favored during the 18 year long rule of Park Chung-hee, when it and the surrounding area served as his political base. Daegu champions conservative political ideas and movements today. Daegu is a political base for the ruling Saenuri Party. History Throughout and before recorded history, Daegu has served as a nexus of transportation, lying as it does at the junction of the Geumho and Nakdong rivers. During the Joseon Dynasty, the city was the administrative, economic and cultural centre of the entire Gyeongsang region, a role largely taken over now by Busan in South Gyeongsang. Prehistory and Early history Archaeological investigations in the Greater Daegu area have revealed a large number of settlements and burials of the prehistoric Mumun Pottery Period (c. 1500-300 BC.). In fact, some of the earliest evidence of Mumun settlement in Gyeongsang Province has been unearthed in Daegu at Siji-dong and Seobyeon-dong. The Dongcheon-dong site is a substantial village of the Middle Mumun (c. 850-550 BC.) and contains the remains of many prehistoric pit-houses and agricultural fields. Megalithic burials (dolmens) have also been found in large numbers in Daegu. During the Proto–Three Kingdoms of Korea period, Daegu was the site of a walled-town polity known in historical records as Dalgubeol. The first mention of Dalgubeol is dated to 261. We know nothing of its earlier history, and little of what came later, except that it was absorbed into the kingdom of Silla no later than the 5th century. Silla Silla defeated the other Three Kingdoms of Korea in the late 7th century, with assistance from Tang China. Shortly thereafter, the king of Silla considered moving the capital from Gyeongju to Daegu, but was unable to do so. We know of this incident through only a single

line in the Samguk Sagi, but it is presumed that it indicates the entrenched resistance of the Gyeongju political elites to such a move.
In the late 1990s archaeologists excavated a large scale fortified Silla site in Dongcheon-dong, Buk-gu. The site at Locality 2 consists of the remains of 39 raised-floor buildings enclosed by a formidable ditch-and-palisade system. The excavators hypothesize that the fortified site was a permanent military encampment or barracks. Archaeologists also uncovered a large Silla village dating to the 6th to 7th centuries at Siji-dong . The city was given its current name in 757. Most relics of the Silla period are found on Palgongsan around Donghwasa temple in northern Daegu. Donghwasa itself dates from the Silla period, as does the pagoda of King Minae.
Later Three Kingdoms
During the Later Three Kingdoms period, 890-935, Daegu was initially aligned with Hubaekje. In 927, northern Daegu was the site of the Battle of Gong Mountain between the forces of Taebong under Wang Geon and those of Hubaekje under Gyeon Hwon. In this battle, the forces of Taebong were crushed and Wang Geon himself was saved only by the heroism of his general Shin Sung-gyeom. However, it appears that the conduct of the Hubaekje forces at this time changed local sympathies to favor Wang Geon, who later became the king of Goryeo.
Numerous place-names and local legends around Daegu still bear witness to the historic battle of 927. Among these are "Ansim," which literally means "peace of mind," said to be the first place where Wang Geon dared to stop after escaping the battle, and "Banwol," or half-moon, where he is said to have stopped and admired the moon before returning to Taebong. A statue commemorating the battle now stands in northern Daegu, as does a memorial to Sin Sunggyeom.
Goryeo
The first edition of the Tripitaka Koreana was stored in Daegu, at the temple of Buinsa. However, this edition was destroyed when the temple was sacked in 1254, during the Mongol invasions of Korea.
Joseon
Always an important transportation center, in the Joseon Dynasty Daegu lay on the Great Yeongnam Road which ran between Seoul and Busan. It lay at the junction of this arterial road and the roads to Gyeongju and Jinju.
In 1601, Daegu became the administrative capital of Gyeongsang province, and the city has been the capital of North Gyeongsang province since that province's formation in 1896.
Daegu's first regular markets were established during the late Joseon period. The most famous of these, and the only one to still be operating, is the Yangnyeongsi herbal medicine market. This became a center of herbal trade in Joseon, and even attracted buyers from neighboring countries. Traders from Japan, who were not permitted to leave the Nakdong River valley, hired messengers to visit the market on their behalf.
Korean Empire
Korea began to open to the world in the late 19th century. In 1895, Daegu became the site of one of the country's first modern post offices, as part of the reforms pushed by the Japanese after the murder of Queen Min. Beginning in the late 1890s, many Japanese merchants and workers came to Daegu, which lay on the newly constructed Gyeongbu Line railroad connecting Seoul and Busan.
In 1905, the old fortress wall was surreptitiously destroyed. Only one portion of this, the First Yeongnam Gate, remains, standing now in Dalseong Park. The rest of the fortress wall is remembered only through the names of the streets Dongseongno and Bukseongno, "east fortress street" and "north fortress street," which now run where the wall once stood.
Japanese rule
The Korean independence movements were active in Daegu. These began as early as 1898, when a branch of the Independence Club was established in the city. As the demise of the Korean Empire approached in 1907, local citizens led by Seo Sang-don organized the National Debt Repayment Movement. This movement spread nationwide, although it was unsuccessful in its attempt to repay the country's debt through individual donations. Resistance activities continued after the 1910 annexation, notably during the Mar 1st movement of 1919. At that time, four major demonstrations took place in Daegu, involving an estimated 23,000 people.
The women of Daegu were active in the independence struggle, as they were elsewhere in the country. The Patriotic Women's Educational Society, or aeguk buin gyoyukhoe (애국부인교육회), was based in the city. Women also took a leading role in the National Debt Repayment Movement, including the kisaeng Aengmu.
Many schools and colleges were established in Daegu, both by private organizations and by the Japanese government. These included the government-run Daegu Normal School, later Daegu Teachers' College, which became the Teachers' College of Kyungpook National University after 1945.

South Korea

The end of Japanese rule in 1945 brought years of turbulent change to Daegu. Under the USAMGIK provisional military government and the subsequent First Republic, Daegu was a hotbed of unrest. In October 1946, the Daegu uprising took place, one of the most serious incidents of unrest during US military rule, where police attempts to control rioters on October 1 caused the death of three student demonstrators and injuries to many others, sparking a mass counter-attack killing 38 policemen. It was also the site of major demonstrations on February 28, 1960, prior to the fraudulent presidential election of that year.

Daegu and all of North Gyeongsang saw heavy guerrilla activity in the late 1940s, as thousands of refugees arrived from the fighting in Jeolla. In November 1948, a unit in Daegu joined the mutiny which had begun in Yeosu the previous month.

During the Korean War, much heavy fighting occurred nearby along the Nakdong River. Daegu sat inside the Pusan Perimeter, however, and therefore remained in South Korean hands throughout the war. As in many other areas during the Korean War, political killings of dissenters were widespread.

In the second half of the 20th century, the city underwent explosive growth, and the population has increased more than tenfold since the end of the Korean War. The city was heavily politically favored during the long military dictatorship of Park Chung-hee, when it and the surrounding area served as his political base. Conservative political movements remain powerful in Daegu today.

In the 1980s, Daegu became a separately administered provincial-level Directly Governed City (Jikhalsi), and was redesignated as a Metropolitan City (Gwangyeoksi) in 1995. Today, Daegu is the 3rd largest metropolitan area in Korea with respect to both population and commerce.

With the establishment of the Daegu-Gyeongbuk Free Economic Zone, Daegu is currently focusing on fostering fashion and high-tech industries.In the 1980s, Daegu separated from Gyeongsangbuk-do and became a separately administered provincial-level Directly Governed City (Jikhalsi), and was redesignated as a Metropolitan City (Gwangyeoksi) in 1995. Today, Daegu is the 3rd largest metropolitan area in Korea with respect to both population and commerce.

Symbols of Daegu

City Emblem

The official Daegu City logotypes are provided in Korean, Chinese and English and were designed to be used in harmony with the city's emblem. Designation date: October 10, 1996.

City Logotypes

The official Daegu City logotypes are provided in Korean, Chinese and English and were designed to be used in harmony with the city's emblem.

Designation date: October 10, 1996.

City Slogan: "Colorful Daegu"

The official slogan of Daegu, "Colorful Daegu", is aimed at creating an impression of youth, brightness, elegance, exuberance and vitality as well as diversity and progress. Designation date: December 31, 2004

Bird of Daegu / Eagle

The eagle represents the progressive spirit of frontierism shown by Daegu's citizens. ◈ Designation date: July 1, 1983.

Tree of Daegu / Fir

The fir symbolizes the courage, everlastingness and nobility of Daegu's citizens. Designation date: July 18, 1972

Flower of Daegu / Magnolia

The magnolia represents the values of innocence; purity and self-sacrifice to which Daegu's citizens aspire.
Designation date: July 18, 1972

2. How good is the city knowledge-based development strategy and the capability to enact it? (1. Identity)

Daegu Gyeongbuk Free Economic Zone (DGFEZ) Authority decided to make 2014 the first year of a quantum jump of investment attraction.

	- Choice and concentration for attracting foreign direct investment based on three major target industries - The Diversification of Cooperation Institutes and the acceleration of attracting joint ventures - Creating outcomes through the strengthening of cooperation network with Seoul-based Embassies and Chambers of Commerce The DGFEZ Authority (Commissioner Choi Byung-Rok) decided to make 2014 the first year of Quantum Jump for investment attraction, which would be connected with the rising trend of 2013 investment attraction. The DGFEZ Authority attained US$ 130 million of foreign direct investment (FDI) in 2013 in terms of MOU, continuing the rising investment trend of 2012 (US$ 148 million). In terms of FDI arrival, it recorded US$ 68 million, a 62% increase on 2012 (US $42 million). What is unique is that DGFEZ Authority achieved 7 foreign direct investments in 2013, which is more than half of the total 15 investments of FDI since its establishment in 2008. Meanwhile, 32 domestic companies decided to invest in DGFEZ in 2013, with an expected total investment of around 240.6 billion KW (US$ 223.6 million). Even though the low value of Yen and global economic recession is expected to continue in 2014, DGFEZ Authority will try to overcome those obstacles to attain more than US$ 100 million of FDI in 2014. ★ 7 foreign direct investment companies in 2013, including LFJ Korea, Hwajin, BPH Korea, Penox Korea, Jesung Gear, Ugint Korea, ASSAP Steel. ★ 32 domestic investment companies in 2013, including Daejoo Machinery, Samick Precision, Daesung Hi-Tech, Samwon Auto Valley, Daewoo Pharmacy, and others. ○ Choice and concentration; 3 major target industries According to the "First Free Economic Zone Basic Plan" in July 2013, IT conversion, Transportation & machinery parts and Health Care were designated as the DGFEZ's 3 major target sectors by the Korean Central government. The DGFEZ Authority is currently focusing on these 3 major sectors. At the same time, it will try to raise the IR potential through the Matrix Analysis, where sectors and regions would be analyzed through horizontally and vertically, with 142 foreign IR activities analyzed since the launching. ○ Diversification of Cooperation Institutes and acceleration of attracting Joint ventures Since the launch, the DGFEZ Authority has largely cooperated with KOTRA, the largest investment-attracting consulting institute in Korea, as the major partner. Recently the authority has linked to global consulting institutes and cooperated with them, such as Oxford Intelligence, etc,. It will continue this diversification in 2014. Meanwhile, the DGFEZ Authority continues to seek out local companies that want a joint investment with foreign companies, which accounted for more than 50% out of total foreign investment in the DGFEZ. If necessarily, it would go to overseas for the joint IR with the local companies, which will provide foreign companies for investment opportunities in the DGFEZ, consequently raising possibilities for investment attraction. ○ Strengthening cooperation networks with foreign chambers of commerce and foreign embassies in Korea The DGFEZ Authority will continue to strengthen its relationship with the US, Canadian, French, German, Swedish and Australian chambers of commerce in Korea, which have already built their co-operative relationships with the authority. In addition, Nuremberg Chamber of Commerce in Germany, Zone Corp in UAE, and European Free Zone in Turkey that have already concluded MOUs with DGFEZ Authority will incorporate the details of investment cooperation with the authority. Source: News release from the DGFEZ Authority (Jan. 2014)
	3. How good are the city's strategic intelligence systems (e.g. does it have a Future Center or equivalent initiative?) (2. Intelligence) Daegu is a manufacturing industry city. The major industries are textiles, metals and machinery. In the year 2010, Daegu had a regional GDP of $45,387 million with 7.2% real GDP growth rate. The GDP per capita though is well below Korea national average. The quality of the apples grown around the city is renowned around Korea. Many companies such as Daegu Bank, Korea Delphi, Hwasung corp., and TaeguTec are situated in this city, and Samsung and Kolon were founded here. Numerous factories are located in the industrial complexes situated in the west and north sides of the city including the Seongseo Industrial Complex, West Daegu Industrial Complex and the Daegu Dyeing Industrial Complex. The city is the economic and industrial core of the Daegu-Gyeongbuk region, one of the major industrial areas in Korea. It accounted for as much as 94 percent of Korea's trade surplus in 2006. The electronics industries in Gumi and the steel industries in Pohang provided great services to that surplus. World-leading manufacturing facilities for Anycall (Samsung

Mobile) and POSCO's main factories are located near the city. Daegu and its neighbouring cities were designated for the Daegu-Gyeongbuk Free Economic Zone by the central government in 2008. It is specialized in knowledge-based service and manufacturing industries.

Historically, Daegu has been the commercial center of the southern part of the Korean Peninsula with Seoul in the center and Pyongyang in the north (currentlyNorth Korea), because of its advantageous location. Some of the large, traditional markets like Seomun Market are still flourishing in the city.

Additionally, Daegu was considered the third major economic city in Korea, after Seoul and Busan. However, due to the decline of the textile industry, which is the heart of Daegu's economy, the overall economic growth of the city has also fallen.

Also, the city is the warmest region in South Korea due to the humid subtropical climate. This climate condition provides the region with high quality apples and oriental melons. The fruit industry is a crucial support for the local economy. Due to the stagnant economy, Daegu's population began to decrease after 2003. Recently, the local government has begun focusing on working towards economic revival and concentrating on improving the city's fashion industry.

Daegu is to establish the Daegu National Industrial Park on 8.5㎢ land where industrial, residential, commercial and research institutions will be provided to 24,000 people. The area has been designated by the Ministry of Land, Infrastructure and Transport as the Daegu Science Park in September, 2009 and aims to become the new axis of industries along with the Nakdong river industrial belt including the Seongseo 5 High-tech Industrial Complex, Seongseo 1~4 industrial complexes, Dalseong 1st and 2nd industrial complexes, Technopolisand Hyeonpung industrial complex to attract companies in sectors, such as future vehicles, advanced machinery, electronics and telecommunications and renewable energy. Also, the Daegu National Industrial Park will be a green high-tech complex by transforming the existing textiles, general machinery, automobile parts industries to intelligent automobiles parts, embedded S/W and solar energy industries under the cooperation with large-scale industrial complexes in the Yeongnam region including Gumi (electronics), Masan?Changwon (machinery) and Ulsan?Busan (automobiles).

■ Overview

- Location: Areas of Guji Myeon, Dalseong County (near Dalseong 2nd Industrial Park FIZ)
- Area: 8,548,000 m² ;
- Project period: 2009 ~ Dec. 2018 (Phase 1: 2016)
- Project cost: about KRW 1.7572 trillion
- Project developer: Korea Land and Housing Corporation (75%), Daegu Urban Development Corporation (25%)
- Target business: electronics and telecommunications, high-tech machinery, future cars, etc.
  ※ Non-metallic mineral products (C23), electronic devices, computers, videos, sound and communications equipment manufacturing (C26), medical, precision and optical instruments and clocks (C27), electrical devices (C28), other machinery and equipment (C29), automobiles and trailers (C30)

■ Site conditions

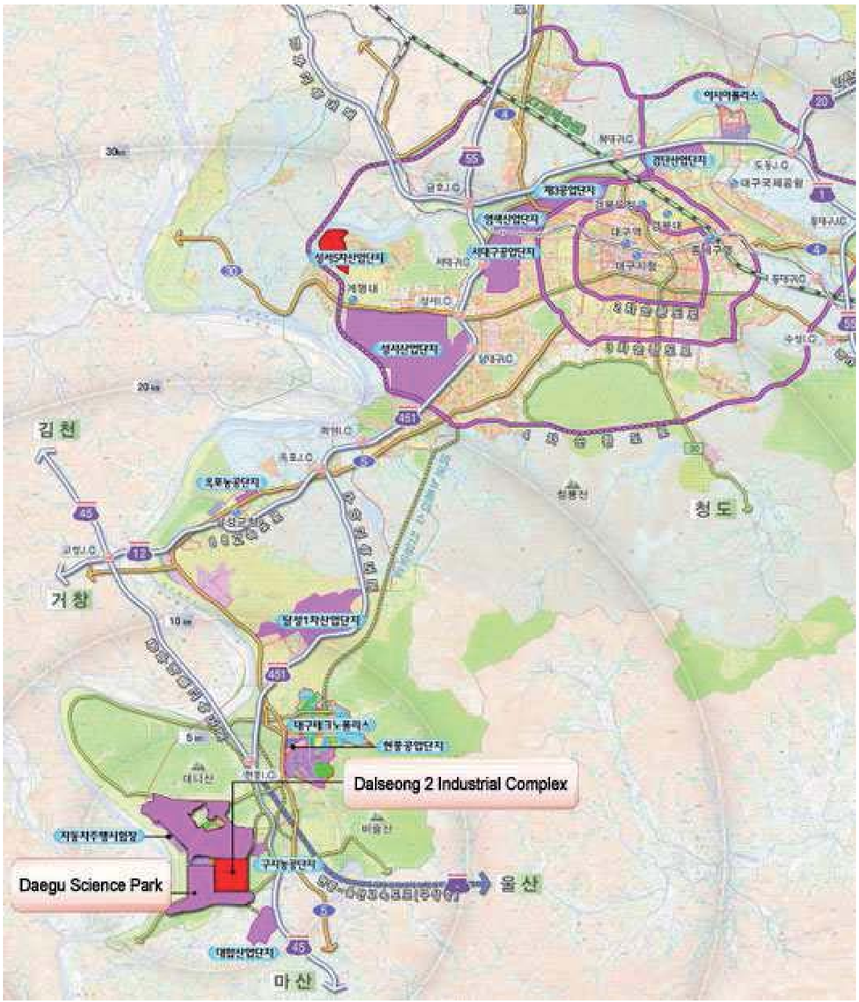
- Roads between arboretum and Technopolis and an expressway between Hyunpung and Ulsan are under review

■ Progress and plan

- Apr. 30, 2008 ~ Dec. 6, 2008: Feasibility study (Korea Research Institute for Human Settlements)
- Aug. 26, 2008: Announcement of establishment of Daegu National Industrial Park (Ministry of Land, Transportation and Maritime Affairs)
- Dec. 2008 ~ May. 2009: Establishment of Industrial Complex Plan (Development and implementation plan)

- May. 28, 2009: Applied for designation as Daegu National Industrial Complex
- Sept. 30, 2009: Designation
- Oct. 2009: Basic surveys on obstructions and lands
- Jan. 2013: Began construction of District 1 and 2 (5.92 million m²)
- Jun. 5, 2013: Groundbreaking ceremony
- Dec. 2016: Expected to complete the construction of phase 1

■ Location Map



■ Plan for land use

■ Bird's Eye View

	 http://www.investkorea.org/ikwork/reg/eng/co/index.jsp?l_unit=90202&m_unit=90311&code=1450401&category=1
B. FINANCIAL and RELATIONAL CAPITALS 	4. How strong is the city's social cohesion? (4. Relational) Generally Daegu is known as a conservative city. As well as being the largest inland city in the country beside Seoul it has become one of the major metropolitan areas in the nation. Traditionally, Buddhism has been strong; today there are still many temples. Confucianism is also popular in Daegu, with a large academy based in the city. Neon cross-topped spires of Christian churches can also be seen in the city. Until very recently, Korea was largely considered to be a homogenous, racially intolerant country that had little or no experience with large-scale immigration. However, this paradigm is in the process of changing. For the first time in the country's history, large numbers of foreigners are immigrating to work and live in Korea, and many are seeking to become Koreans. In particular, international marriage migrations, especially those of women entering the country through marriages to Korean men, have become common in South Korea. This has given rise to serious challenges within the country. Although conventional ideologies portray Korea as a country of a single race, culture, and language, the growing number of immigrants has disrupted this homogenous monoculture. Indeed, there are signs that Korea has reached a turning point, with an increasingly permanent and visible migrant population challenging the country's national identity. This article explores the statistics and trends related to international marriage migrant women in South Korea, particularly in terms of their social insecurities and health-related problems. In addition, some aspects of Korean governmental policies for the social integration and health promotion of these women are examined, and some suggestions are made for ways in which public health nursing and nursing education may be changed in response to the current trends. http://www.ncbi.nlm.nih.gov/pubmed/21087310
	5. How good are the city's regional, national and international relations? (4.Relational). International Partners • Heidelberg Technology Park

- Higher Corporation for Specialized Economic Zones (ZonesCorp)
- The Gujarat Vittal Innovation City (GVIC)
- MEMS Industry Group
- Sophia Antipolis
- Universitat Autonoma de Barcelona
- World Trade Center Dulles Airport
- Zhongguancun Science Park

Twin towns – Sister cities

- United States Atlanta, United States (1981)
- Kazakhstan Almaty, Kazakhstan (1990)
- Vietnam Danang, Vietnam (1993)
- China Qingdao, China (1993)
- Brazil Minas Gerais, Brazil (1994)
- Japan Hiroshima, Japan (1997)
- Russia Saint Petersburg, Russia (1997)
- Bulgaria Plovdiv, Bulgaria (2002)
- Taiwan Taipei, Taiwan (2010)
- China Ningbo, China (2013)

6. How healthy are public financial accounts? (3. Financial)
DGB Financial Group (Korean: DGB금융그룹, abbreviated as DGBFG) is a South Korean banking holding company headquartered in Daegu, Korea. Its flagship company, Daegu Bank, is one of the largest regional banks in the country, mostly serving customers in the Daegu-Gyeongbuk region.
The group was founded on May 17, 2011 upon the Financial Supervisory Service's approval for the establishment of a financial holding company for Daegu Bank and its two arms, Daegu Credit Information and Kardnet. Ha Chun-soo is currently serving as president and CEO of both Daegu Bank and DGB Financial.
Based on the management ideology, [Dream and rich with local residents], for the past 47 years Daegu Bank has provided local residents the best financial service and become the foundation for the region development. Not only is Daegu Bank exerts in general performance to become the [world's excellent region bank in practicing sustainability management] but also including ethics, environment, and social contribution to become the words leading bank.
The DGB Financial Research Division carries out vital role in the following business areas: research on financial industry and financial strategy, industry analysis, sustainability management, green finance. We will continue to serve as a think-tank for the DGB Financial Group, assisting in the group's effort to be the leading financial group contributing to the vitalization of the local economy.
Five Business Areas ;
1. Financial strategy research : Financial strategies, customer, channel, trend
2. Financial industry research : Financial industry, financial market, local finance
3. Industry Analysis : Industry analysis, research on local economy and real estate
4. Sustainability Management : Strategy and planning for DGB Financial Group's sustainability management
5. Green Finance : Strategy and planning for DGB Financial Group's Green Management
http://www.dgbfg.co.kr/cms/group/dfg/eng/sdi_111/sdi_1115/1188625_2169.html

C. INSTRUMENTAL TANGIBLE CAPITALS.

7. How good is the city's location, climate and physical landscape? (Instrumental tangible)
Daegu sits in a basin surrounded by low mountains. Palgongsan to the north, Biseulsan to the south, Waryongsan to the west, and a series of smaller hills in the east. The Geumho River flows along the northern and eastern edges of the city, emptying in the Nakdong River west of the city.
The mountains that comprise the basin trap hot and humid air. Similarly, in winter, cold air lies in the basin. The area receives little precipitation except during the rainy season of summer, and is sunny throughout much of the year. Data gathered since 1961 indicates that the mean temperature for January, the coldest month in Daegu, is 0.6 °C (33 °F) and that for August, the warmest month, is 26.4 °C (80 °F). The City's lowest record temperature was −20.2 °C (−4 °F),[22] and the City's highest record temperature was 40.0 °C (104 °F).

8. How advanced are the city's environmental policies? (Instrumental-tangible)
Daegu Regional Environmental Office
Overview

	The Daegu Environmental Measurement Management Office was established in January 1980 and expanded to the Daegu Regional Environmental Office in January 1990. In February 2009, the Office was reorganized to have six departments and one branch office in line with reorganization of the Ministry of Environment and its subsidiary organizations. With the jurisdiction over Daegu Metropolitan City and Gyeongsangbuk-do, the Daegu Regional Environmental Office has conducted the following tasks: managing watershed of Nakdong river, monitoring environmental infrastructure and hazardous waste, assessing environmental impact, and operating environmental measurement network. As Wangpicheon area(Geunnam-myeon, Seo-myeon, Uljin-gun, Subi-myeon, Yeongyang-gun,102.84㎢) was designated as ecology and scenery preservation area on October 14, 2005, the Office has made efforts to preserve the area's superb topography and scenery, and habitat of rare wildlife. In addition, the Office has done its best to contribute to preservation of the global environment as well as regional one so that human being can enjoy clean and safe life. History January 1980 Open the Daegu Environmental Measurement Management Office May 1983 Expand the Daegu Environmental Measurement Management Office(3 departments and 27 staff) October 1986 Open the Daegu Environmental Branch Office after combining the Daegu Environmental Measurement Management Office and Daegu/Gumi Central Inspection Team January 1990 Expand to the Daegu Regional Environmental Office (3departments and 2 branch offices) May 1994 Reorganize into the Daegu Regional Environmental Management Office with the change into Basin Environmental Offices of four rivers(4departments) October 1995 Open Pohang/Gumi Environmental Branch Office August 2002 Reorganize from the Daegu Regional Environmental Management Office to the Daegu Regional Environmental Office (4departments and 2 branch offices) February 2006 Expand the Office in line with the reorganization of the Ministry of Environment and its subsidiary organizations (7departments and 2branch offices) February 2009 Reorganize the Office in line with the reorganization of the Ministry of Environment and its subsidiary organizations (6 departments and 1 branch office) Areas covered

Areas Covered	Administrative Districts			Area(㎢)	Population(1,000)
	City	County	District		
Total	10	14	7	19,911	5,207
Daegu Metropolitan City	-	1	7	885	2,526
Gyeongsangbuk-do	10	13	-	19,026	2,681

http://eng.me.go.kr/eng/web/index.do?menuId=43

The 2013 International Conference on the "Challenges in Environmental Science and Engineering" (CESE-2013) organized by Korean Society of Water and Wastewater (KSWW), will take place in Daegu, Korea. This is the sixth international conference in the CESE series. Researchers, policy-makers, academics, students and the broader community active in contributing solutions to the myriad of environmental questions that are posed to ensure sustainability, are welcome to meet in Daegu to share their knowledge and visions for the future.
http://cese-conference.org/2013-home.htm

9. How good is the quality of urban physical infrastructure? (Instrumental-tangible)
Beyond the issue of municipal control and local utility as ownership, some cities seek clean local power as a way to keep pace with the demands of industrializing society. Since 2000, Daegu in South Korea has pursued increasingly comprehensive urban planning that links renewable energy with local economic development. During the 1997-98 Asian economic crises, the devaluation of South Korea's currency contributed to a doubling of energy prices due to the nation's large reliance on imported energy. Against the backdrop of high population density and rapid urbanization, this focused attention on Daegu's need to alter its energy model.

Daegu had established a goal of local renewables meeting 5 percent of its total

energy demand by 2010, with long term targets through 2050. In addition, the Center for Solar City Daegu, a joint effort of the municipality and Kyungpook National University, is working to disseminate green technologies. These include PV and solar water heating installations at schools, on the university campus, and at sewage and water treatment facilities. To help homeowners install solar roof systems, the city and national government are funding up to 80 percent of installation costs. Strong citizen participation has been reinforced by municipal leaderships in Daegu.
Society, Ethics, and Technology, Update Edition by Ralph Morton Winston: https://books.google.com.mx/books?id=DP7zD5xaThMC&pg=PA394&lpg=PA394&dq=daegu+urbanization&source=bl&ots=vrEtXDO6BF&sig=AUQUy8x9EkI3ZbJdNd4LLzpUt5g&hl=en&sa=X&ei=nJrKVPzsHsj5yQSIhYDgDg&ved=0CEsQ6AEwCQ#v=onepage&q=daegu%20urbanization&f=false

10. How good is the city's transportation and telecommunications connectivity? (Instrumental-tangible).
Rail

Dongdaegu Station
Daegu is the hub of the Korean inland railroad traffic. The main railroad of the country, Gyeongbu Line passes through the city. The largest railroad station in the city, Dongdaegu Station has the second largest passenger traffic in Korea after Seoul Station, and the largest train traffic. The station re-opened in 2004 after extensive renovations serving the KTX highspeed train, Saemaul and Mugunghwa trains. All kinds of trains except KTX depart from Daegu Station, an all-new building with cinemas, restaurants and a department store, located near the city centre. It has the tenth largest passenger traffic in Korea. Daegu Line branches off from Gacheon Station of Gyeongbu Line.
Metro

The city also has a subway system, consisting of two heavy rail lines. Line 1crosses the city from northeast to southwest, while Line 2 crosses from west to east. Line 3 from northwest to southeast is under construction as an elevated monorail. All the lines are and will be operated by the Daegu Metropolitan Transit Corporation (DTRO). Another line will operate in a few years as a heavy rail system using the Gumi–Daegu–Gyeongsan section of Gyeongbu Line. Line 4 is a long-range plan and will be a circle line. Fare is 1200 won on distance and 1100 won with a prepaid card. There is a free interchange scheme between the metro and bus within an hour of first use for the prepaid card users.

Daegu Metro Line 1 was, until mid-2005, the only rapid transit line in the South Korean city of Daegu. It is operated by the Daegu Metropolitan Transit Corporation. Line color is maroon.

The line first began running from Jincheon to Jungangno on November 26, 1997. The section from Jungnangno to Ansim was opened shortly thereafter, on May 2, 1998. The west end of the line was extended from Jincheon to Daegok, reaching its current length on May 10, 2002. However, service on the entire line was stopped for several months in 2003 following the Daegu subway fire.

Line 1's 25.9 kilometer course lies entirely within the metropolitan city of Daegu, although proposals have been made to extend it into the neighboring city of Gyeongsan. As of 2011, trains run 312 times per day during the week, and 288 times on weekends and holidays. It takes 50 minutes and 30 seconds to go from one end to the other.

Daegu Metro Line 2 is the second rapid transit line in the South Korean city of Daegu. It is operated by the Daegu Metropolitan Transit Corporation.

The line first began running from Munyang to Sawol on October 18, 2005, a distance of 29 km. The line had been scheduled to open some years earlier, but fallout from the IMF crisis of the late 1990s caused delays in construction.

On 19 September 2012, the extension from Sawol to Yeongnam University opened.

Line 3 (monorail) is under construction, scheduled to be open in May 2015.

Road

There are two types of buses which are local and limited express. Limited express buses have more seats, but often passengers are required to stand. As of 2008, Local bus fare costs around 1100 won, Limited express bus fare would set you back around 1500 won. Discounted fare is available with a prepaid card.

Bus route numbers are made up with 3 digits, each number indicates the area that bus serves. For example, number 407 bus runs from zone four, to zone zero, and then to zone seven. Other routes, usually circular, are named for the districts they serve and numbered 1 through 3.

Traffic is sometimes heavy; however, the major thoroughfares handle fairly high volumes of traffic without too much trouble.

Air

Daegu is served by Daegu Airport (international/domestic) located in northeastern Daegu.

Daegu International Airport (Hangul: 대구국제공항; Hanja: 大邱國際空港; Revised Romanization: Daegu Gukje Gonghang; McCune-Reischauer: Taegu Kukche Konghang) is primarily a domestic airport in the city of Daegu, South Korea. In 2013, 1,084,585 passengers used the airport. The airfield also is a military base with ROKAF's 11th Fighter Wing based; its three squadrons are flying F-15K.

While the airport serves a growing metro area with more than 2.5 million residents, passenger numbers at Daegu airport have been declining since 2004, the year KTX highspeed rail reached Daegu. The 2013 number of about 1.1 million is half the number of passengers that were using the airport until 2003.

D. HUMAN INDIVIDUAL and HUMAN COLLECTIVE CAPITALS.

11. How 'youthful' is the city (e.g., how large is the demographic cohort of people under the age of 25)? (5. Human individual).

As of the end of December 2013, the number of population registered in Daegu Metropolitan City stood at 2,524,890 persons, which showed a decrease of 2,676 persons (∆0.10%) compared to 2,527,566 persons recorded at the end of December 2012, while it showed a decrease of 4,395 persons (∆0.17%) compared to 2,529,285 persons recorded at the end of 2011.

The number of foreigners residing in Daegu is 23,302 persons, which showed an increase of 1,380 (6.29%) compared to December of 2012 and an increase of 1,288 (5.85%) compared to the end of 2011. The number of households at the end of 2013 recorded 960,265 households, while the number of average family members per household was

2.63 persons.

Population by Gender

As of the end of December 2013, the number of population by gender in Daegu Metropolitan City recorded 1,246,071 males (a decrease of 3,249 males compared to the end of 2013, ∆0.26%) and 1,255,517 females (a decrease of 807 females compared to the end of 2012, ∆0.06%).

Division	Total	Korean		Foreigner		Household
		Male	Female	Male	Female	
Daegu	2,524,890	1,246,071	1,255,517	13,072	10,230	960,265
Jung-gu	76,963	37,276	38,970	328	389	35,780
Dong-gu	345,347	171,738	172,064	484	1,061	138,851
Seo-gu	217,550	109,196	106,203	1,196	955	90,793
Nam-gu	167,020	81,060	85,002	338	620	75,038
Buk-gu	448,841	222,780	221,579	2,194	2,288	165,041
Suseong-gu	462,471	225,950	235,054	664	803	164,518
Dalseo-gu	618,613	303,952	306,406	5,201	3,054	222,326
Dalseong-gun	188,085	94,119	90,239	2,667	1,060	67,918

※ As of December 31, 2013

Number of foreigners registered by nationality

The number of foreigners living in Daegu Metropolitan City recorded 23,302 persons, which showed an increase of 1,360 persons (6.29%) compared to the end of the previous year. The largest number of foreigners was Chinese (30.52%, including Korean Chinese), followed by Vietnamese (18.41%) and Indonesian (6.9%).

The ratio of foreigners against the whole population of Daegu Metropolitan City was 0.92%.

(Unit: Persons)

http://english.daegu.go.kr/cms/cms.asp?Menu=28

12. How good are public health standards? (6. Human collective)

Some large university hospitals make the city the medical hub of south-eastern Korea. The Kyungpook National University Hospital, founded as Daegu-dongin-uiwonin 1907, is the well-known hospital in the city. The Dongsan Hospital (attached to Keimyung University), founded as Jejungwon in 1899, is one of the oldest western style medical clinics in Korea. The Yeungnam University Medical Center has the largest number of beds in the city. The yearly treatment amount of these tertiary hospitals is the second largest in South Korea after that of

Seoul. The Daegu Catholic University Medical Center is also included in them. http://www.himssasiapac.org/11/docs/HIMSS_Asia_10_Post_Event_Report.pdf

Daegu Health College provides medical training to aspiring professionals in Daegu metropolitan city, South Korea. The current president is Nam Seong-hui (남성희). About 100 instructors are employed. The courses of study are divided among five divisions: Health (which includes fields such as clinical pathology and radiology), Nursing, Medical Industry, Social Work, and Arts.

The college opened its doors as Daegu Technical School of Health in 1971. Its status was raised to that of a technical college in 1979, and in 1998 it became simply Daegu Health College.
http://en.wikipedia.org/wiki/Daegu_Health_College

Daegu-Gyeongbuk High-tech Medical Complex

■ Overview

Location: within the Daegu Innovation City in Sinseo-dong, Dong-gu, Daegu City

Area: 1030,000㎡ (innovation city 4216,000㎡)

Project period: 2009~2038 (Construction: 2009~2013)

Total budget: KRW 4.6 trillion (national expense KRW 1.1 trillion, municipal expense KRW 0.9 trillion and private investment KRW 2.6 trillion)

Land for sales :Jun. 29, 2012~

Facilities

- Government facilities: New Drug Development Support Center, High-tech Medical Equipment Development Support Center, Lab Animal Center, Clinical Drug Manufacturing Center

- Regional and private facilities: Communication Center (Daegu City), High-tech Clinical Trial Center, research institutions and laboratory enterprises, venture centers etc.

■ Background

Dec. 16, 2009: Designation and announcement of the high-tech medical complex

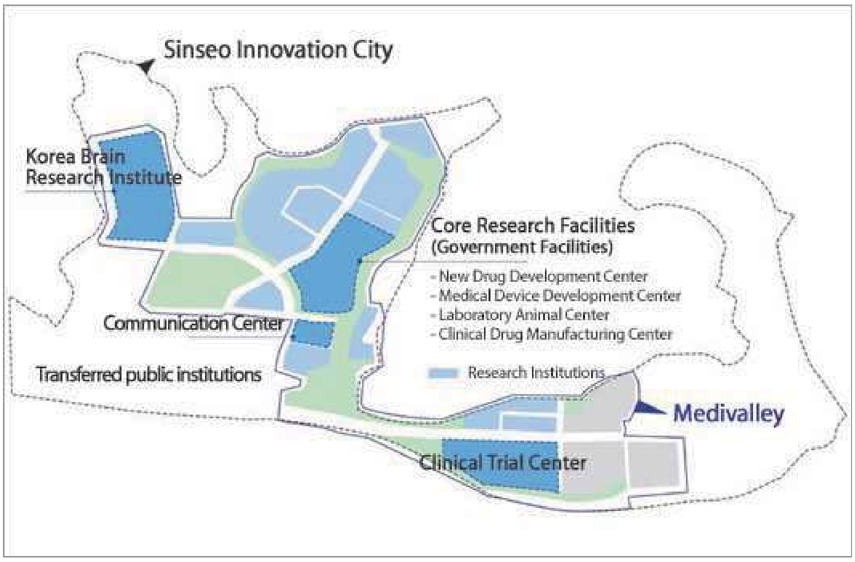
Jan. 27, 2010: Finalization of the plan to establish the high-tech medical complex

Oct. 27, 2011: Began construction of government and regional facilities

Dec. 2013: Completed the construction of the complex

■ Bird's Eye View

■ Design of High-tech Medical Complex



■ Plan for the sales of research facilities

289,369㎡(Total area for sale 466,272㎡, sale completed 176,903㎡) ※As of Jun. 30, 2014 Possible to parcel out the land into an optimal size (minimum 1,650㎡)

Sale price KRW 596,838/㎡ (KRW 1,973,017/3.3㎡) ※Reference price of plant land of industrial zone in Daegu: Seongseo Industrial Complex 3~5 million won/3.3㎡

	Period: Jun. 29, 2012 ~ ※ Application on a rolling basis Land for Sales ・General sale: Application on a rolling basis from Jun. 29, 2012 ・Special supply: Attract excellent research institutions and laboratories Tenants: universities, research institutions, laboratory enterprises, local and foreign preclinical trial institutions ※ The manufacturing industry cannot move into the complex. However, it is possible to produce medical supplies and equipment for clinical trials. Requirements (Human resources and facility standard) ・Human resources: three researchers who conduct only medical research and development and no other works including sales and business. (one researcher for a venture company in accordance with Article 2 of the Act on Special Measures for the Promotion of Venture Businesses) ・Facility standard: The tenant should be equipped with the following facilities to independently carry out medical research and development: - one or more laboratories - experiment equipment and research tools that researchers can use independently - subsidiary facilities including facilities for air purification and air conditioning and heating ■ Incentives Tax Support ・National tax: Corporate tax, income tax - 100 percent exemption for the first three years and 50 percent reduction for the next two years. ・Local tax: Acquisition tax exemption / property tax - 100 percent exemption for the first ten years and 50 percent reduction for the next 3 years. ・Foreign-invested company: corporate tax, income tax - 100 percent exemption for maximum five years and 50 percent reduction for the next two years, acquisition tax exemption, property tax? 100 percent exemption for the first 15 years. Financial support ・Subsidies for the regional investment promotion: maximum KRW 6 billion for newly established companies and transferred companies ・Subsidies for location and investment: maximum KRW 1 billion

	・Special subsidies for large-scale domestic and foreign investment companies: support a part of the total investment (partial support of site purchase cost, construction cost, facility and equipment cost) ・Subsidies for employment and training: no more than KRW 500,000 per person and within 6 months ・Foreign-invested companies: Companies with foreign investment of more than 30 percent (Support site purchase cost, rent cost, construction cost and subsidies for employment and training) ※This may differ according to the type of tenant and the scope of investment. (Supported by relevant laws and the Daegu City Ordinance) Special support ・Support R&D budget for research and development of new drugs and high-tech medical equipment ※Support companies through national R&D budget for the high-tech medical complex and the fund for the establishment of Medi-city. ・Create Medi-city funds (KRW 50 billion for the promotion of medical industry) and medical industry funds. ・Support to foster tailored resources, utilize the excellent domestic and foreign resources and infrastructure and create a work environment. Land purchase support ・Payment in installment for five years free-of-interest or offer discount (12.37 percent) for payment all at once. ※Research institutions of SMEs and venture companies support a part of the communication center (4,000㎡) / support sales for private institutions (under progress) Special case of regulation ・Medical Service Act - Allow foreign medical personnel to conduct medical services at medical institutions within the complex for medical R&D. ・National Health Insurance Act - Recognize as medical care when medical supplies, equipment and technology are used to patients for clinical trials. (Substantial reduction of clinical trial cost). ・Pharmaceutical Affairs Act / Medical Appliances Act - Item permission is given to medical supplies and equipment that do not meet the standard of production facility.

- International rules are applied to the permission and notification of importing medical supplies and equipment for research purposes, the manufacturing of medical supplies and equipment and the permission standard for import items.

・Bioethics and Safety Act

- A sub-committee of the National Bioethics Committee is established in the complex to separately deliberate the items concerning bioethics and safety.

- The institutions in the complex utilizes the Institutional Bioethics Review Board

・Immigration Control Act

- Extend the period of stay for foreign researchers (2→5 years).

・Patent Act

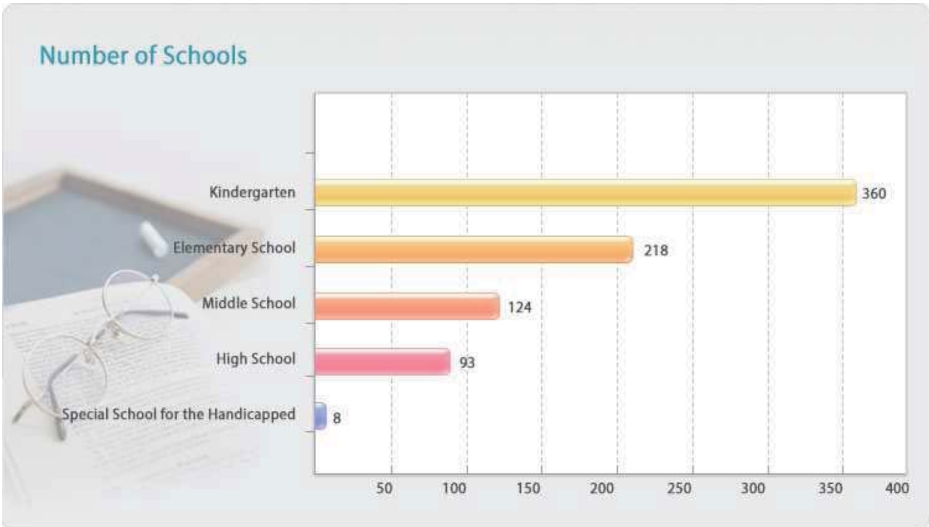
- Preference examination for the R&D patent developed in the complex.

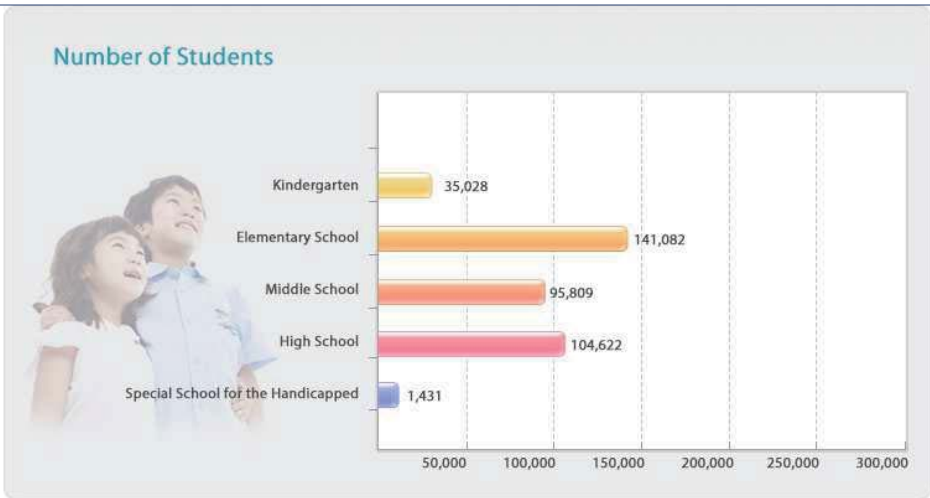
Administrative support

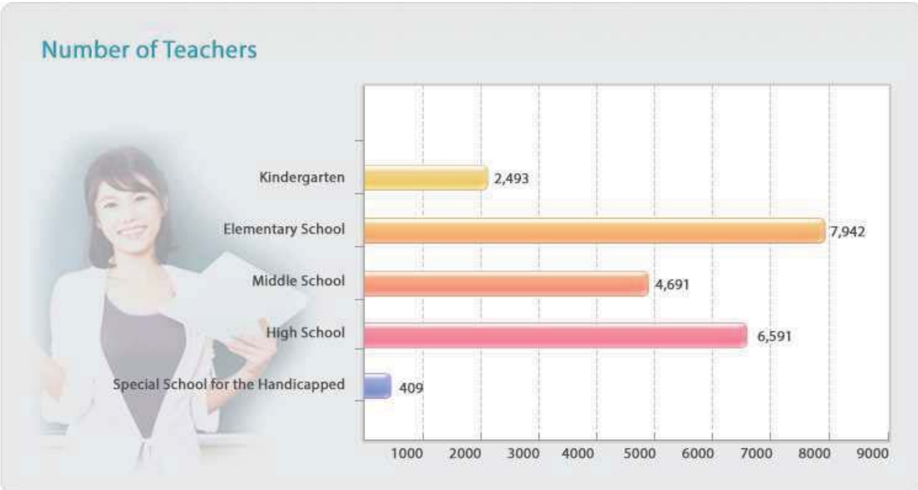
・Provide one-stop service of approval and permission from sales to move-in.

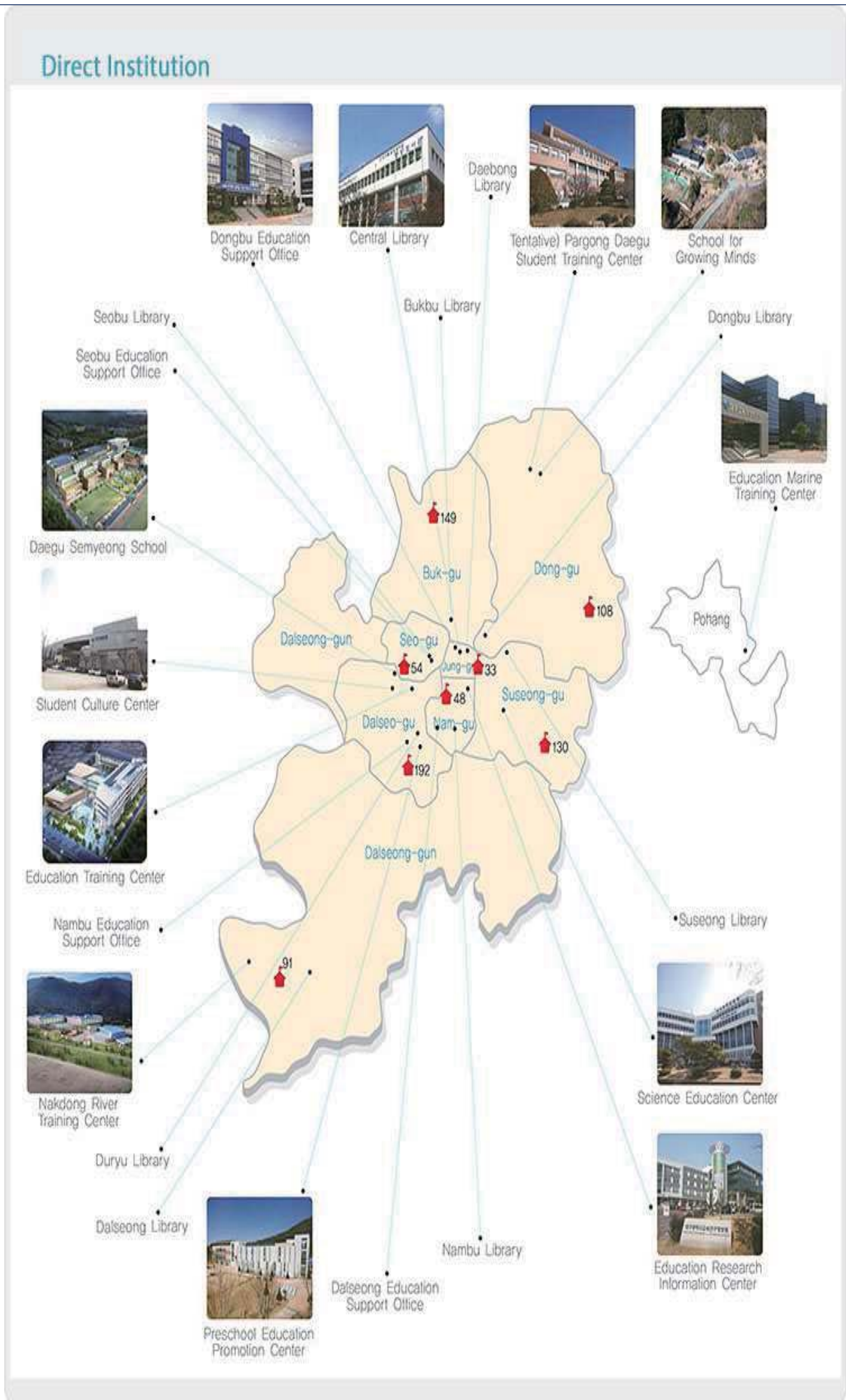
・Designate a public servant who manages from consulting to research and development.

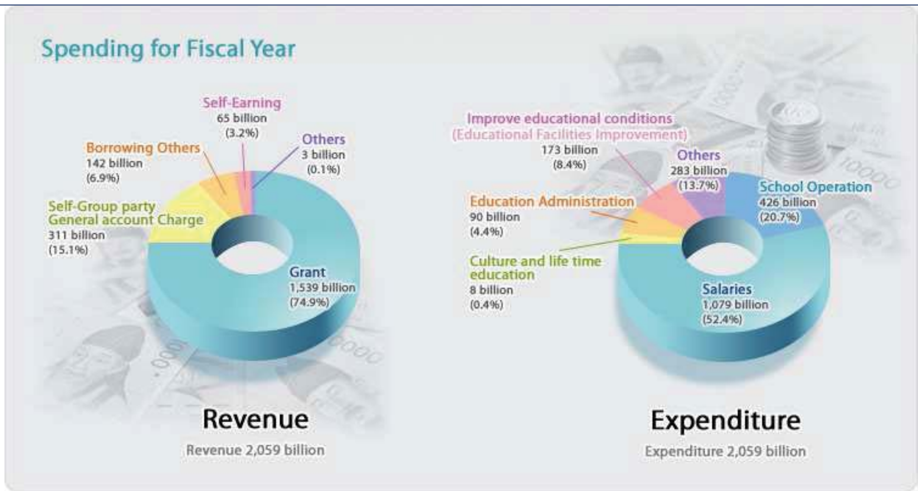
13. How equal are social and economic opportunities for individuals citizens to develop their full potential? (5. Human individual).




Number of Students
Kindergarten
35,028
Elementary School
141,082
Middle School
95,809
High School
104,622
Special School for the Handicapped
1,431
50,000
100,000
150,000
200,000
250,000
300,000


Number of Teachers
Kindergarten
2,493
Elementary School
7,942
Middle School
4,691
High School
6,591
Special School for the Handicapped
409
1000
2000
3000
4000
5000
6000
7000
8000
9000


Direct Institution
Dongbu Education Support Office
Central Library
Daebong Library
Tentative) Pargong Daegu Student Training Center
School for Growing Minds
Seobu Library
Bukbu Library
Dongbu Library
Seobu Education Support Office
Education Marine Training Center
Daegu Semyeong School
Buk-gu
Dong-gu
149
108
Pohang
Dalseong-gun
Seo-gu
54
33
Student Culture Center
48
Suseong-gu
Dalseo-gu
Nam-gu
130
192
Education Training Center
Dalseong-gun
Nambu Education Support Office
Suseong Library
91
Nakdong River Training Center
Science Education Center
Duryu Library
Dalseong Library
Nambu Library
Education Research Information Center
Dalseong Education Support Office
Preschool Education Promotion Center



EPIK Program

It was established in 1995 and is affiliated with the Korean Ministry of Education. Since its inception, EPIK has had the goals of improving the English-speaking abilities of Korean students and teachers, developing cultural exchange between Korea and abroad, and of introducing new teaching methods into the Korean education system.

To help accomplish these goals, EPIK invites responsible, enthusiastic native English speakers with a motivation to share their knowledge and language with Korean students and teachers to Korean public schools throughout the country.

https://www.epik.go.kr/index.do

Sports

The official emblem of the 2011 World Championships in Athletics

On March 27, 2007, the city was selected to host the 2011 World Championships in Athletics. Daegu competed with cities such as Moscow, Russia and Brisbane, Australia to earn the votes of the IAAF Council. The event was the fourth IAAF World Championships in Athletics to be held outside Europe, and the first games in mainland Asia. It was also the third worldwide sports event held in Korea after the 1988 Summer Olympics in Seoul and 2002 FIFA World

Cup in Korea and Japan. Daegu also hosted three matches in the 2002 FIFA World Cup, and the 2003 Summer Universiade. The city hosts the Colorful Daegu Pre-Championships meeting every year since 2005.

A home game of the Samsung Lions, one of the most popular sports teams in the city.

Daegu Stadium is the second largest sports complex in South Korea as a seating capacity of 66,422. Daegu simin undongjang hosted some soccer matches at the Seoul Olympics. Now the city is planning a new baseball stadium next to its football stadium.

E. INSTRUMENTAL KNOWLEDGE-BASED CAPITALS

14. How robust is the governance and social organization structure? (8. Instrumental intangible)

Outlines	Households	Population	Area
Daegu	960,265	2,524,890	883.68
Jung-gu	35,780	76,963	7.06
Dong-gu	138,851	345,347	182.22
Seo-gu	90,793	217,550	17.48
Nam-gu	75,038	167,020	17.44
Buk-gu	165,041	448,841	94.08
Suseong -gu	164,518	462,471	76.46

Dalseo-gu	222,326	618,613	62.34
Dalseong-gun	67,918	188,085	426.60

The Daegu Metropolitan City budget for the year 2014 is designed as a 'solid budget to prepare for the future' and seeks to ensure public safety for Daegu citizens and expand upon the city's growth potentials. Budgeted funds for expanding growth potentials to create food items for the future will be used to: invest in creating future growth engine and establishing a foundation for a creative economy through industrial enhancement.

Budgeted funds for expanding SOC and ensuring the safety of citizens will be used to: provide more convenient public transportation (including developing the Daegu Metro Line 3, etc.) and create an even safer city by establishing an integrated control center for CCTV cameras, etc.

Budgeted funds for culture, education, and welfare will be used to: strengthen support for the city's culture and art, expand educational investments, and push forwards citizen-focused welfare programs

Budgeted funds to improve citizens' quality of life will be used to: continue to invest in the improvement of the urban environment by funding urban regeneration projects, creating pocket parks, and conducting river improvement projects, etc.

Projected Budget

The 2014 totals KRW 6,020,600,000,000, which is an increase of KRW 112.1 (1.9%) from the previous year.

Funds for general accounts total KRW 4,414,700,000,000, which is an increase of KRW 194.7 billion (∆4.6%) from the previous year.

Funds for special accounts total KRW 1,605,900,000,000, which is a decrease of KRW 82.6 billion (∇4.9%) from the previous year.

Allocation of Investment Resources by Field

The total net investment for 2014 is KRW 3,996,600,000,000.

The total investment for 2014 is KRW 4,339,800,000,000 (general accounts: KRW 2,971,400,000,000; special accounts: KRW 1,368,400,000,000)

The total net investments amounts to KRW 3,996,600,000,000 where overlapping transfer expenses to accounts of KRW 343.2 billion were deducted (increased by KRW 24.5 billion to record 0.6% increase)

Present status of the allocation of investment resources

15. How good is the coverage and quality of public information services (e.g., e-Government)? (8. Instrumental-intangible)

"e-Government" refers to a system of utilizing information technology and digitizing the affairs of administrative and public agencies to effectively facilitate civil services and interactions across the government.

The Korean government has pursued and established the e-Government as a core vehicle to sharpen its competitive edge, based on the global-leading IT infrastructure of the nation such as broadband internet network.

Korea laid the foundation of e-Government by building basic computer networks across the nation and overhauling laws, regulations and policies in the 1980s and 1990s. By intensively

	focusing on the development of e-Government from 2000, Korea successfully implemented the e-Government system through the convergence and connection of dispersed, stand-alone systems across the government in the late 2000s. Thanks to these efforts, Korea ranked first among all UN member countries in 2010 and 2012 in the "e-Government Development Index" and "e-Government Participation Index" of the United Nations e-Government assessment. Various e-Government systems of Korea have been exported to other countries, and as such, Korea's e-Government has been highly and widely recognized in the international community for its excellence. The Korean government has recently initiated the "Smart e-Government Strategy" to help Korean people access public services without constraints of space, time, or medium through fusing and integrating Korea's cutting-edge IT technology and public services. The strategy is also a part of continuous efforts of the government to solve the low birthrate, aging population and other social issues and to proactively respond to social security, public welfare and other future issues. City Hall • Mayor's Office • Political Affairs Coordination Office • Spokesperson • Audit & Inspection Office • Vice Mayor for Administrative Affairs • Vice Mayor for Economic Affairs Planning and Coordination Bureau • Policy Planning Division • Budget Division • Evaluation Division • Tax Division • Legal Affairs Division • Information Management Division Happy Citizens' Bureau • Safety Affairs Division • Disaster Prevention Division • Civil Affairs Division • Public Communication Division Local Autonomy & Administration Bureau • General Affairs Division • Autonomous and Administrative Affairs Division • HR Management Division • Accounting Division • Public and Judicial Police Division Public Health & Welfare Bureau • Welfare Policy Division • Public Health Division • Senior Citizen Welfare Division • Disability Welfare Division • Food Management Division Culture, Sports and Tourism Bureau • Culture & Arts Policy Division o Cultural Contents Division o Sports Promotion Division o Tourism Division Urban Re-creation Bureau • Urban Planning Division • Urban Re-creation Promotion Division • Urban Design Division • Housing & Construction Division • Land Information Division Construction & Transportation Bureau • Transportation Policy Division • Bus Operation Division • Taxi Operation Division • Construction Industry Division • Road Division

	<u>Creative Economy Bureau</u> • Economic Affairs Division • Employment & Labor Division • Investment Promotion Division • International Affairs & Trade Division • Social Economy Division • Agricultural Industry Division • Advanced Industry Division • Machinery & Energy Division • Textile & Fashion Division <u>High-Tech Medical Industry Bureau</u> • Health Policy Division • High-Tech Medical Complex Support Division • Medical Tourism Division <u>Green Environment Bureau</u> • Environment Policy Division • Resource Recirculation • Water Management Division • Parks and Green Area Division <u>Fire Safety Headquarters</u> • Fire Administration Division • Prevention and Safety Division • Response and Rescue Division • 119 Emergency Operation Room • 119 Special Rescue Division
	16. How diverse and creative is the city's cultural environment? (8. Instrumental-intangible). The city government has found cooperative ways to facilitate partnerships between education and industry. Public libraries, increasing in number in recent years, have been used as spaces for social education in regional communities. In Daegu, there are 43 arts groups that hold regular performance. The city government runs seven municipal art groups: the symphony orchestra, ChoirM , a dance troupe, boys & girls choir, Korean traditional music orchestra, opera and theater company. There are also many museums, galleries and theaters for residents to satisfy their cultural needs. The Daegu National Museum, Daegu Citizens' Hall, and Daegu Culture & Arts Center are among the most popular art spaces. Sports facilities are also easily found in Daegu, with 25 public facilities and 1,844 private facilities operated throughout the city. The Samsung Lions, the city´s baseball team, won the Korean Series in 2006. The population of Daegu is diverse, and includes many non-Korean residents. Its military bases host several thousand Americans, and many South and Southeast Asian immigrants can be found in the west side of town. Students from around Asia have been drawn to Daegu to study at its universities. <u>http://www.daeguartfactory.kr/eng/community/relatedsite.action</u> Many traditional ceremonies and festivals in agrarian society disappeared in the process of modernization. A Confucian ritual ceremony called Seokjeondaeje is held at Daegu-hyanggyo every spring and autumn. The Yangnyeongsi herb medical festival and Otgol village festival are the contemporary festivals about traditional culture. Lately in the city, enthusiasm about performing arts is growing and the local government is trying to meet its demand. Daegu International Opera Festival (DIOF) in October since 2003, Daegu International Musical Festival (DIMF), and Daegu International Bodypainting Festival (DIBF) are three of the most famous festivals on each field in Korea, although those have short histories. Various festivals in various themes like the Colorful Daegu Festival, Dongseongno festival, Palgongsan maple festival, Biseulsan azalea festival, Korea in Motion Daegu, and so on, are held by the city, each ward, or the specific groups, all through the year. On August 25 through August 31, 2008, Daegu hosted the first ever Asian Bodypainting Festival, a sister event of the World Bodypainting Festival in Seeboden, Austria. Museums Daegu Art Museum Daegu National Museum – A notable national museum collecting relics excavated in and around Daegu

	Daegu Bangjja Yugi (Korean Bronzeware) Museum Hengso Museum of Keimyung University Korea Video Museum Kyungpook National University Museum Museum for Daegu National University of Education Museum of Natural Dye Arts TheatersDaegu Opera House – The first theater in Korea only for performing opera Suseong Artpia Keimyung Art Center – One of the largest scale theaters in the city. Daegu Culture and Arts Center The Daegu Culture and Arts Center opened in May, 1990 and is a grand facility housing a performance center, exhibition hall and outdoor stage. The performance hall consists of a large (1,090 seats) and small (320 seats) theater. The large stage is mainly used for concerts, dances, plays and opera performances while the smaller stage is for solo recitals and plays. The exhibition hall consists of 13 rooms and an international conference hall. Behind the exhibition hall building is an outdoor stage with seating for 700 guests. The stage is also used for concerts, dances and madangnori and also can be rented for wedding ceremonies. The outdoor facility at Duryu Park is among the largest in Korea with a capacity of 27,000 people. The hall is for performances of diverse genres such as music concerts, plays, musicals and operas. Other amenities at the park include an art shop selling traditional living items and a coffee house. Daegu Culture and Arts Center is a top attraction in Daegu. The schedule is always filled with events hosting various municipal art groups (orchestra & choir, dance corps, Korea traditional music group, theatre, youth choir and opera group) and local artists. At the same time, it maintains a pleasant atmosphere to rest and relax for Daegu urbanites. http://english.visitkorea.or.kr/enu/SI/SI_EN_3_1_1_1.jsp?cid=1151465
	17. How good is the city's collective capacity to foster economic and political innovation? (8. Instrumental-intangible). The city is the economic and industrial core of the Daegu-Gyeongbuk region, one of the major industrial areas in Korea. It accounted for as much as 94 percent of Korea's trade surplus in 2006. The electronics industries in Gumi and the steel industries in Pohang provided great services to that surplus. World-leading manufacturing facilities for Anycall (Samsung Mobile) and POSCO's main factories are located near the city. Daegu and its neighbouring cities were designated for the Daegu-Gyeongbuk Free Economic Zone by the central government in 2008. It is specialized in knowledge-based service and manufacturing industries. The Daegu-Gyeongbuk Free Economic Zone (DGFEZ) Is a Free Economic Zone located in the southeastern part of South Korea. DGFEZ has 8 sites spanning over 20 square kilometers in Daegu Metropolitan City and Gyeongsangbukdo (Gyeongbuk) Province (Pohang, Gyeongsan, and Yeongcheon cities). As of January 2014, DGFEZ is home to 150 organizations attracting over $2 billion in investment ($350 FDI). The Daegu-Gyeongbuk region is home to 5.5 million people and over 13% of the nation's manufacturers including global conglomerates Samsung, LG, Hyundai and POSCO. DGFEZ focuses on 4 major industries; IT Convergence, High-tech Transportation Components, Green Energy, and Knowledge Services. The development of these districts is scheduled to conclude in 2020. DGFEZA has offices in Daegu and Seoul. The Daegu-Gyeongbuk Free Economic Zone was designated by the Korean central government on May 6, 2008 with the offices of DGFEZ opening its doors on August 13, 2008. The current commissioner of DGFEZ Authority is Byung-Rok Choi. Seongseo Industry District Seongseo Industry District is a high-tech complex for automotive, machinery and IT convergence companies. In January 2011, Seongseo Industry District was re-designated as part of Daegu's Special R&D Zone, and is no longer part of DG-FEZ, though there are still several foreign companies within the complex.[4] In April 2011, Samsung LED and Sumitomo Chemical (from Japan) announced plans to invest 460 billion won (approx. USD425 million)

	to form a joint venture that will produce LED core materials (Saphire Wafers) in the Seongseo 5 High-Tech Industrial Complex. Stion (U.S.), a manufacturer of CIGS thin film solar PV cell announced plans to invest $320 million within Seongseo District in the spring of 2012. Size: 1.47 km2 Location: Dalseong, Daegu Gyeongsan R&BD District Gyeongsan R&BD District is a site that is currently under development. Once complete the site will be geared for construction equipment manufacturing and R&D, medical devices manufacturing, working in collaboration with a large cluster of private education institutes in the region. Size: 6.47 km2 Location: Gyeongsan City, Gyeongbuk Province Fashion Design District (Esiapolis) Easiapolis is a fashion-based district that combines commercial, industrial, and residential. Esiapolis houses Lotte Outlet, clothing retailers, restaurants, and other entertainment facilities (CGV Movie Theater) The district also houses numerous Fashion-based R&D/education institutes including Daegu Textile Center (DTC) College of Korea Textile & Fashion Polytechnics (CKTFP), Korea Research Institute for Fashion Industry (KRIFI). Daegu International School which opened in September 2010 is also part of Esiapolis. Size: 1.18 km2 Location: Dong-gu, Daegu International Culture Industry District The Culture Industry District will focus on the gaming industry. This district was designated as a Culture Industry Promotion District by the central government in April, 2008. Currently, 109 culture technology- related companies reside in this district, with further plans to attract a Game Contents Complex, a Broadcasting Media Center an ICT Park tower and an ICT Park mall. In May 2010, Dassault Systemes opened a R&D center at Daegu ICT Park. The R&D center will focus on the design of luxury ships. Size: 0.07 km2 Location: Nam-gu, Daegu Daegu Technopolis Daegu Technopolis is designed to become a leading high-tech science city in Northeast Asia. The site combines R&D, Education and High-tech Eco-friendly Manufacturing. Various national institutes and university branches specialized in convergence industries from automotive, green energy, electronics and telecommunication industries are within the district. In Jan. 2011, Daegu Technopolis received designation as a Special R&D Zone by the central government.[10] The first stage of development in Technoplis was completed in 2010, with the Daegu-Gyeongbuk Institute of Science & Technology opening its doors as the first resident.

	As of May 2012, there have been two sizable investments within Technopolis. Hyundai IHL (a subsidiary of Hyundai Mobis) completed the first stage of its $95 million investment (April 2012) and it is operating a manufacturing center for automotive LED lamps.[12] Nakamura-Tome Precision Industry has invested $19.7 million to construct a factory that is scheduled to be completed by the end of 2012. Size: 7.27 km2 Location: Dalseong, Daegu Suseong Medical District Suseong Medical District takes a role as a center for Oriental medicine in Korea that bridges Oriental and Western medicine and establishes the district as a Mecca for alternative medicine research. Suseong Medical District aims to attract a foreign hospital, a Medical School, medical tourism facilities and R&D manufacturers. In part, high quality facilities for medical services helped this area receive the highest residential satisfaction score as rated by the National Consumer Satisfaction Index. Size: 1.79 km2 Location: Suseong, Daegu Sinseo Meditech District Sinse Meditech District is located inside Daegu Innovation City. The new development is part of a relocation plan made by the Korea Central Government for a balanced regional development. Daegu Innovation City will be home to 12 public agencies including KOGAS when development is complete around 2015. In August 2009, the Korea Ministry of Health selected Daegu as one of 2 cities to house new high-tech medical facilities worth at least 5.6 trillion won ($4.6 billion). The "so-called" Medivalley will facilities will specialize in pharmaceuticals, medical devices and clinical testing. Size: 4.22 km2 Location: Sinseo dong, Daegu Yeongcheon High-Tech Park Yeongcheon High-Tech Park is a manufacturing industrial complex. The district is home to an Automobile Park that supplies parts and materials for nearby automotive manufacturers including Hyundai Motors. Boeing Avionics Maintenance, Repair and Overhaul Facility (BAMRO) is under construction and will be complete by the end of 2014.[16] The BAMRO will service avionics components for the Republic of Korea Air Force (ROKAF) fleet of F-15K Slam Eagles. Size: 2.30 km2 Location: Yeongcheon City, Gyeongbuk Province Yeongcheon Industry District Yeongcheon Industry District is a district for automotive components, avionics, and logistics. This district is located in the middle of the Auto Valley, which stretches from Gumi to Ulsan. The Gyeongbuk Hybrid Technology Institute and Gyeongbuk Research Institute of Vehicle

	Embedded Technology will provide support and technical expertise. As of September 2012, several foreign companies have invested in Yeongcheon Industry District. Daicel Corporation (Japan) invested 36 million USD in December 2011, to establish an airbag inflator factor. Faurecia (France) invested 21 million USD to construct a seat frame factory. Size: 1.67 km2 Location: Yeongcheon City, Gyeongbuk Province Pohang Fusion Tech District Pohang is located in the center of Korea's East Coast Energy Cluster which stretches from Uljin to Gyeongju. Within this cluster, the nation's largest wind power and nuclear complexes operate. This area is also known for having some of the nation's best research institutes. Pohang Fusion Tech District will house Fuel Cell research and production, Wind Power, R&D institutes and Enterprises. In addition, the Korea's only accelerator laboratory (PAL) is located nearby at POSTECH. Size: 3.75 km2 Location: Pohang City, Gyeongbuk Province

What Knowledge Activities Promote Creativity?

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Abstract

Various types of knowledge generating activities induce creativity. However, little empirical research explored a positive link between knowledge activities and creativity. This study explores knowledge activities promote creativity. Knowledge activities include reading books, writing email, reading newspapers, searching internets, and watching TV. We use three types of creativity: (1) a propensity to pursue uniqueness, (2) a propensity to nurture imaginativeness, and (3) a propensity to propose and accept new things. We use a web based on-line survey (Gallup Korea) conducted with South Korean citizens from January 15th to 30th, 2013. We found reading books and newspapers and searching internet significantly increase creativity, but watching TV not. This suggests watching TV is not useful to promote the degree of creativity. Further research is required to not only why watching TV has no impact on creativity but also why and how reading books and newspapers stimulate creativity.

Keywords: Creativity, Knowledge activities, Literacy

Determinants of RFID adoption:

A quantitative meta-analysis

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------------------------------------<Abstract>--------------------------------------

In this study, we are trying to figure out factors that determine RFID adoption by doing quantitative meta-analysis by calculating effect size of factors that Roger suggested in his innovation diffusion theory. To do this, we tried to measure what Roger suggested again and then extend it. Also we tried to suggest future direction for future researchers. Specifically we tried to compare mean effect size of technological, organizational, and environmental factors. And then we did SUR analysis and meta-regression analysis using Fisher's standardized effect score. In mean effect size analysis, technological factor was the most powerful factor that affect RFID adoption among Roger's innovation diffusion factors. But when we added region standard, environmental factor was the most influential factor especially in South Asia. In SUR and meta-regression analysis, South Asia, ratio of IT firms and North America showed moderating effect that moderate the relationship between innovation factors and RFID adoption. But when meta independent variable about firm size added, IT ratio and North America variables turned out to be insignificant, implicate that there might be some relationship between large firm size and South Asian firms. These results not only show the power of developmentalism in developing countries but also give us some advises that we should have various point of views when we analyze technology diffusion.

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1. Introduction

In this study, we are trying to figure out the factors that determine the adoption of RFID technology by doing quantitative meta-analysis. Specifically we have tried to do two kinds of quantitative meta-analysis in this study. First of all, we did calculate mean effect size from each previously published literatures and then compare it by innovation diffusion factors and region. Second, we did meta-SUR analysis using Fisher's Z score. We expect that we can check the efficiency of Roger's (1983) original theory and extend it simultaneously by adding variable about government through this study. Also, we would like to suggest future direction for future studies by doing meta-SUR analysis.

To draw out necessity of this study, we have to understand the strengths that quantitative meta-analysis has. As Meyer and Sullivan (2001) pointed out, usually it is hard to estimate total amount of effect size of independent variables because each study has different characteristics and backgrounds. Most of the studies that deal with adoption determinants of innovative technology usually focused on very restricted region and company so it is very hard to aggregate the total effect size. But unfortunately, adoption of innovative technology like RFID technology is a global trend. After Wal-Mart adopt and commercialize its implementation in 2005, not only developed countries such as United States but also developing countries like Republic of Korea or Taiwan were trying to adopt new method of management aggressively. So it is necessary to aggregate all the empirical result and analyze them with a broad view. We can draw aggregated total amount of effect of adoption determinants of innovation diffusion factor when using quantitative meta-analysis.

Besides When utilize quantitative meta analysis method in empirical study, we can figure out not only just aggregate effects and calculate total effect size but also subdivide the effects by various standards. In this study, we deducted mean effect size by region and by three innovation diffusion factor. First of all, we can test the effectiveness of Roger's original theory by calculating mean effect size of each innovation factor. Roger and his descendants suggested three sorts of innovation diffusion factor; technological, organizational and environmental factor. We will collect statistical values from collected studies and convert them to standardized correlation score by three factor. By doing so, we can figure out the most powerful innovation factor that determines adoption of brand new technology.

Also, as we mentioned above, not only developed countries but developing countries are actively adopting innovation technology but its beginning is somewhat different from developed countries'. Although scholars like Johnson (1987) argue that we should concentrate on the effect of governments' support and policy when analyzing innovative technology adoption in developing countries based on developmentalism, Roger (1983) did not include category that represented governments' support in his original theory. Some of Roger's descendants such as Ramanathan et al.

(2013), Lai et al. (2014) and Lin and Ho (2009) suggested the potential existence of governments' support but inserting government-oriented variable in the model of technology adoption is not common in social science field. Since we did subsidize regions into five categories; North America, South Asia, East Asia, and Europe, we can estimate the power of developmental government especially in developing countries. We expect this can extend Roger's original theory and give us more specific explanation about technology adoption that varies depending on region.

Lastly, we can draw what kinds of specific characteristics of studies can affect and moderate the relationship between innovation factor and RFID adoption by doing meta-SUR analysis. We have coded study characteristics such as sampling characteristics and regional characteristics as meta independent variables and try to show how these variables significantly affect the relationship between dependent variable (innovation factor) and independent variable (RFID adoption) from original studies. Also, we choose SUR model, rather than multiple regression model, to reflect the effect of other dependent variables because usually three innovation factors are correlated to each other. By doing this, we can draw potential independent variables that future studies should deal with.

2. Literature Review

2.1. Roger's (1983) Innovation Diffusion Theory

Roger's (1983) innovation diffusion theory would be the most famous and powerful model that can explain the determinants of innovation diffusion. Since Roger published *Diffusion of Innovations* in 1983, lots of scholars were started to study innovation diffusion (Bradford and Florin, 2003). Based on Roger's original theory, scholars like Bradford and Florin (2003), O'Leary (2000), Davenport (1998) and Wen et al (2009) set three factors as main determinant factors of innovation technology adoption. Those factors are organizational characteristics factor, technological characteristics factor and environmental characteristics factor. In this section, we are trying to examine how Roger and his descenders define each factor based on Roger's theory.

2.1.1. Organizational factor

Branford and Florin (2003) argue that organizational characteristics factor should include support from top manager or organization's leader. To adopt innovative technology, decision makers have to gain organization leader's consent and support because usually the leaders can provide the capability to adopt and use technology sustainably (Laughlin, 1999). Also, top manager can give fine parts the information about brand new technology and let them know exactly about the project (McGowan and Madey, 1998).

Another scholars like Patterson et al. (2003) concentrate on the size of the firm. According to them, considering the size of the firm would be very important when it comes to technology adoption because usually big size firms keep the extra capacity to discover new technology and generate the economy of scale (Wen et al., 2009). Also, according to Grover and Goslar (1993), generally big size companies have more strong will to adopt brand new technology because of their financial resources.

Iacovou et al. (1995) argue that organizational readiness includes financial readiness and technological readiness. First of all, abundant budget and financial readiness are also helpful for adopting technology more easily. As Lai et al (2014) pointed out from their study about RFID adoption in Taiwan hospital, adoption of brand new technology can be interrupted if there is not enough financial resources. Correlation between financial readiness and technology adoption was improved in lots of empirical researches such as Krasnova et al. (2008).

Technological readiness like previous IT experience (Lai et al., 2014), technological knowhow (Fazel et al., 2011) is also important factor that can affect the decision of technology adoption. According to Schmitt and Michahelles (2009), firms with fluent IT experience or knowhow possess better ability to evaluate and manage innovative technology.

2.1.2. Technological factor

Technological factor is made up of four different components; appropriateness, usefulness, convenience, and benefit. According to Schmitt and Michahellas (2009), appropriateness and compatibility of technology is an important factor in determining technology adoption. To adopt technology successfully, a brand new technology should be accommodated to current systems flexibly (Janz et al., 2005).

Perceived benefit is also a very effective factor. When people perceive the benefit of technology, the speed of adoption become faster (Roger, 1983). Scholars like Lee and Shim (2007), Sharma and Citurs (2005) stressed the importance of perceived benefit because it is the most critical factor in RFID adoption from their perspective.

Perceived usefulness looks little bit similar to perceived benefit in some ways, but what perceived usefulness would like to stress is somewhat different from perceived benefit. According to Zailani et al (2015), perceived usefulness represents individual's perceptions about technology that innovative methods will increase performance and efficiency. Some scholars like Wu and Wang (2005) and Yen et al. (2010) evaluate perceived usefulness as more important factor than convenience because increased usefulness can even change the tendency of job performance and productivity in the end (Zailani et al., 2015).

2.1.3. Environmental factor

External pressure or competitive from the outside market is set as environmental factor according to Roger (1983) and Bradford and Florin (2003). As Poston and Grabski (2001) pointed out, when one company adopted and started brand new technology, other competitors started to feel impatient because they are anxious about their potential benefit that first mover of technology might have dispossess from them. Effect of external pressure is also improved empirical from lots of previous studies. Scholars like Fitzek (2003), Jones et al., (2005), Brown and Russell (2007) figure out the power of competitive pressure in supply chains.

2.2. Developmentalism

Although Roger (1983) did not include governments' support in his innovation diffusion model, we did insert variable about government's supportive policy that encourage firms to adopt brand new technology. According to Roger's original theory, the three powers that drive innovation adoption are technological, social constructionism and commercialization. Technological determinism includes the belief that technology will change the whole society. Contrary to this scientism, defenders of social constructionism support the view that social factors shape a technology. The rest of Roger's theory is commercialization that only focuses on the market power.

But especially in developing countries like Asian countries, the government has ability to mobilize social resources to drive their country more effectively and efficiently (Johnson, 1987). Therefore, sometimes innovation technologies are adopted with the strong support of the government. In those cases, usually the power of the government is much bigger than the market power, so the market players plays very limited role in adopting brand new innovation technology. We are trying to test the effect of government policy especially in developing countries like South Asia at this point.

3. Methodology

3.1. Quantitative Meta-Analysis

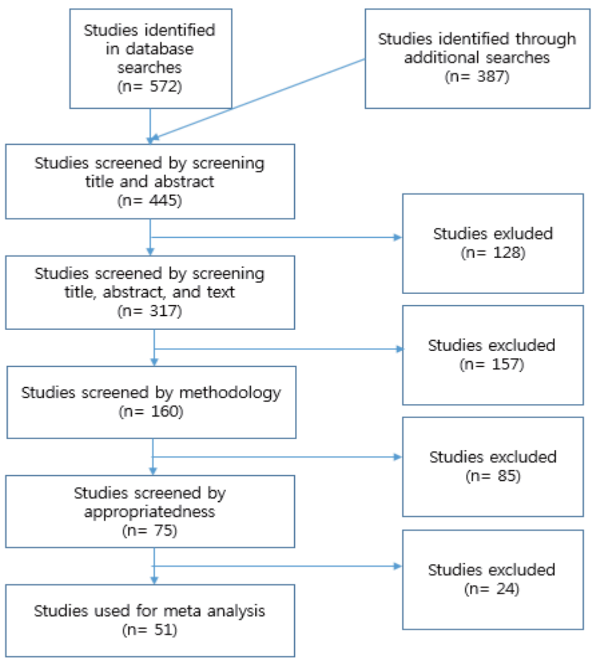
A quantitative meta-analysis is composed of three stages. As Wang and Bushman (1999) noted, quantitative meta-anlaysis is a statistical research method that combines results of empirical studies by using statistical methodology. To do meta-analysis, we have to first collect statistical values such as correlation, odds ratio, t-value or F-values from each published paper and coded each values into the datasheet. Other than statistical values that we suggested here, any statistical values that indicate the degree of correlation between independent variables and dependent variables would be accepted. Second, we have to convert collected statistical values to Fisher's Z score for standardization. Comparing each literatures' empirical results cannot be done without standardization. To make Fisher's Z score, we have to convert statistical values we have collected from various empirical studies to r (correlation) followed by Fisher's equation. If you convert all the statistical value to r, you can draw Fisher's Z score using those correlations. Usually we call this Fisher's Z score as 'effect size.' Finally, since all the statistical values you want to use for quantitative meta-analysis are standardized, you can calculate average effect size using standardized Fisher's Z score. After calculating mean effect size, you can convert it to correlation values using Fisher's equation. If converted correlation is bigger than 0.4, we can suppose the correlation between independent and dependent variable is strong.

Also, we can do multiple regression analysis using standardized Fisher's Z score. There are three big differences between normal multiple regression and meta regression analysis. First, dependent variable used in meta-regression-analysis is standardized correlation between dependent and independent variables reported in original studies. Therefore, meta independent variables in fact are the moderating variables that affect the relationship between original independent and dependent variable. Second, in meta-regression-analysis, independent variables are about characteristics of literatures, such as publication year, country, descriptive statistics of sample etc. Third, in meta regression analysis, number of observation of variance are used as weight to revise potential biases.

3.2. Data Collection

[Figure 1] below shows the sequential flow chart that we use for this study. As you can see from [Figure 1], there are six stages for collecting literatures. First of all, we searched previously published literatures about RFID adoption from various types of e-database. Most of the literature were found through Google Scholar (78%) and the rests were collected from Science Direct, Web of Science, and Proquest Central. Also, we asked experts in technology innovation field for recommendation. 72 studies were collected in the first stage. And then, we screened each papers by screening title and abstract. Studies that deal only with technological issues were excluded. At second stage, another 157 studies were excluded additionally followed by standard. In quantitative meta-analysis, researchers collect statistical values and standardize them to compare mean effect size. For this reason, studies that choose empirical research as methodology can only be utilized as a data resource. At fourth stage, qualitative studies were excluded and the total number of excluded papers was 85. 75 research papers were left at fifth stage and we started coding the data at this point. But among 75 studies, there were ones that lack of any statistical values we had to have. In this case we e-mailed each study's corresponding author to ask information. We included studies with corresponding author's reply to our dataset but if there were no sign of reply, we excluded them (n=24). Finally, we could get 51 empirical studies for our quantitative meta-analysis.

[Figure 1] Flow chart for data collection



3.3. Measuring variables

We organized the variables included in quantitative meta-analysis and explanation about measurement in [Table 1]. In fact, dependent variables used in quantitative meta-analysis represents the correlation between dependent variables and independent variables from original studies. Since Roger's three innovation diffusion factor (organizational, technological, environmental) are independent variables from original studies and their degree of correlation with RFID adoption intention will be used for quantitative meta-analysis. We wrote three innovation factor as meta dependent variables in [Table 1] just for marking convenience here. Organizational factor is composed of firm size, leader support, financial readiness and technological readiness. Technological factor includes appropriateness, perceived benefit, convenience and usefulness of RFID technology. Last innovation diffusion factor, environmental factor has only one component according to Roger's original theory, external pressure from outside market and competitors, but to test the effect of government especially in developing countries, we added government policy variable for environmental factor.

[Table 1] Measuring Variables

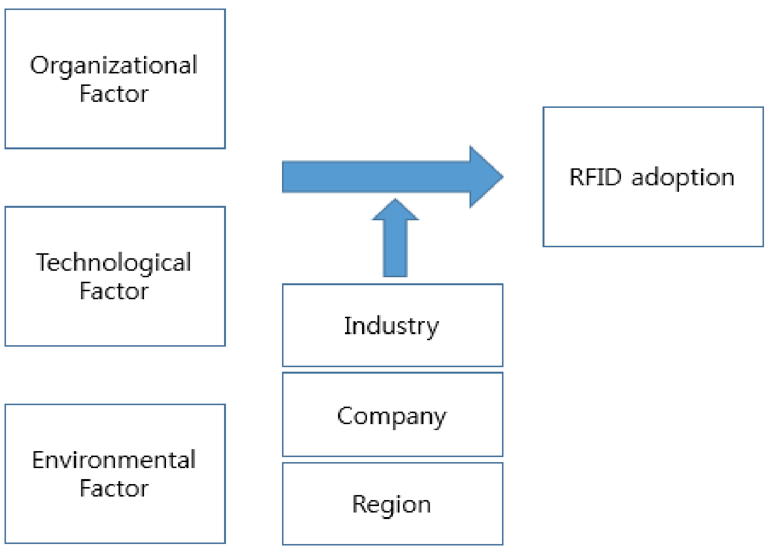
Variable			Contents
Meta Dependent Variables	**Organizational**		Firm Size, leader Support, Financial Readiness Technological Readiness
	Technological		Appropriateness, Perceived Benefit, Convenience Usefulness
	Environmental		External pressure from outside market, Government policy
Meta Independent Variables	**Industry**	**Manufacture**	Ratio of respondents who works for manufacturing industry
		Retail	Ratio of respondents who works for retail industry
		IT	Ratio of respondents who works for IT industry
	Company	**Chief manager**	Ratio of respondents who are in Chief manager's position
		Large Company	Ratio of respondents who works for companies whose annual sales are more than 50million dollars
	Regional	**North America**	Whether the region that study is done is in North America or not (yes=1, no=0)
		South Asia	Whether the region that study is done is in South Asia or not (yes=1, no=0)

3.4. Analytical Frame

In this study, we did two different sorts of empirical research to figure out the determinants of RFID adoption. First of all, as we mentioned before, we did mean effect by using Fisher's standardized Z score. After finishing mean effect size analysis, we did meta-SUR analysis using standardized score. [Figure 2] shows analytical framework we use for meta-SUR analysis. As we mentioned above in methodology part, in meta-regression analysis, the dependent variable indicate the correlation between independent variable and dependent variable from original studies. Also in meta-regression analysis, researchers set independent variables as specific characteristics that each study has. For example, published year, region or country that studies were done, characteristics of samples are usually used as meta independent variables. Since dependent variable is about correlation of original independent and dependent variables, independent variable of meta-regression analysis is understood as moderating variable that moderates the relationship between original ones.

In our meta-SUR analysis, the relationships between RFID adoption intention and three innovation diffusion factors that Roger suggested were set as dependent variables. Independent variables can be categorized in three category; type of industry, company and region.

[Figure 2] Analytical Frame for meta-SUR model



4. Empirical Analysis

4.1. Mean Effect Size Analysis

In this section, we will suggest our empirical research results that draw from mean effect size analysis and meta-SUR analysis. [Table 1] below shows results of mean effect size analysis by innovation diffusion factors. As Roger suggested from his study done in 1983, we have set organizational factors, technological factor and environmental factor as three main factors that can determine the adoption of innovative brand new technology. As you can see from [Table 1], among organizational factors, technological readiness (0.429) of each organization is turned out to be the most powerful factor. The average standardized Fisher's Z score of organizational factor is 0.365 and it can be converted to correlation score which is 0.35. Among the technological factors, the perceived usefulness of RFID technology scored the highest Fisher's Z score (0.479). Although perceived benefit won the second place but it also showed very strong correlation between RFID adoption intention and itself (0.479). The average Fisher's Z score of technological factor is 0.438. When we convert this mean effect size to correlation followed by Fisher's equation, the average effect size was 0.412. Finally, we did mean effect size analysis using factors about environments that companies who have intention to adopt RFID face. Environmental factor is composed of two detailed factors; external pressure from outside market and competitors, government's supportive policy. External pressure from the outside market has about 0.011 higher score point (0.411) than government's policy factor (0.400). The average effect size of external pressure factor and government policy factor is 0.405 and it can be converted to Fisher's correlation score which is 0.366. In conclusion, among the three diffusion factors, technological factor was the most important and powerful factor. The total average of three factors was 0.366.

[Table 2] Mean effect size by diffusion factor

variable	variable2	Fisher's z score	mean effect Size
Organizational Factor	firm size	0.304	
	leader support	0.401	
	financial readiness	0.326	
	tech readiness	0.429	

Average		**0.365**	**0.35**
Technological Factor	Appropriateness	0.37	
	Benefit	0.479	
	convenience	0.409	
	usefulness	0.493	
Average		**0.438**	**0.412**
Environmental Factor	External pressure	0.411	
	Government policy	0.400	
Average		**0.405**	**0.366**

We did mean effect size analysis again adding region standard. We categorized regions that published studies were done into five categories; East Asia, North America, South Asia, Europe. Technological factor scored the highest score (0.384) among three factors in East Asia. Organizational factor has 0.380 and environmental factor has 0.383 of mean effect size. Same with East Asia, technological factor (0.394) was turned out to be the most powerful factor. Organizational factor (0.388) and environmental factor (0.364) tail after. In South Asia, all three factors are turned out to be have higher mean effect size than 0.4. Although all three factors are strong, but environmental factor is the highest. This is different from what was found in the first mean effect size analysis. As we mentioned above, technological factor was the most influential factor in our first mean effect size analysis. But unlike this result, especially in South Asia, environmental factor score was higher than technological factor. Technological factor won the last position in South Asia. This implicate that RFID adoption aspect can be different from developed countries. Mean effect size of environmental factor is higher than 0.4 in Europe too. We can recognize the effect of environmental factor especially in South Asian countries such as Singapore, Taiwan and European countries. Although environmental factor includes external pressure from outside market and government support simultaneously, but environmental factor did not appear to be strong enough even in North America, where market power rules everything. In fact in North America, technological factor(0.394) was the most influential factor in technology adoption. Therefore, results shown in South Asia implicate the existence of leverage of development-oriented governments.

[Table 3] Mean effect size by region

Region	Variable	Fisher's Z score	Mean Effect Size
East Asia	Technological	0.405	0.384
	Organizational	0.400	0.380
	Environmental	0.404	0.383
North America	Technological	0.416	0.394
	Organizational	0.409	0.388
	Environmental	0.382	0.364
South Asia	**Technological**	**0.470**	**0.438**
	Organizational	**0.478**	**0.445**
	Environmental	**0.537**	**0.491**
Europe	Technological	0.418	0.395
	Organizational	0.407	0.386
	Environmental	**0.504**	**0.465**

4.2. Meta SUR Analysis

We did a exploratory meta-SUR analysis to figure out what kinds of characteristic of each literature affect the relationship between RFID adoption and three innovation diffusion factors using standardized Fisher's Z score. [Table 4] below shows the results of meta-SUR analysis. Since p-value Breusch-Pagan test was very close to 0, we can reject null hypothesis of Breusch-Pagan test. That means we should use SUR (Seemingly Unrelated Regression model) rather than multiple meta-regression. Also, since we have singular covariance matrix of errors we followed solution that Takada (1995) suggested. He stated that "a common procedure for handling this singularity problem is to drop an arbitrary equation and then estimate the remaining equation". We used different set of independent variables for each innovation factor according to Takada (1995).

We suggest two results from two different models in [Table 4]. The only difference those two model have is [model 2] includes additional variable about the size of the company. We insert company size variable in equation where correlation between environmental factor and RFID adoption intention is independent variable. The first column of each model represents the equation where correlation between RFID adoption intention and organizational factor is dependent variable. Second and Third column are deal about relationship between RFID adoption and technological, environmental factor as their dependent variable. We use specific characteristics of published studies as meta independent variable that moderate the relationship between original dependent variable and independent variable. There are three categories about the characteristics of industry, company, and region in meta independent variable. Industry characteristics includes the ratio of responders from specific sector (manufacture, retail, IT). ‘Chief manager’ variable in company category is about the ratio of responders in chief manager position and ‘Large company’ variable represents the ratio of responders from large size company. If the total sales of company that responder works for is over 50million dollars, we perceived it as a large company. Regional variable has two detailed variable; North America and South Asia.

As you can see from [Table 4] below, in [model 1], IT, North America, and South Asia meta independent variables are turned out to be significant for all three dependent factors. That means, the more the survey respondents are belong to IT industry, and the more each study deals with North America or South Asia case, it is more likely to moderate the relationship between RFID adoption and organizational/technological/environmental factors. But when ‘Large Company’ variable added in [Model 2], IT and North America variable turned out to be insignificant. That means, only South Asia variable moderates the relationship between RFID adoption and innovation diffusion factors when company size controlled. In fact both the coefficient of ‘largecom’ variable and its correlation between meta dependent variable has positive signal, so the positive signal will remain when they are multiplied. It means the coefficient can be overly estimated without largecom variable. In fact, most of the firms located in North America or in IT industry have relatively small firm size when compares to South Asia’s. That means, in North America and IT industry RFID adoption are more centered around small size firms. Also in South Asia, it seems that firms with rather large size are more willing to adopt RFID technology. Actually South Asian firms who adopted RFID technology have rather large firm size. There might be influence of developmentalism-oriented government who cared about increasing the size of the pie and tried to nurture large firms to become a conglomerate strategically.

[Table 4] Meta-SUR analysis result

Dependent Variables		Model 1			Model 2		
		(1) Organizational	(2) Technological	(3) Environmental	(1) Organizational	(2) Technological	(3) Environmental
Industry	**Manufacture**	0.000 (0.001)	7E-05 (5E-04)		-0.001 (0.002)	-0.001 (0.001)	
	Retail	0.000 (0.001)	0.000 (0.001)		-0.001 (0.002)	0.000 (0.002)	
	IT	**0.005*** (0.002)**	**0.005*** (0.002)**	**0.005*** (0.002)**	0.003 (0.002)	0.003 (0.002)	0.003 (0.002)
Company	**Chief manager**	0.000 (0.000)			0.001 (0.003)		
	Large Company						0.001 (0.001)
Regional	**North America**	**0.262*** (0.092)**	**0.262*** (0.092)**	**0.263*** (0.093)**	-0.011 (0.118)	0.012 (0.109)	0.031 (0.110)
	South Asia	**0.289*** (0.080)**	**0.289*** (0.080)**	**0.289*** (0.080)**	**0.260*** (0.105)**	**0.290*** (0.085)**	**0.312*** (0.083)**
R-squared		0.1706	0.1704	0.1687	0.2535	0.2377	0.2348
Chi2		16.07	16.02	15.42	18.08	16.31	16.35
N of obs		76	76	76	51	51	51

*p<.05, **p<.01, ***p<.001

5. Conclusion

In this study, we tried to figure out the factors that can determine the adoption of RFID technology from various countries. Specifically we did two different sorts of empirical analysis in this study. First, we calculated mean effect size by region and three different innovation diffusion factors using collected statistical values. Second, we did meta-SUR analysis to find out what study characteristics can affect the relationship between three innovation factors and RFID adoption. Unlike Roger's (1983) original theory, we have let variable about governments' support include in environmental factor. We tried to test the effectiveness of Roger's innovation diffusion model which was published in 1983 and tried to extend and develop the theory in a direction that can contain not only developed countries but also developing countries where innovative technologies like RFID are adopted aggressively.

According to our empirical result, among the three innovation diffusion factors that Roger suggested in 1983, technological factor turned out to be the most powerful factor that can affect the adoption of RFID technology. Environmental factor and organizational factor are followed. What this result means that firms did make RFID adoption decision based on its technological usefulness, appropriateness, convenience and perceived benefit rather than external pressure, government support or organizational readiness. Also among all the factors usefulness scored the highest Fisher's Z score. But when we add one more standard, region, technological factor score was little bit lower than environmental factor score especially in South Asia where developing countries like Taiwan and Malaysia adopt RFID technological under governments' control and support. Besides, technological factor showed the lowest score among three factors in South Asia. Similar results were drawn from meta-SUR analysis. South Asia region was turned out to be significant meta independent variable for all three SUR equation. Furthermore, ratio of IT firm and North America variable changed to be insignificant when meta independent variable about firm size controlled. This result implement that most of the firms in South Asia who adopted RFID technology have rather large firm size. We would like to figure out the exact relationship between these variables in the future research.

In conclusion, aspects of RFID technology in developing countries are different from developed countries. Until now, most of the innovation technology adoption studies are deal with developing countries like United States because markets and firms in developed countries had enough capability to adopt and use brand new technology. But as we can see from this study, sometimes firms did adopt technology for some different reasons. In developing countries, governments' support can play a very important role because most of the social policy are based on developmentalism. We have to have various point of views to analyze technology diffusion in this sense.

Although we have got some implications about RFID adoption determinant from this study, this study has some limitations. First of all, we have 71 observations collected from 51 different studies. Although most of the quantitative meta regression analysis has small size of observation and according to Hunter and Schmidt (2004), "In meta regression, the sample size is often as small as 15, 20 and 30." But 71 data points are not enough for doing regression analysis. Second, quantitative meta analysis has inborn limitation because most of the studies are published only when they make reviewers and publishers satisfied. For this reason, data, or previously published papers collected to be used as data in quantitative meta analysis have publication bias. Future meta analysis should add future published paper into dataset and try to do more detailed analysis than ours. Also researchers should vary the resources of data to minimize publication bias.

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Exploring Reasons for Illegal Use of Software: An Application of Q-Methodology

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Abstract

This study, relying on Q methodology, explores various perceptions regarding a widespread illegal use of software such as counterfeiting and piracy. This study developed thirty two Q-statements, borrowing policy ideas from relevant literature review of software piracy and expert interviews. Q sorts were collected from 30 respondents, including public officials, staffs of game company, graduate students, professors, and citizens. Our Q methodology provides four different Q factors from price-stick model, stick-punishment model, price-carrot model to moral model. All these models agree that the use of illegal software is wrong and that such illegal use is derived from social and cultural factors. These Q-methodology results suggest a consistent and structural reform in order to reduce the degree of illegal use of software.

Keywords: Software, Illegal Use, Counterfeiting, Q-Methodology

Appendix 1

Appendix 1. Agendas of the General Meeting of SOItmC

Agendas of the General Meeting of

Society of Open Innovation: Technology, Market, and Complexity (SOItmC)

President: JinHyo Joseph Yun (DGIST)

(jhyun@dgist.ac.kr, +82-10-6697-8355)

Agenda 1 (Report): The Signboard of SOItmC

Agenda 2 (Report): The Building History of SOItmC

Agenda 3 (Decision): Composition of SOItmC

Agenda 4 (Report): Special Issue Journals of SOItmC & KCWS 2015

Agenda 5 (Report): The Planning on SOItmC 2016 Conference

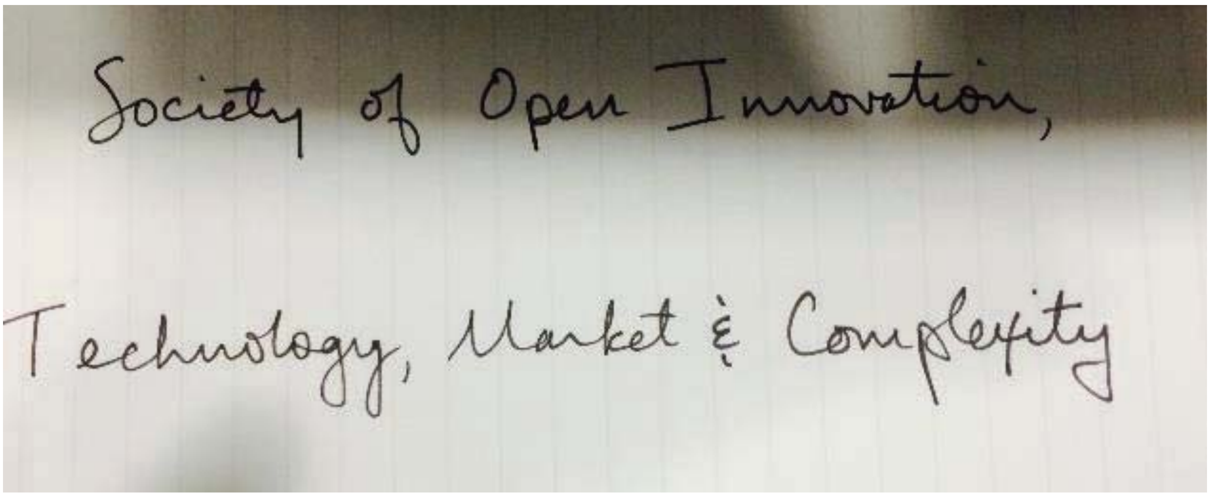
Agenda 6 (Report): The Course of Preparation

Agenda 7 (Report): Settlement of Budget

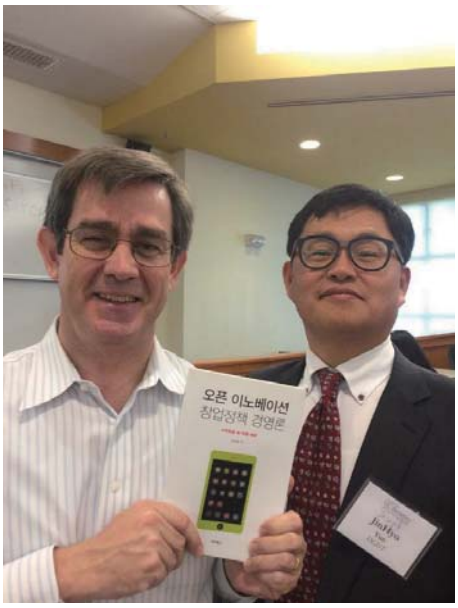
Agenda 8 (Decision): Proposal for Global Research Project with an International Organization

Agenda 1 (Report): The Signboard of SOItmC

※ Attached in front of the Secretariat



※ Written by Prof. Henry Chesbrough (UC Berkeley, USA)


오픈 이노베이션
창업정책 경영론

Agenda 2 (Report): The Building History of SOItmC

○ (12. 29, 2014) Submitted the required documents to Central Radio Management Office, the Ministry of Science, ICT and Future Planning of Korea

○ (2. 3, 2015) First revision of the documents after evaluation by the office

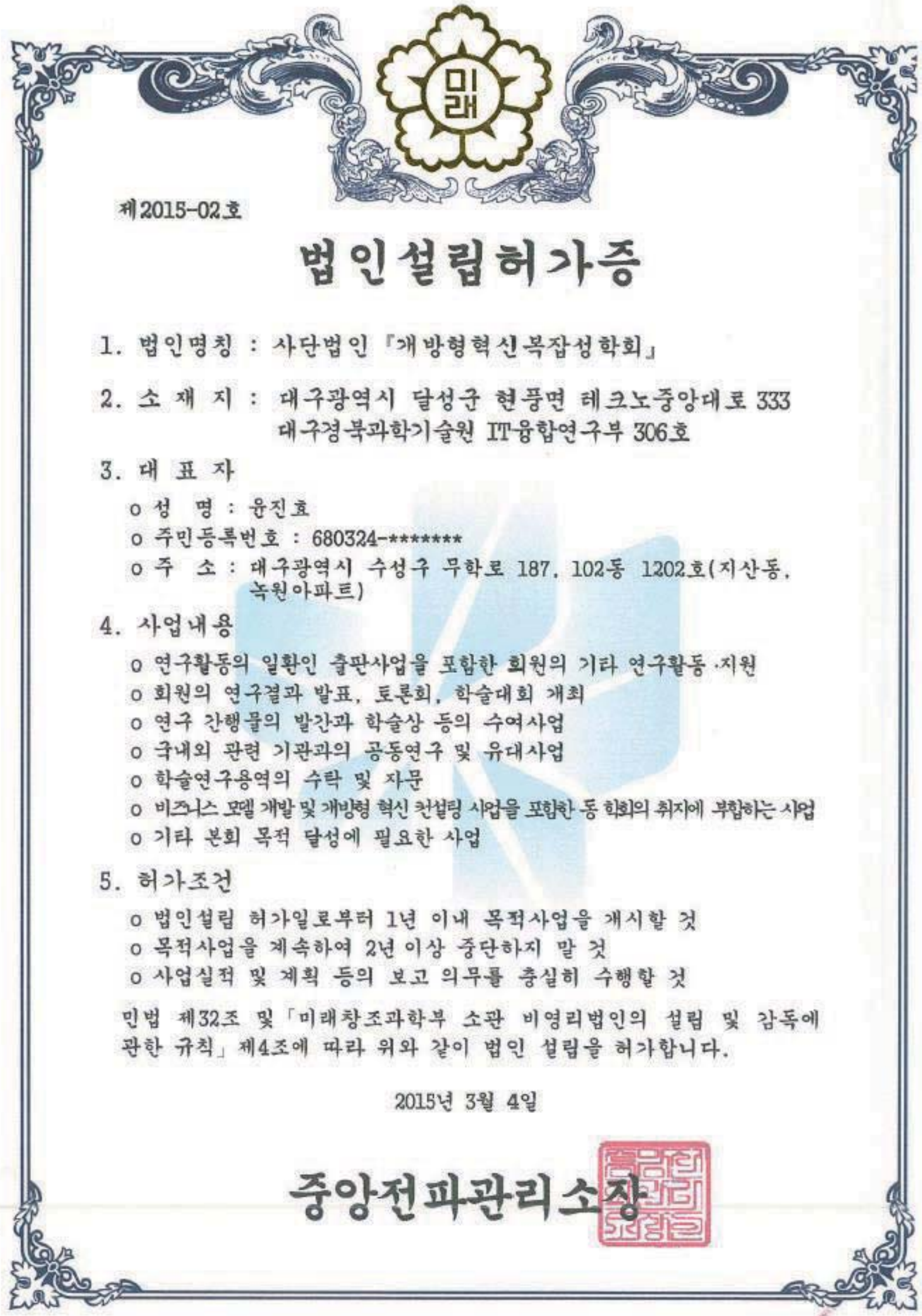
○ (3. 4, 2015) Foundation of SOItmC, allowed by the Ministry of Science, ICT and Future

Planning of Korea

○ (3. 24, 2015) Registration of SOItmC

○ (3. 26, 2015) Business Registration Certificate, Issued.

※ SOItmC, registered under the Jurisdiction of the Ministry of Science, ICT and Future Planning of Korea



제2015-02호

법인설립허가증

1. 법인명칭 : 사단법인 『개방형혁신복잡성학회』

2. 소 재 지 : 대구광역시 달성군 현풍면 테크노중앙대로 333
대구경북과학기술원 IT융합연구부 306호

3. 대 표 자
- 성 명 : 윤진효
- 주민등록번호 : 680324-*******
- 주 소 : 대구광역시 수성구 무학로 187, 102동 1202호(지산동, 녹원아파트)

4. 사업내용
- 연구활동의 일환인 출판사업을 포함한 회원의 기타 연구활동 ·지원
- 회원의 연구결과 발표, 토론회, 학술대회 개최
- 연구 간행물의 발간과 학술상 등의 수여사업
- 국내외 관련 기관과의 공동연구 및 유대사업
- 학술연구용역의 수탁 및 자문
- 비즈니스 모델 개발 및 개방형 혁신 컨설팅 사업을 포함한 동 학회의 취지에 부합하는 사업
- 기타 본회 목적 달성에 필요한 사업

5. 허가조건
- 법인설립 허가일로부터 1년 이내 목적사업을 개시할 것
- 목적사업을 계속하여 2년 이상 중단하지 말 것
- 사업실적 및 계획 등의 보고 의무를 충실히 수행할 것

민법 제32조 및「미래창조과학부 소관 비영리법인의 설립 및 감독에 관한 규칙」제4조에 따라 위와 같이 법인 설립을 허가합니다.

2015년 3월 4일

중앙전파관리소장

※ Certified Copy of Register

등기사항전부증명서(말소사항 포함)[제출용]

등기번호	000393
등록번호	171821-0003933

명 칭	사단법인 개방형혁신복잡성학회
주사무소	대구광역시 달성군 현풍면 테크노중앙대로 333, 대구경북과학기술원 이 이티융합연구부 306호

목 적

본 법인은 지식기반 경제사회의 도래로 인해 지식의 양 및 유통속도가 빠르게 증가하고 있는 현실 속에서 여러 학문 영역 간의 경계를 허물고 기술과 시장의 창조적 연결에 관한 개방형 혁신 연구 기술과 시장의 창조적 결합에 의한 새로운 비즈니스 모델 창출 그리고 기술 시장 및 환경의 진화적이고 복잡계적인 관계에 대한 새로운 다양한 연구와 실천을 통해서 거의 정체상태에 머물고 있는 현대 자본주의의 한계를 극복할 수 있는 학술적 현실적 제안을 인류에게 제시하고자 한다. 위 목적을 달성하기 위하여 다음의 사업을 행한다.

1. 연구활동의 일환인 출판사업을 포함한 회원의 기타 연구활동 및 조성지원
2. 회원의 연구결과 발표, 토론회, 학술대회 개최
3. 연구간행물의 발간과 학술상 등의 수여사업
4. 국내외 관련 기관과의 공동연구 및 유대사업
5. 학술연구용역의 수탁 및 자문
6. 비즈니스 모델 개발 및 개방형 혁신 컨설팅사업을 포함한 동 학회의 취지에 부합하는 사업
7. 기타 본회의 목적달성에 필요한 사업

임원에 관한 사항

이사 윤진효 680324-******* 대구광역시 수성구 무학로 187, 102동 1202호(지산동, 녹원맨션)
 대표권제한규정 이사 윤진효 외에는 대표권이 없음.

이사 최상옥 680218-*******
이사 최종인 640831-*******
이사 노환진 571010-*******
이사 김경훈 660824-*******
이사 이상현 770830-*******
이사 신창환 710818-*******
이사 안흥주 680712-*******
이사 이두석 670810-*******
이사 권기석 700901-*******
이사 원동규 640206-*******
이사 정광호 650803-*******
이사 박경배 731019-*******

기 타 사 항

1. 자산의 총액
 금 0원

~~1. 해산~~
~~정관 제1조의 규정에 의한 목적의 달성 또는 그 목적의 달성불능 등으로 법인을 해산하고자~~

[인터넷 발급] 문서 하단의 바코드를 스캐너로 확인하거나, 인터넷등기소(http://www.iros.go.kr)의 발급확인 메뉴에서 발급확인번호를 입력하여 위·변조 여부를 확인할 수 있습니다.
발급확인번호를 통한 확인은 발행일부터 3개월까지 5회에 한하여 가능합니다.

000052103319432030005112082127O1B9DABFEBC1F819670917 4 발행일:2015/03/24 발급확인번호 3936-AAPL-GYRJ

- 1/2 -

등기번호	000393

~~할 때에는 총회에서 재적회원 3분의 2이상의 찬성을 얻어야 한다. 다만, 회원이 없게 된 경우 에는 총회의 결의 없이 해산한다.~~

2015 년 03 월 24 일 착오발견 2015 년 03 월 24 일 등기

1. 설립인허가연월일

2015년 3월 4일

1. 존립기간 또는 해산사유

정관 제1조의 규정에 의한 목적의 달성 또는 그 목적의 달성불능 등으로 법인을 해산하고자 할 때에는 총회에서 재적회원 3분의 2이상의 찬성을 얻어야 한다. 다만, 회원이 없게 된 경우 에는 총회의 결의 없이 해산한다.

2015 년 03 월 24 일 착오발견 2015 년 03 월 24 일 등기

법인성립연월일	2015 년 03 월 20 일

등기기록의 개설 사유 및 연월일

설립

2015 년 03 월 20 일 등기

수수료 1,000원 영수함 --- 이 하 여 백 ---

관할등기소 : 대구지방법원 서부지원 등기과 / 발행등기소 : 법원행정처 등기정보중앙관리소

이 증명서는 등기기록의 내용과 틀림없음을 증명합니다. [다만, 신청이 없는 분사무소에 관한 사항의 기재를 생략하였습니다]

서기 2015년 03월 24일

법원행정처 등기정보중앙관리소 전산운영책임관 등기정보중앙관리소전산운영책임관인

* 실선으로 그어진 부분은 말소(변경,경정)된 등기사항입니다. * 등기사항증명서는 컬러로 출력 가능함.

[인터넷 발급] 문서 하단의 바코드를 스캐너로 확인하거나, 인터넷등기소(http://www.iros.go.kr)의 발급확인 메뉴에서 발급확인번호를 입력하여 위·변조 여부를 확인할 수 있습니다. 발급확인번호를 통한 확인은 발행일부터 3개월까지 5회에 한하여 가능합니다.

발급확인번호 3936-AAPL-GYRJ

00005210331943203000511208212701B9DABFEBC1F819670917 4 발행일:2015/03/24

- 2/2 -

※ Business Registration Certificate

국세청
www.nts.go.kr

사 업 자 등 록 증

(법인사업자:본점)

등록번호 : 885-82-00014

법인명(단체명) : 사단법인 개방형혁신복잡성학회

대 표 자 : 윤진효

개 업 연 월 일 : 2015 년 03 월 24 일 법인등록번호 : 171821-0003933

사업장 소재지 : 대구광역시 달성군 현풍면 테크노중앙대로 333, 306호
대구경북과학기술원 아이티융합연구부

본 점 소 재 지 : 대구광역시 달성군 현풍면 테크노중앙대로 333, 306호
대구경북과학기술원 아이티융합연구부

사 업 의 종 류 : 업태 서비스 종목 학술단체및학회운영, 연구
서비스 간행물 발행 및 출판

NATIONAL TAX SERVICE REPUBLIC OF KOREA
NTS
국세청

발 급 사 유 : 신규

사업자 단위 과세 적용사업자 여부 : 여 ( ) 부 (V)
전자세금계산서 전용 전자우편주소 :

2015 년 03 월 26 일

남대구세무서장

국세청

NTS 국세청

Agenda 3 (Decision): Composition of SOItmC

Position	Number
President	1
Honorable member	10
Advisory member	12
Vice President	47
Director	61
Auditor	2
Member	Approximately, 300

	Title	Name	Term (Years)	Affiliation
1	President & Executive Director	JinHyo Joseph Yun	3	Senior Researcher, Division of IoT and Robotics Convergence Research, DGIST Professor, Management of Innovation, DGIST

	Title	Name	Term (Years)	Affiliation
1	Honorable member	Loet Leydesdorff	N/A	University of Amsterdam
2	Honorable member	Fumio Kodama	N/A	University of Tokyo
3	Honorable member	Francisco Javier Carrillo	N/A	Tecnologico de Monterrey
4	Honorable member	Ulrich Witt	N/A	Max Planck Institute of Economics
5	Honorable member	KongRae Lee	N/A	DGIST
6	Honorable member	Keun Lee	N/A	Seoul National University
7	Honorable member	Keld Laursen	N/A	Copenhagen Business School
8	Honorable member	Venni V. Krishna	N/A	Jawaharlal Nehru University
9	Honorable member	Philip Cooke	N/A	Cardiff University
10	Honorable member	Fred Phillips	N/A	Stony Brook University

	Title	Name	Term (Years)	Affiliation
1	Advisory member	TaiYoo Kim	N/A	Seoul National University
2	Advisory member	JeongRo Yoon	N/A	KAIST
3	Advisory member	MinHwa Lee	N/A	KAIST
4	Advisory member	JeonIl Moon	N/A	DGIST
5	Advisory member	BongJin Cho	N/A	Keimyung university
6	Advisory member	GeunWoo Ryu	N/A	Keimyung university
7	Advisory member	SungSoo Seol	N/A	Hannam University
8	Advisory member	SunYang Chung	N/A	Konkuk University

9	Advisory member	ByungKeun Kim	N/A	Korea University of Technology and Education
10	Advisory member	JooHan Kim	N/A	National Science Museum
11	Advisory member	Taeho Park	N/A	Director & Professor of School of Global Innovation and Leadership, San Jose State University
12	Advisory member	MunCho Kim	N/A	Emeritus Professor of Sociology, Korea University
	Title	Name	Term (Years)	Affiliation
1	Vice President & Executive Director	KiSeok Kwon	3	Professor, Public Administration, Hanbat National University
2	Vice President & Executive Director & Head of Awards Committee	KyungBae Park	3	Professor, Business Administration, Sangji University
3	Vice President & Head of Awards Committee	Glenn S. Banaguas (Philippines)	3	Professor of De La Salle Araneta University (DLSAU)
4	Vice President & Executive Director & Head of Open Innovation Index Development & Evaluation Committee	DooSeok Lee	3	Professor of School of Basic Science, DGIST
5	Vice President & Executive Director & Head of Open Innovation Index Development & Evaluation Committee	ChangHwan Shin	3	Professor of Social Welfare, Kyungpook National University
6	Vice President & Head of Open Innovation Index Development & Evaluation Committee	Tim Minshall (UK)	3	Director of Manufacturing Engineering Tripos (MET), Cambridge University
7	Vice President & Executive Director & Head of Consulting Committee	KyoungHun Kim	3	Head of Neo Economy Society Institute, Inc.
8	Vice President & Head of Consulting Committee	YeongWha Sawng	3	Professor of Management of Technology, Konkuk University
9	Vice President & Head of Consulting Committee	Penghui LYU (China)	3	Professor of Wuhan University, School of Information Management
10	Vice President & Executive Director & Head of Open Innovation Platform Development Committee	Heungju Ahn	3	Professor of School of Basic Science, DGIST
11	Vice President & Head of Open Innovation Platform Development Committee	WooSung Jung	3	Professor of Industrial and Management Engineering, POSTECH
12	Vice President & Head of Open Innovation Platform Development Committee	Robert Huggins (UK)	3	School of Planning and Geography Cardiff University

13	Vice President & Executive Director & Head of Academic Committee	DongKyu Won	3	Chief Researcher, Analysis Division of Industrial Market, KISTI
14	Vice President & Head of Academic Committee	Avvari V. Mohan (Malaysia)	3	Professor of University of Nottingham, Business School
15	Vice President & Auditor	ByungJoon Choi	6	CEO of IGSP, Inc. ※ For the reason that an auditor is not allowed to take a position of executive director simultaneously, after the term as auditor, ByungJoon Choi will be added, as initially commissioned, to Executive Director Committee.
16	Vice President & Auditor	ByungTae Kim	6	Head of Creative Industry Division, Daegu Gyeongbuk Development Institute ※ For the reason that an auditor is not allowed to take a position of executive director simultaneously, after the term as auditor, ByungJoon Choi will be added, as initially commissioned, to Executive Director Committee.
17	Vice President & Executive Director	SangOk Choi	3	Professor of Public Administration, Korea University
18	Vice President & Executive Director	SangHyun Lee	3	CEO of Sntec, Inc.
19	Vice President & Executive Director	HwanJin Nho	3	Professor of School of Basic Science, DGIST
20	Vice President & Executive Director	JongIn Choi	3	Professor of Graduate School of Entrepreneurship, Hanbat National University
21	Vice President & Executive Director	KwangHo Jung	3	Professor of Graduate School of Public Administration, Seoul National University
22	Vice President	JungDong Lee	3	Professor of Technology Management Economics and Policy Program, Seoul National University
23	Vice President	SHI Lei (China)	3	Professor of School of Environment, Tsinghua University
24	Vice President	WiChin Song	3	Research Division of Social Technology Innovation, STEPI
25	Vice President	SangHo Lee	3	Professor of Urban Engineering, Hanbat National University
26	Vice President	YoungJoo Ko	3	Head of Future Strategies Center, Korea Research Institute of Chemical Technology
27	Vice President	Domingo Ribeiro (Spain)	3	Facultad de Economı´a, University of Valencia
28	Vice President	Guenter Koch (Germany)	3	Professor, associated with Technical University of Graz, Austria Danube University Humboldt Cosmos Multiversity

29	Vice President	JungHee Han	3	Professor of Management of Technology MBA, Chonnam National University
30	Vice President	EunNyeong Heo	3	Professor of Energy Resources Engineering, Seoul National University
31	Vice President	SangCheol Lee	3	Senior Researcher, IoT and Robotics Convergence Research, DGIST
32	Vice President	Glenn S. Banaguas	3	De La Salle Araneta University
33	Vice President	HeeSang Lee	3	SungKyunKwan University
34	Vice President	ChoongJae Lim	3	KeiMyung university
35	Vice President	Aino Kianto (Finland)	3	Professor of Lappeenranta University of Technology
36	Vice President	Andreas Braun (Germany)	3	Professor of BES Business School Berlin Potsdam
37	Vice President	Bettina Von Stamm (Germany)	3	Adjunct Professor, Hult Business School Gastdozent, TUM (Technical University Munich)
38	Vice President	Blanca C. Garcia (Mexico)	3	Professor of El Colegio de La Frontera Norte (Colef)
39	Vice President	Giovanni Schiuma (Italy)	3	Professor of Università degli Studi della Basilicata
40	Vice President	JangHyun Kim	3	Professor of Interaction Science SungKyunKwan University
41	Vice President	Paola Paoloni (Italy)	3	Professor of Niccolò Cusano University – Rome
42	Vice President	Stephen McLaughlin (Ireland)	3	Professor of National University of Ireland Maynooth
43	Vice President	Tan Yigitcanlar (Australia)	3	Professor of Queensland University of Technology
44	Vice President	Tommi Inkinen (Finland)	3	Professor of University of Helsinki
45	Vice President	SeungHee Lee	3	Southern Illinois University
46	Vice President	Xin Yi (Bangladesh)	3	Professor of School of Architecture, Southeast University
47	Vice President	Dominik F. Schlossstein (Germany)	3	Project Manager at ERGO Versicherungsgruppe AG

	Title	Name	Term (Years)	Affiliation
1	Director	WooYoung Jung	3	Director, Convergence Research Center for Future Automotive Technology, DGIST
2	Director	JoonWoo Son	3	Senior Researcher, IoT and Robotics Convergence Research, DGIST
3	Director	Natalja Lace (Latvia)	3	Professor of Riga Technical University

4	Director	MoonJong Choi	3	Senior Researcher, Wellness Convergence Center, DGIST
5	Director	EuiSeob Jeong	3	Chief Researcher, Seoul Team, KISTI
6	Director	ByungWoon Kim	3	ETRI
7	Director & Head of Consulting Committee	YounSeok Park	3	TECHNOVALUE, Inc.
8	Director	Yohan Kim	3	Daegu TechnoPark
9	Director	MyungSan Jun	3	SPICUS Service, Inc.
10	Director	SunAh Kim	3	Kumoh National Institute of Technology
11	Director	DongJin Park	3	2ver media, Inc.
12	Director	Pun-Arj Chairatana	3	Noviscape Consulting Group Co., Ltd
13	Director	ChiSoo Ahn	3	Director of Policy and Strategy, KBSI
14	Director	ByungHeon Lee	3	Kwangwoon University
15	Director	SunHi Yoo	3	KISTI
16	Director	Chengli Shu	3	Xi'an Jiaotong University
17	Director	Chia-Liang Hung	3	National Chi Nan University
18	Director	ByeongSun Lee	3	Omning Co., Ltd
19	Director	Ddembe Williams	3	KCA University
20	Director	YongSu Ko	3	KISTEP
21	Director	Deok Soon Yim	3	Korea Institute for Innovation Cluster
22	Director	SangMoon Park	3	Kangwon National University
23	Director	DongHwan Kim	3	ChungAng University
24	Director	Valentina Della Corte	3	University of Naples Federico Ⅱ
25	Director	DongWon Sohn	3	Inha University
26	Director	DongWuk Yim	3	Korea National University of Transportation
27	Director	HeeDae Kim	3	Daegu Digital Industry Promotion Agency
28	Director	Francisco Escribano E. Sotos	3	Titular de Universidad
29	Director	Guenter KOCH	3	Humboldt Cosmos Multiversity
30	Director	Yuri Sadoi	3	Meijo University
31	Director	YooJin Han	3	Sookmyung Women's University
32	Director	HyueSu Ha	3	Kyungpook national university
33	Director	SungSoo Hwang	3	Yeungnam University
34	Director	Ir. Januar Heryanto	3	Universitas Pelita Harapan Surabaya
35	Director	Isabel Pardo Garcia	3	Universidad de Castilla-La Mancha
36	Director	JaeHyun Lee	3	Daegu University
37	Director	Chih-cheng Lo	3	National Changhua University of Education

38	Director	JeongHwan Jeon	3	GyeongSang National University
39	Director	JeongHwan Lee	3	Myongji University
40	Director	JinHan Kim	3	Kumoh national university
41	Director	JongYeon Lim	3	KISTI
42	Director	JungTae Hwang	3	Hallym University
43	Director	Richard Hu	3	University of Canberra
44	Director	JinWon Kang	3	KISTEP
45	Director	Melih Bulu	3	Istanbul Sehir University
46	Director	NamChul Shin	3	Pace University
47	Director	EunHee Kim	3	Chonnam National University
48	Director	TaeWoon Kim	3	Keimyung University
49	Director	TaeHee Kim	3	National Research Foundation of Korea
50	Director	SukJae Jeong	3	KwangWoon University
51	Director	SunYoung Park	3	Konkuk University, Management of Technology
52	Director	SunWoo Kim	3	Science and Technology Policy Institute
53	Director	WonIl Lee	3	Hanbat National University, Business Administration
54	Director	YunBae Kim	3	SungKyunKwan University, Management of Technology
55	Director	ManHyung Cho	3	Hannam University
56	Director & Head of Awards Committee	WanJong Joo	3	TAEBAEK, Intellectual Property Law Firm
57	Director	YongHan Choi	3	Seoul Education Research & Information Institute
58	Director	JinWoo Im	3	DGIST
59	Director	YoungDuk Kim	3	DGIST
60	Director	TaeSoo Eom	3	Director of Time and Space LAB
61	Director	HoonSik Tak	3	Chairman of Korea Public Marketing Laboratory

※ Membership Application Form

Agreement to join as a member of

Society of Open Innovation : Technology, Market, and Complexity (SOItmC)

www.openinnovationtmc.org

1. Registration form

<table>
<tr><td>Name</td><td colspan="2">First Name:
Middle Name:
Family Name:</td></tr>
<tr><td rowspan="2">Phone Number</td><td colspan="2">(Mobile)</td></tr>
<tr><td colspan="2">(Office)</td></tr>
<tr><td>Primary Email</td><td colspan="2"></td></tr>
<tr><td>Institute & Division</td><td colspan="2"></td></tr>
<tr><td>Position</td><td colspan="2"></td></tr>
<tr><td>Address of
the Office</td><td colspan="2">(Please include Postal Code)</td></tr>
<tr><td colspan="2">Agreement for SOItmC member</td><td>(sign)</td></tr>
</table>

2. You can send the email with the form filled and any opinions through the address below

Email: openinnovationtmc@gmail.com (☎: +82-53-785-4411)

※ Membership fee for a year is included in the registration fee of SOItmC & KCWS 2015

※ This is as effective as joining the webpage as a member

Agenda 4 (Report): Special Issue Journals of SOItmC & KCWS 2015

○ Journal of Open Innovation: Technology, Market, and Complexity (JOItmC)

- · The papers from 12 keynote speakers of the conference will be invited to the JOItmC and processed in regular steps (No payment involved)
- · (The fee for JOItmC Special Issue is paid by Open Innovation & Business Model Research team, DGIST)
- · Outstanding papers chosen from the conference will be also invited for publication and processed in regular steps (Payment, not funded)

○ Science, Technology and Society (STS)

- · Best papers chosen from the conference will be invited to STS (No payment involved)
- · (The fee of $3,000 for STS Special Issue has been already paid by Open Innovation & Business Model
- · Research team, DGIST)

○ International Journal of Knowledge Based Development (IJKBD)

- · The papers of 'Encouraging Awards' will be invited to IJKBD (No payment involved)
- · (The fee of $2,000 for IJKBD Special Issue has been already paid by Open Innovation & Business Model
- · Research team, DGIST)

Agenda 5 (Report): The Planning on SOItmC 2016 Conference

○ Hosted by School of Global Innovation & Leadership at SJSU

○ Organized by School of Global Innovation & Leadership at SJSU, SOItmC, UCB (TBD) & World Capital Institute

○ Sponsored by SV Center for Operations & Technology Management, SV Center for Entrepreneurship & Others.

1. Date: May 31 (Tue.) – June 3, 2016 (Fri.)
2. Venue: San Jose State University (SJSU), California, USA
3. Theme: Open Innovation for Start-ups and Collaborative Supply Chain
4. Program Schedule

   · 1st Day: Industry Tour (Cisco or Google) & Welcome Reception

   · 2nd Day: Subtheme - Open innovation for starts-up (Or Technology collaboration), Open Innovation and Business Model Case Competition Session

   · 3rd Day: Subtheme - Open innovation for collaborative supply chain

   · 4th Day: Culture tour (Napa Valley Winery Tour)

   ※ Joint Research works of Professors and Undergraduate Students of DGIST could be added to the program, and, among them, best outputs will be selected for the special issues (Tentative)

5. Special Issue

   · JOItmC: 12 papers (Editor-in-Chief: JinHyo Joseph Yun, DGIST, Korea)

   · STS: 8 papers (Editor-in-Chief: Venni V. Krishna, Jawaharlal Nehru University, India)

   · Journal of Supply Chain and Operations Management: 8 papers (Editor-in-Chief: Taeho Park, San Jose State University, USA)

   · Planning to invite 10 - 20 papers from SCI Journals

   · Planning to invite the special issue from Technology Forecasting and Social Change (Editor-in-Chief: Fred Philips, Stony Brook University, USA)

Agenda 6 (Report): The Course of Preparation

○ Steps forward SOItmC & KCWS 2015

· 10. 27, 2014: Inaugural General Meeting
· 20, 2015: 1st Preparation Seminar for the SOItmC & KCWS 2015
· 02. 06, 2015: 2nd Preparation Seminar for the SOItmC & KCWS 2015
· 03. 05, 2015: 3rd Preparation Seminar for the SOItmC & KCWS 2015
· 04. 03, 2015: 4th Preparation Seminar for the SOItmC & KCWS 2015
· 06. 14 – 06. 18, 2015: SOItmC & KCWS 2015

Agenda 7 (Report): Settlement of Budget

· Income (Approximate)

Sources	Amount
DGIST	\ 43,000,000
Daegu Metropolitan City Government	\ 6,000,000 ~ 7,000,000
Institutes(Or Chairs) of Special Sessions	\ 36,000,000 ~ 48,000,000
Conference Registration Fees (Target Amount)	\ 35,000,000
Total	\ 127,500,000

· Expense (Approximate)

Sources	Amount
Webpage Set-up	\ 35,000,000
Four Preparation Seminars	
Invitation for keynote speakers (Round-trip airfares, Accommodations, Honorariums)	\ 36,000,000 ~ 48,000,000
Advertising Materials (Placard, Banners, Souvenirs, etc)	\ 25,000,000
Printing (Poster, Proceedings, Name tags, etc)	
Postal Service Cost	\ 10,000,000
Gala Dinner, Tea & Snacks Table	\ 25,000,000
Art Performance	
Personnel for the SOItmC & KCWS 2015	
Appreciation Plaque & Awards	
Total	\ 138,000,000

Agenda 8 (Decision): Proposal for Global Research Project with an International Organization

○ Aim: What should we do to overcome the growth limits of capitalism forward?

○ Honorable Advisors: Loet Leydesdorff(University of Amsterdam), Fumio Kodama(University of Tokyo), Francisco Javier Carrillo(Tecnologico de Monterrey), Ulrich Witt(Max Planck Institute of Economics), KongRae Lee(DGIST), Keun Lee(Seoul National University), Keld Laursen(Copenhagen Business School), Venni V. Krishna(Jawaharlal Nehru University), Philip Cooke(Cardiff University), Fred Phillips(Stony Brook University)

○ The research project with an international organizations such as OECD, UN or EU will be on the subject of Schumpeterian Dynamics of Open Innovation Economy System in the pursuit of overcoming the Growth Limits of Capitalism.

· Anyone who hopes to join the research project can participate in.

· Please make sure the intention of participation by the end of September, 2015.

· (Email: openinnovationtmc@gmail.com)

· On behalf of SOItmC, the President (JinHyo Joseph Yun) plans to submit the proposal to the international organization in the December, 2015.

Appendix 2. Gala Concert with Dinner

SOItmC and KCWS 2015 Gala Program

1. Outline

When: June 15, 2015; 07:30–09:00 p.m.

Where: Daegu Gyeongbuk Institute of Science and Technology,
E1 Convention Hall

Organized by: Korea Paparotti Culture Foundation

Person in charge: Park Gyeong-sik
010-2877-3491
barkspol@hanmail.net

2. Schedule

07:20–09:30 p.m.: Playing background music in the premier event venue

07:30–08:10 p.m.: Playing music for ceremonies and dinner

08:10–09:10 p.m.: Performances after dinner

3. Sequence of Performances

1) Karis String Quartet

Violin 1: Kim Mu-jin

Violin 2: Bae Hye-wan

Viola: Cho Jae-hyeong

Cello: Baek Seung-gyeong

- *Mozart's "Serenade in GM Eine Kleine Nachtmusik K. 525"*
- *Mozart's "Divertimento in DM, KV 136"*
- *Bach's "Serenade"*
- *Elgar's "Salut d'Amour"*

2) "Puriyeon," Korean Traditional Music Performance Group

Janggu: Kim Do-yeon

Gayageum: Jung Seon-yeong

Daegeum: Jang Seong-woo

Haegeum: Oh Mi-jin

Piri (pipe): Park In-yeong

Sori (singing): Woo So-hye

- *Cheonnyeonmanse*
- *Freestyle solo with daegeum*
- *Gangmaeul (River Village)*
- *Playing of Namdo folk songs (Seongjupuri, Namwonsanseong, and Jindo Arirang)*

3) Korea's Trumpet Prodigy

Kim Bu-geon

- *Trumpet in the Night Sky*
- *My Way*

4) "Puriyeon," Korean Traditional Music Performance Group

Janggu: Kim Do-yeon

Gayageum: Jung Seon-yeong

Daegeum: Jang Seong-woo

Haegeum: Oh Mi-jin

Piri (pipe): Park In-yeong

Sori (singing): Woo So-hye, Choi Hyo-Joo

- *Haegeum solo*
- *Ssukdaemeori*
- *Beautiful Country*

Appendix 3. Historical & Cultural Tour

Date: June 18, 2015
Place: Andong Hahoe Village (UNESCO designated World Heritage Site)

Participation Fee($50) includes round-trip bus service (Daegu to (from) the site), lunch, guidance, and souvenirs

Appendix 4. Transportations to DGIST

• First Step (From Incheon International Airport to DongDaegu Station)

From Incheon International Airport, there are three modes of transportation to the Daegu Metropolitan City where the DGIST is located.

1) Take a connecting flight to the Daegu International Airport Takes 55 min., Fare: around $80

2) Take a KTX express train to the DongDaegu Station Takes 3hrs., Fare: around $50

3) Take an express bus to the DongDaegu Station Takes 4hrs 30 min., Fare: around $30)

• Second Step (From DongDaegu Station to DGIST)

From DongDaegu station, there are two choices to reach the DGIST, the venue of the Conference

1) DongDaegu station → DGIST
   Take a taxi (40 mins., around $40)

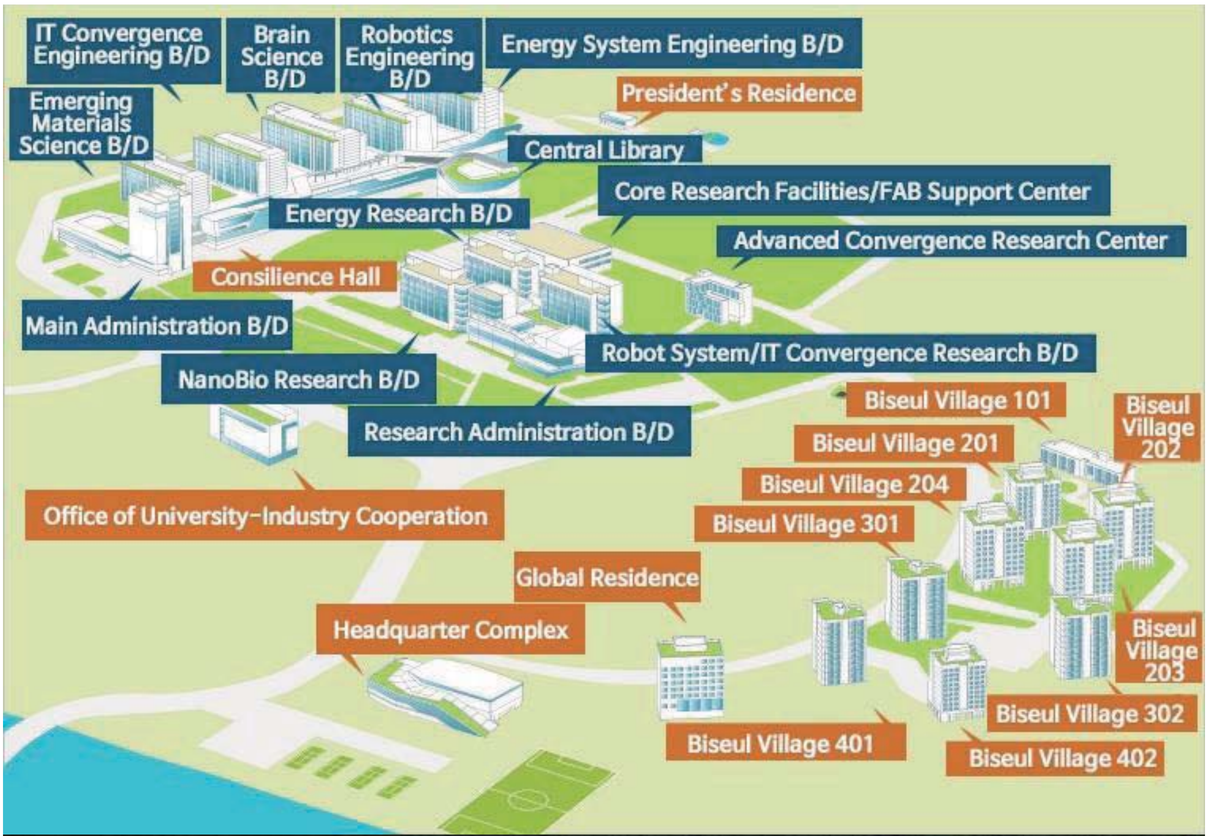
2) DongDaegu station → DaeGok subway station → DGIST (50 mins, around $15)
   You can take a subway from the DongDaegu station to the DaeGok subway station, and from the 3rd Exit of the DaeGok station, we recommend to take a taxi up to the DGIST. (You can tell or show the taxi driver the address of the DGIST)

※ Address:333 Techno Jungang-daero, Hyeonpung-myeon, Dalseong-gun, Daegu, 711-873. (Tel. +82-10-3429-2728, +82-10-6697-8355)

Appendix 5. Journal of Open Innovation: Technology, Market, and Complexity

(www.jopeninnovation.com)

Appendix 6. Campus Map



Appendix 7. Call for Paper

Call for Papers & Invitation

Society of Open Innovation: Technology, Market, and Complexity (SOItmC) &
Knowledge Cities World Summit (KCWS) 2015
June 14 – 18, DGIST (R1, Research Administration B/D), Daegu, Korea
(www.openinnovationtmc.org)

Open Innovation, Knowledge City & Creative Economy

Welcome anyone who is interested in the academic and practical topics can **register the conference**

Full paper submission (until 06. 10, 2015)
Submission of Open Innovation Cases and Business Models (until 06. 10, 2015)

Keynote Speakers

Tan Yigitcanlar (Australia)
- A Professor, Queensland University of Technology, Australia
- An Associate Editor of the International Journal of Knowledge Based Development and International Journal of Environmental Science and Technology
- Presentation Theme: "Incentivising innovation: insights from Australian and Brazilian incentive schemes"

Venni V. Krishna (India)
- A Professor, Jawaharlal Nehru University
- Editor-in-Chief, Science, Technology and Society (SSCI)
- Presentation Theme: "Globalization of R&D and Innovation: View from Asia"

JinHyo Joseph Yun (Korea)
- Tenured Senior Researcher and Professor, Division of IoT and Robotics Convergence Research, DGIST
- Editor-in-Chief of Journal of Open Innovation: Technology, Market, and Complexity(JOItmC)
- Presentation Theme: "How do we conquer the growth limit of capitalism: Schumpeterian Dynamics of Open Innovation Economy System"

Katri-LiisLepik (Estonia)
- Associate professor, Institute of Political Science and Governance
- Organiser of the KCWS 2014
- Presentation Theme: "Strategic management for public sector innovation in knowledge societies"

Philip Cooke (Norway)
- A Professor, Center for Innovation, Bergen University College, Norway
- Editor of "European Planning Studies" (SSCI)
- Presentation Theme: "The Future of Innovation: Challenges, Complexity & Crossovers"

Tommi Inkinen (Finland)
- A Professor, University of Helsinki, Finland
- A Steering Group Member of the International Geographical Union's(IGU) Global Information Society Commission
- Presentation Theme: "Reflections on the innovative city: examining three innovative locations in a knowledge bases framework"

Taeho Park (USA)
- Director & Professor, School of Global Innovation and Leadership, San Jose State University
- Editor-in-Chief, Journal of Supply Chain and Operations Management
- Presentation Theme: : "Open Innovation in Supply Chain Management for Creative Economy"

Fumio Kodama (Japan)
- A Professor Emeritus, the University of Tokyo and Shibaura Institute of Technology
- Ex Editor of Research Policy (1993 - 2009)
- Presentation Theme: "Corporate and Public Policies for Open Innovation: Demand Articulation in the Open-Innovation Paradigm"

Blanca Garcia (Mexico)
- An Associate Professor, Northern Borderlands Research College, Mexico
- Executive Director at the World Capital Institute(Awards Program)
- Presentation Theme: "Knowledge Cities Benchmarking: The case of Daegu, Korea"

Javier Carrillo (Mexico)
- A Professor, Monterrey University of Technology, Mexico
- Founder and President of the World Capital Institute (www.worldcapitalinstitute.org)
- Presentation Theme: "Knowledge-based Development as cultural disruption"

KongRae Lee (Korea)
- Professor at DGIST (Ph.D at Science and Technology Policy (SPRU), Sussex University (1994))
- Founder & President of ASIALICS (Asia Association of Learning, Innovation and Coevolution Studies)
- Presentation Theme: "Sectoral differences in convergence innovation: implications for open innovation"

Keun Lee (Korea)
- A Professor, Department of Economics, Seoul National University
- Winner of 2014 Schumpeter Prize for his book on Schumpeterian Analysis of Economic Catch-up (CUP 2013)
- Presentation Theme: "Schumpeterian Analysis of Catch-up and Catch-up cycles"

Special Sessions

Special Session 1.
"City of Future, Future of City: Open Innovation and Ubiquitous City"
- Session Chair: SangHo Lee (Hanbat National University)

Special Session 6.
"Technology Policy for Open Innovation & Knowledge City"
- Session Chair: SangOk Choi (Korea University)

Special Session 2.
"Complexity, Open Innovation & Knowledge City"
- Session Chair: DongKyu Won (KISTI)

Special Session 7.
"Open Innovation for Smart Mobility & Complexity"
- Session Chair: WooSung Jung (POSTECH)

Special Session 3.
"Start-ups, Open Innovation, and Knowledge City"
- Session Chair: ChoongJae Im (Keimyung University)

Special Session 8.
"Smart Technology for Good Governance "
- Session Chair: KwangHo Jung (Seoul National University)

Special Session 4.
"Daegu Techno-Park, Open Innovation and Creative City "
- Session Chair: YoHan Kim (Daegu TechnoPark)

Special Session 9.
"Open Innovation and Creative Entrepreneurship from Gyeongbuk TP and University Entrepreneurship Center"
- Session Chair: Jaehoon Rhee (Yeungnam University)

Special Session 5.
"Open Innovation: Technology, Society & Dynamics"
- Session Chair: KyungBae Park (Sangji University)

Special Session 10.
"The Importance of Valuation and Big Data as a Source of Technology Commercialization in Open Innovation Era"
- Session Chair: KeeHeon Cho (Korea Valuation Association)

General Session

General Session 1.
"Open Innovation in Energy"
- Session Chair: Eunnyeong Heo (Seoul National University)

General Session 3.
- Session Chair: SangChul Park (Korea Polytechnic University)

General Session 2.
"Creative Economy & Open Innovation"
- Session Chair: MinHwa Lee (KAIST)

General Session 4.
- Session Chair: KwangHo Jung (Seoul National University)

Special Issue Journals

- Journal of Open Innovation: Technology, Market, and Complexity (Springer Press, Targeting Scopus in 2015)
  - · Editor-in-Chief: JinHyo Joseph Yun (DGIST)
  - · Up to 12 articles would be accepted to the journal
  - · Apart from the 12 articles, additional 12 papers from keynote speakers are submitted to the journal
- International Journal of Knowledge Based Development (Scopus)
  - · Guest Editor: JinHyo Joseph Yun (DGIST) & YounTaik Leem (Hanbat National University)
  - · Up to 8 articles would be accepted to the journal
- Science, Technology and Society (SSCI)
  - · Guest Editor: JinHyo Joseph Yun (DGIST)
  - · Up to 8 articles would be accepted to the journal
  - · Up to 10 articles would be accepted to the journal
  - · Based on a close tie with the journal, the organizing committee will do the best to make publications of papers selected.

Designated General Issue Journals

- Technological Forecasting and Social Change (SSCI)
  - · Editor-in-Chief: Fred Phillips (Yuan Ze University, Taiwan)
  - · Invited Nominator: JinHyo Joseph Yun (DGIST)
  - · Top 3 ~ 5 articles will be selected by the nominator and recommended to the journal for publication.
- Journal of Science, and Technology, Policy, Management (Scopus)
  - · Editor-in-Chief: Patricia Ordonez de Pablos
  - · Invited Reviewers: KiSeok Kwon (Hanbat National University), WooSung Jung (POSTECH), JinHyo Joseph Yun (DGIST), KyungBae Park (Sangji University), DooSeok Lee (DGIST)
- International Journal of Knowledge Based Development (Scopus)
  - · Editor-in-Chief: Francisco J. Carrillo (Monterrey University of Technology)
  - · Invited Reviewers: YounTaik Leem (Hanbat National University) & Tan Yigitcanlar (Queensland University of Technology)
  - · Up to 8 articles would be accepted to the journal
  - · Based on a close tie with the journal, the organizing committee will do the best to make publications of papers selected.

General Issue Journals

- Knowledge Management Research and Practice (SSCI)
  - · Editor: Giovanni Schiuma (University of the Arts London)
- Measuring Business Excellence (Scopus)
  - · Editor: Giovanni Schiuma (University of the Arts London)

For more information, please contact:

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KCWS Chair
•Francisco Javier Carrillo(fjcarrillo@itesm.mx)

Memo

Memo

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