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Business Model, Open Innovation, and Sustainability in Car Sharing Industry—Comparing Three Economies

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Abstract: This paper discusses dynamics and differences of business models in the car-sharing industry and focuses on open innovation as the trigger of diverse business models among Uber in the U.S., DiDi Chuxing in China, and KakaoT in Korea. We seek to answer the following two questions: What creates the differences in the business models of the car-sharing industry? Do the differences in open innovation motivate the diversity of business models among Uber, DiDi Chuxing, and KakaoT? We incorporated participatory observation, interviews, and semi-structured questionnaire methods in our study. We used two-step participatory observation and interview methods, hence carrying out observation and interviews two times by different researchers with Uber drivers in the U.S., DiDi-Chuxing drivers in Beijing, and KakaoT taxi drivers in Korea to confirm the interview and participatory observation results. First, business models of the car-sharing firms Uber, DiDi-Chuxing, and KakaoT are not fixed but rather are dynamically changing. Second, business models of car-sharing firms are the result of interaction with government regulations, the taxi industry, public transportation, and the automotive car industry. Third, open innovation strategies of car-sharing firms determine the contents and dynamics of car-sharing business models, such as the revenue business model, responsibility business model, and system business model upon interaction with four agencies.

Keywords: car-sharing industry; open innovation; business model; Uber; DiDi-Chexing; KakaoT

1. Introduction

While the 20th century saw the beginning of the individual ownership era of the car, the sharing economy has arrived in the 21st century with diverse car-sharing models even though there are possibilities of the existence of digital divide and the socially unequal availability of the rede sharing initiatives [1,2]. Today, in the U.S., anybody can call a sharing car, identify the location of the car on a cyber map, pay without a card in hand, and evaluate the level of the sharing car driver from one to five stars [3]. If we have apps for car-sharing right now, we can live comfortably in the U.S., where the individual car ownership era started 100 years ago, without owning a car.

The sharing economy is exchanging the traditional manufacturing industry for a new service industry—the car-sharing industry. In this new service industry, the traditional factors of a service industry, such as the difference between individual entrepreneurs and individual owners, the business process of an entrepreneurial service firm, the financial resources motivation problem, etc., may be treated totally differently from the perspective of an open innovation platform [4–6]. For example,

franchise factors, such as trust, partnership, or the relationship between franchiser and franchisee, should be changed as open innovation, platform trust, data safety, etc., in the open innovation platforms of a sharing economy, such as Uber, Appstore, or Airbnb [7–10].

There are presently diverse different car-sharing business models in the world, including business to consumer (B2C) models, such as Zipcar and Car2Go, SOCAR, peer-to-peer (P2P) models, such as RelayRides, SnappCar, Getaround, and Drivy, short distance carpooling models, such as Lyft, Uber, SideCar, DiDi-Chuxing, KakaoT, and Grab, and long distance carpooling models, such as Carpooling.com, BlaBlaCar, and GoCarShare, as well as other ride sharing models, such as Coot Networks, Spinlister, and Boatbound [11,12].

This paper discusses the dynamics and differences of business models in the car-sharing industry and focuses on open innovation as the trigger of the diverse business models among Uber in the U.S., DiDi Chuxing in China, and KakaoT in Korea.

1.1. Research Questions

The main research question is as follows: What causes the differences in business models in the car-sharing industry? We additionally posed two detailed research questions: Does the difference in open innovation motivate the diversity of business models among Uber, DiDi Chuxing, and KakaoT? If so, what were the differences in open innovation and business models among Uber, Didi Chuxing, and KakaoT?

1.2. Research Scope

We used participatory observation, deep interviews, and a case study. In addition, we used literature reviews to validate the interview results. Through this kinds of qualitative research, we analyzed data from direct fieldwork observations, in-depth, open-ended interviews, and written documents, allowing us to arrive at more meaningful conclusions than in quantitative research in the case of a new industry analysis, such as car-sharing [13,14]. Participatory research including participatory observation breaks the linear mode of conventional research and focuses on a process of sequential reflection and action [15]. Furthermore, participatory observation, with the purpose to enable action at some level, emphasizes the research [16]. However, our participatory observation on the driving of a shared car was limited in terms of action because we interviewed the sharing car drivers with a semi-structured questionnaire. That is, we mixed participatory observation, interview, and questionnaire methods in our study [17]. Researchers in this study acted as participants at the outside of the target group, so to say sharing car drivers to experience under study, watch, and take field notes from a distance [18].

2. Literature Reviews and Research Framework

2.1. Literature Reviews

According to research in Korea, carpooling services have a significant socioeconomic cost-savings effect on traffic congestion, environmental cost reduction, and so forth, and will therefore play an important role in traffic demand management [19]. In China, the user community of an e-hailing platform enterprise, Didi-Chuxing, has grown larger than the size of the traditional taxi user community. This has motivated the success of this car-sharing economy business model in China with an increasing difficulty to control this market by the government [20]. Access or sharing-based consumption, defined as transactions that can be market-mediated, but where no transfer of ownership takes place, is becoming increasingly popular, but nonetheless is not well researched or theorized [21]. Even in the car-sharing industry, there is considerable diversity between, for example, Zipcar, which is based on an access base, and Uber, which conducts sharing very differently. In addition, the car-sharing industry has changed dynamically from the Car-Sharing Portland (CPS), which was the first car-sharing

organization in the U.S., to Uber today, and is being treated as a new approach to today's urban transportation problems [22].

In Europe, the early adopters of the car-sharing with the increase of information sharing devices in urban mobility have been largely motivated by diverse reasons such as environmental concerns and financial savings including excessive time for public transport, residential parking problems, major changes in the personal lives or mobility situations, or rising insurance costs or a lack of funds, to replace a vehicle [2,22]. The new floating car-sharing systems, such as Car2Go, can have environmental, social, and economic effects altogether, even though the effects can differ according to city characteristics or technological development [23]. It should also be noted that, until 2000, the car-sharing service was focused on addressing environmental issues, such as changing consumer behavior through eco-efficient services, environment friendly identity-promoting of car-sharing service users, or emissions reduction with car ownership reduction [24–26]. However, the development of professional car-sharing by environmentally concerned citizens did not remain but instead shifted to user-led innovation processes with additional market value with more attractive technologies, such as relocation algorithms for free-floating car-sharing systems [27,28]. The consumption of sharing and collaborative services, such as Airbnb, Zipcar, and Freecycle, is skyrocketing with their reliance on the internet, especially web 2.0. Web 2.0 collectively refers to websites that allow users to contribute content and connect with each other in the 21st century [29,30]. Zipcar is different from car-sharing organizations in the 20th century to the extent that it is a commercial car-sharing organization with a fleet of automobiles in North America and some European cities. Similar examples include Uber, DiDi-Chuxing, and KakaoT. The sharing economy now includes both social (relational, communitarian) and economic (allocative, profit-seeking) aspects that appear to be in tension [31]. The sharing economy thus lacks a shared definition so far, and some have argued that the sharing economy is not about sharing at all [32,33].

It should also be noted that, as car-sharing moves from an environmentally friendly lifestyle to a new kind of business, sharing economy firms such as Uber, Didi Chuxing, and KakaoT are disrupting traditional industries across the globe, for example, Airbnb in the hotel industry and Uber in the taxi industry [34]. The sharing economy thus has attracted a great deal of attention recently, and platforms such as Airbnb and Uber are experiencing explosive growth, which in turn has led to regulatory and political battles [35]. In many countries, regulation is often the most significant barrier to future growth of the sharing economy, which encompasses four broad categories: recirculation of goods, increased utilization of durable assets, exchange of services, and sharing of productive assets [34,35]. For example, the taxi industry of Shenzhen, China, which has a sufficient population for the taxi industry, is in serious danger with the growth of e-hailing and ride-sourcing by DiDi-Chuxing [36]. The interests of sharing economy firms and city governments are often aligned, but the failure to engage with potential regulators early on can raise the suspicion that companies are trying to exploit loopholes rather than develop a legitimate business model [37].

As information technology (IT) is spreading across industries in the fourth industrial revolution, new business models that challenge traditional business strategies emerge, namely, open innovation and open business models, which are the core of sharing economy firms, such as Airbnb, Uber, and others [38–40]. In a sharing economy, people, organizations, and communities as active participants produce or co-produce goods and services collaboratively or co-operatively, and sharing economy firms mainly pursue open innovation strategies and open business models [41]. Business models of a sharing economy are also fundamentally linked with technological innovation to the extent that business models mediate the link between technology and firm performance by openness and user engagement, which are known as open innovation business models [42]. The sharing economy can be used as an umbrella term for gig economy, on-demand service, and collaborative consumption and is based on the second IT revolution in the fourth industrial revolution [43]. The sharing economy has many diverse business models in four dimensions: technology, such as tech-driven, tech-enabled, and low/no-tech; transaction, such as market, alternative, and free; business approach, such as profit-driven, hybrid, and

mission-driven; shared resources, such as new resources, used resources, and under-utilized existing resources; and a governance model, ranging from traditional corporate structures to collaborative governance models [44]. Business models in the sharing economy share the following five factors: (1) largely market-based; (2) high-impact capital based platform; (3) crowd-based networks rather than centralized institutions or hierarchies; (4) blurring lines between the personal and the professional; and (5) blurring lines between fully employed and casual labor, which has a new kind of relationship of digital trust [12]. Most business models in the sharing economy can be evaluated as open innovation business models because a sharing economy means a crowd-based economy [12].

2.2. Research Method, and Research Framework

First, we carried out participatory observations and deep interviews with KakaoT taxi drivers in Seoul and Daegu, the first and third largest metropolitan cities in Korea, from 2 June to 5 August, 2018, with the semi-structured questionnaire provided in Appendix A and from 1st to 7th in Appendix B. In addition, we interviewed KakaoT taxi drivers in Wonju, a small city in Korea, from 27 November to 27 December, 2018 from 8th to 17th in Appendix B. These second interviews and the participatory observation were conducted by the Sangji University research team to confirm or validate the first interviews, and the participatory observation was conducted by the Daegu Gyeongbuk Institute of Science and Technology (DGIST) research team. In addition, for three drivers, we only included the conducted participatory observation as they declined being interviewed.

Second, we interviewed 13 Uber drivers from 1st to 13th in Appendix C in San Francisco on 17–23 August, 2018, with the semi-structured questionnaire presented in Appendix A. In addition, we interviewed six Uber drivers in West Philadelphia, near St. Joseph University during September 2018–February 2019. These six interviewees are listed in Appendix C from 14th to 19th. The second interviews were conducted by the St. Joseph University team to confirm or validate the interviews and participatory observation, seeing results were obtained by the DGIST research team of Korea.

Third, we interviewed 14 DiDi-Chuxing drivers in Beijing from 17 August to 23 August, 2018, with the same semi-structured questionnaire presented Appendices A and D. In addition, we carried out participatory observation and interviews of 10 DiDi-Chuxing drivers in Beijing in December 2018 to confirm the deep interview results from 15th to 24th in Appendix D. These additional interviews were conducted by the Tsinghua University research team to validate the first interviews and participatory results from the DGIST research team.

According to national strategy reports for 2025, open innovation is selected as a creative approach for the sharing economy in China. Government regulation structures often discourage such sharing economy innovations, reducing their popularity and slowing their development [45]. It should be noted that taxi drivers have cast Uber as an unsafe and rapacious competitor because it is a creative destruction actor at work, leading lawmakers to shut it out of various markets [46]. Many critics point out to consider who benefits from the sharing economy because the peer-to-peer economy or the gig economy does not benefit workers who are not working in the sharing industry but rather in the taxi industry or automotive industry [47]. However, the representative motivation of car-sharing such as lower carbon footprints has negative effects on the automotive industry because this industry will not grow in tandem as car-sharing is about economic self-interest rather than sharing and is predatory and exploitative [36]. In addition, competing industries or supporting industries of the car-sharing industry, such as public transportation, including buses and car parking systems, will have effects on the open innovation of car-sharing and the developing of business models of the car-sharing industry in addition to new regulations and customer protection from the non-balance of information, the vague distinction between private area and working area, and new social safety network requirements [12].

We want to analyze the car-sharing business model and open innovation of three firms in three countries based on the research framework in Figure 1. We selected four factors that affect the car-sharing industry open innovation, such as taxi industry, public transportation with parking, automotive industry, and government regulation. One reason we selected public transport here is that

ridesharing may have overall negative consequences for a city in several aspects such as promoting the shift from public transport to shared cars or an increase in vehicle kilometers travelled [48].

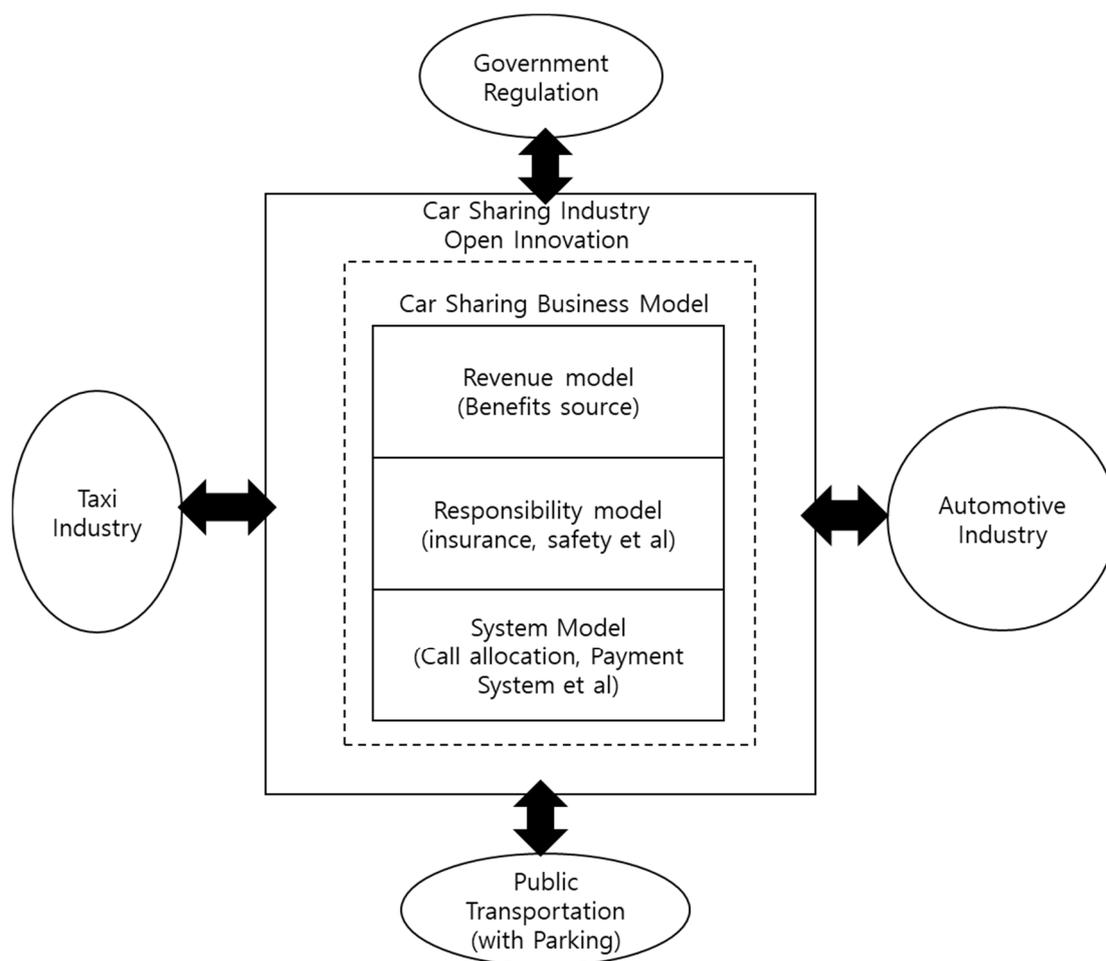


Figure 1. Research framework—car-sharing business model dynamics.

If you highlight this study, the difference in open innovation of car-sharing firms will lead to dynamic diversity of car-sharing business models, including revenue models, such as benefit source; responsibility models, such as insurance, safety; and system models, such as call allocation, payment system, etc. Business models have diverse factors, from nine-factor models to five-factor models, which have three factors in common: revenue model, responsibility model, and system model [49–52].

3. Business Model and Open Innovation of Uber

3.1. Revenue Business Model of Uber and Open Innovation

First, in regards to the revenue model, one Uber X driver receives 75% of customer payment, receiving it as his salary from Uber once per week. An Uber Black driver also receives 75% of customer payment. However, an Uber SUV driver receives 72% of customer payment every Thursday from Uber. An Uber-Select driver receives 70% of customer payment (Uber takes 20%–30% of the driver’s revenue according to their website, but there are two charges that go directly to Uber: “booking fee” and “safe ride fee” (around \$3 total). In short, with rides of five miles or less, the Uber driver cannot make more than \$10 per ride. This was learned from additional interviews on 14th–19th in Appendix C. Moreover, Uber drivers receive \$3 for each delivery for Uber-Eat. However, in some motivation events, Uber drivers sometime receive \$100 for a delivery for Uber-Eat.

Uber call payment increases with both distance and time, but distance has a greater effect on increasing the Uber fee than time has for each situation. However, if any Uber driver receives a call at any place where there are many calls from customers at a busy time, the fee increases dramatically. Therefore, there are large differences between Uber drivers in revenues according to the familiarity with busy places at busy times. In addition, if Uber drivers receive more than 70 calls between Monday and Thursday, they receive incentives of \$100–200 from Uber in addition to their salary. Many Uber drivers enjoy meeting diverse customers in addition to earning money.

Uber drivers expect tips from customers through the Uber App. However, 95% of customers do not give tips to Uber drivers. Furthermore, in the case of Uber Express Pool, if the customer does not appear at the target place, the customer has to pay a \$5 penalty. When Uber-Select drivers go to airports, Uber pays the airport entrance fee of five dollars to the Uber driver. Moreover, if the Uber car does not arrive in 10 minutes after the call, he or she can cancel the call and receive a \$3 payment from Uber.

The high regulations of the San Francisco city government and the U.S.A. federal government, with a high ratio of car drivers and severe traffic and little parking downtown, allowed Uber to prepare a diverse and dynamic differential payment system (Figure 2). Continuous complaints from the taxi industry and continuing criticism from the news led Uber to promote several diverse incentive systems for Uber drivers.

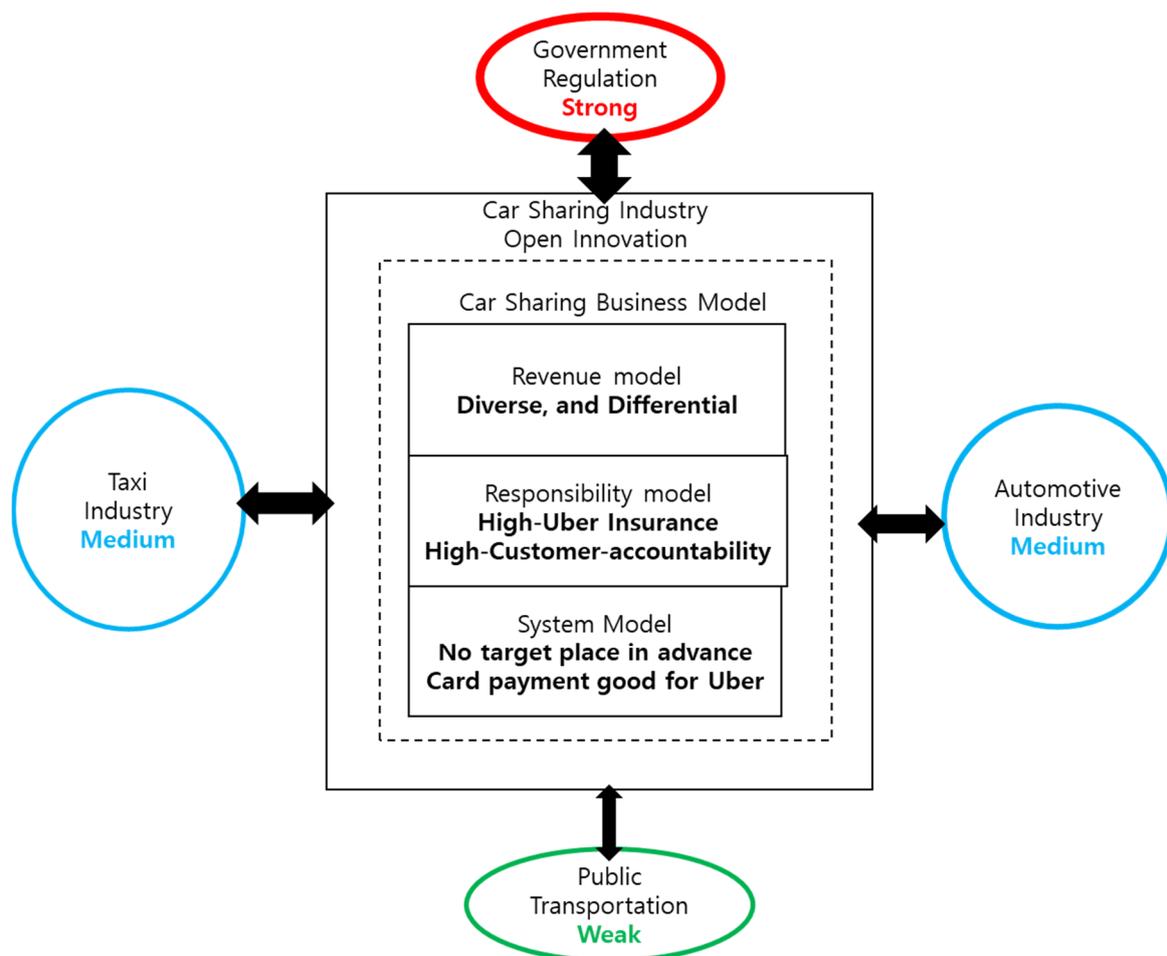


Figure 2. Business model and open innovation of Uber. Source: authors’ own.

3.2. Responsibility Business Model of Uber and Open Innovation

Uber-X drivers are supposed to register for individual insurance like normal drivers. However, accidents during driving with Uber customers are fully covered by Uber in the case of Uber-X

(The general requirements of Uber drivers according to additional interviews in Philadelphia are as follows: ① need to be 21 or older, ② licensed driver in the U.S. for 1 year (≥ 3 years if under age 23), ③ need to have a four-door vehicle that is ≤ 10 years old and in good condition (in Philadelphia ≤ 15 years old vehicle), ④ no vans, box trucks, taxi cabs, government cars, or rebuilt vehicles, ⑤ in-state auto insurance, ⑥ pass vehicle inspection (working seat belts), ⑦ in-state driver license, ⑧ proof of residency in your city and state, ⑨ need to pass driver screening (online review of driving record and criminal history)). However, Uber-Black drivers are supposed to register for commercial insurance, and accidents are also covered by the individual commercial insurance. Uber-express drivers are supposed to also register for commercial insurance, and accidents are covered during Uber driving by the individual insurance. In contrast, Uber-Select does not require individual commercial insurance and no commercial driver license, which are required for Uber-Black and Uber-Express drivers.

Uber has diverse safety systems for the car, driver, and customer together. The Uber driver's photo and all information of the driver are protected in addition to the information of the customer, including phone number, etc. One Uber-Pool customer said that she uses Uber-pool four times per day because of the low price, and always felt safe, even when riding with other customers. Several female customers who use Uber-Pool talked that they normally use Uber-Pool, with the exception of using Uber-X when they are in a hurry because it is cheap and safe.

Furthermore, in the case of a customer vomiting inside an Uber car, if the Uber driver reports the situation to Uber, Uber will pay 400 dollars to the driver in advance and receive payback from the customer later. Similarly, if an Uber customer damages an Uber car, the Uber driver can receive compensation from Uber directly if the driver reports the damage. In this case, Uber also pays a compensation for the damage of the Uber car directly to the driver and receives the money from the customer later.

If anybody wants to become an Uber driver, the candidate should provide an identity card (ID), health reports, criminal record, car information, insurance for the car, a financial credit report, and driver license, and should await the results for three weeks. Uber gives the first candidate a one-year Uber license and checks the driver again after one year. According to Uber drivers' self-evaluation, they, in addition, have usually two or more jobs. The ratio of women among all Uber driver was almost 5%. The female Uber drivers said that they did not feel any danger in driving an Uber car. Uber drivers can choose to reject any customer if the driver feels unsafe, such as in the case of not having a baby seat when the customer has a baby.

Most of all, the safety requirement from the government regulation let Uber to set up individual commercial insurance and a commercial driver license for Uber drivers [53]. An additional requirement from the public transportation agencies and firms induced Uber to set up Uber insurance for Uber customers during riding Uber except when riding in a premium Uber car. In the next step, Uber should prepare a safety system for Uber cars and drivers. Although an appropriate and related system for Uber drivers to reject any customer if he or she feels danger from the customer was controversial because of the possibility of racism, it was accepted into the Uber system because of the high safety requirement for Uber drivers by government regulations, the current conditions of the taxi industry, and the high standard of safety of public transportation (Figure 2).

3.3. System Business Model and Open Innovation of Uber

Uber provides diverse system models that connect the customer and Uber driver through a technological platform. An Uber-Pool driver cannot reject additional customers at the system even if there is not additional revenue for the driver to carry more customers in the Uber Pool driving. In addition, Uber has two different customer allocation systems. The first is, Uber allocates customers according to the destination where the Uber driver has registered in advance. The other is that the Uber system allocates customers to the nearest Uber driver. Basically, the Uber system allocates calls to Uber drivers. However, Uber drivers can cancel the allocation by the Uber system. However, when the Uber driver goes home, a call allocation requirement coinciding with the homeward direction is

possible. In addition, before the Uber driver arrives at any destination, a new Uber call allocation is possible. For example, when we went to a shopping center near Stanford University, the Uber driver received the next Uber call allocation during driving with us, now customers. If Uber drivers are at places where there are not many Uber cars, the in-advance Uber call allocation system during driving other Uber calls is apt to answer the Uber customer early.

Uber customers normally pay the fee in advance with a registered credit card. In addition, the Uber customer's information is unknown to the driver before leaving the car. The Uber customer can pay tips additionally. In the Uber payment system, long-distance driving is not advantageous for the Uber driver because the distance is not accurately included in the calculation of the fee according to the answers or attitude of Uber drivers. In the case of Uber-Pool and Uber-X, the in-advance proposed fee does not change after the Uber car arrives at the destination. Uber pays the received Uber fee through a card system to the Uber driver in diverse ways, ranging from daily payment for early registered long-serving Uber drivers to 3–4 days at a time, and one time per week on fixed days in addition to a one-time payment roughly once a month. That is, Uber pays money to Uber drivers in very diverse ways according to the driver's situations, such as the career of the Uber driver, one day average driving time of the Uber driver, the frequency of Uber driving in one week, or the amount of Uber customers for the Uber driver.

What is important is that Uber drivers cannot know the destination of the called customer before the call is accepted and the Uber car takes in the customer. Uber drivers can reject Uber-pool in advance. However, if the Uber driver accepts Uber-pool, the driver can use fast roads that were indicated to the car when they have more than two customers, which is very important for fast driving in San Francisco. According to female Uber drivers in the San Francisco region, Uber was allocating 70% Uber-pool and 30% Uber-X to female Uber drivers. In case of Uber-pool drivers having customers in many places at the same driving courses, the fee increases. An Uber-pool system like this was a special Uber allocation system that was just being used in limited metropolitan cities, such as San Francisco, New York, and Los Angeles in the U.S., according to an Uber driver in San Francisco.

Weak public transportation systems, high customer privacy by public regulations, and differentiation from taxis in paying system requirements of the taxi industry allow Uber not to show the destination to the driver and keep the driving information confidential, as well as a diverse Uber payment system according to individual to the Uber driver (Figure 2).

4. Business Model and Open Innovation of DiDi-Chuxing

4.1. Revenue Business Model and Open Innovation of DiDi-Chuxing

DiDi-X drivers receive 80% of revenues that the customer paid to DiDi-Chuxing. DiDi drivers can drive the DiDi car for 12 hours per day, and the 12 hours are calculated from the DiDi operating time. DiDi-Premier drivers receive 74% of revenues. The fee of DiDi-Premier is 20% higher than DiDi-X, and the former earns 20% more than DiDi-X drivers. The fee of DiDi-Luxury is five times higher than that of DiDi-X, and three times more expensive than DiDi-Premier. The total number of DiDi-Luxury cars is just 200, and 75% are owned by DiDi-Chuxing itself and 25% by individuals, according to the DiDi drivers our research team interviewed. A DiDi-Luxury driver is supposed to upload six photos every morning before driving. DiDi owned luxury car drivers earn 10,000 yuan for one month with a one-time and weekly payment from DiDi-Chuxing. The fee of DiDi-Pool is 10% lower than the fee of DiDi-X. However, DiDi drivers do not mind choosing DiDi-Pool because the customer number of DiDi-Pool increases and the income of the DiDi driver also increases.

According to the interviews with DiDi drivers, if the distance of DiDi driving increases, the revenue of DiDi-Chuxing increases. If customers pay through Alipay, Alipay gives a small incentive to the drivers as a kind of Alipay promotion in DiDi-Chuxing. If a DiDi driver cancels the allocation more than four times, the driver pays some amount to DiDi-Chuxing. Among DiDi, only DiDi-Luxury can be booked in advance.

If DiDi customers cancel with a reason, the DiDi driver cannot receive compensation money from DiDi-Chuxing even though there are 1–2 times customer cancellations per day. However, in the case of cancellation with no reason by the customer, DiDi-Chuxing pays per 1 km 1 CNY to the DiDi driver. Notably, DiDi-Chuxing gives compensation money of 108 CNY to DiDi drivers for long-distance routes according to the requirement of the customer. DiDi-taxi drivers do not pay money to DiDi-Chuxing, even though among the one-month revenue of 8200 CNY, 3000 CNY is from DiDi calls according to our interviews. Moreover, DiDi-X drivers are required to drive DiDi for at least eight hours per month according to DiDi-Chuxing. DiDi-Luxury can additionally increase the fee by 0.1% at peak times.

What is important is that the revenue of DiDi drivers is more than two times the university-graduated manpower salary at minimum under the weakness of the taxi industry in China and the automotive industry with the support of the Chinese government with a weak regulation power (Figure 3). Many taxi drivers who have cars and are in good condition to work as DiDi drivers moved to DiDi from their occupation as a taxi driver. DiDi-Chuxing is being treated by the Chinese government as a kind of people’s revenue increasing engine according to the deep interviews with DiDi drivers (Figure 3). Several DiDi drivers really moved to DiDi driving after losing their job according to our interviews.

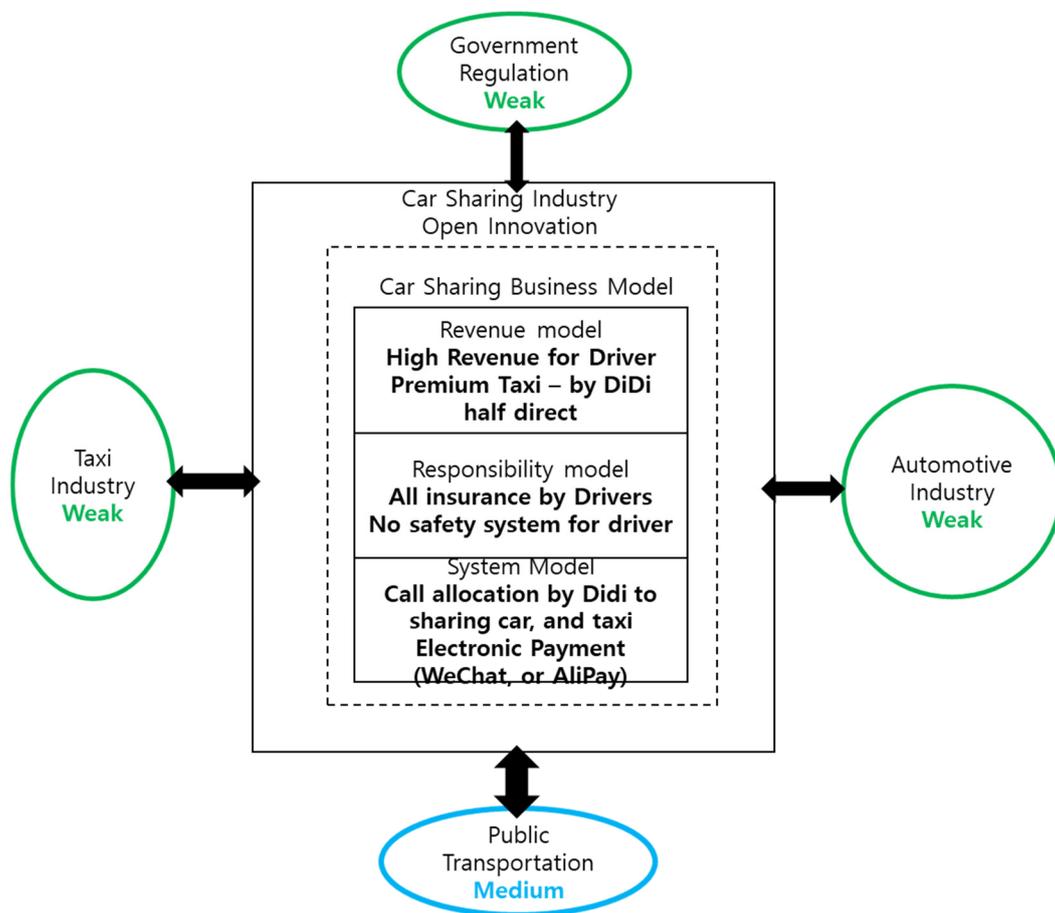


Figure 3. Business model and open innovation of DiDi-Chuxing. Source: authors’ own.

4.2. Responsibility Business Model and Open Innovation of DiDi-Chuxing

DiDi drivers, without exception, are supposed to cover all DiDi-Car insurances and accidents during DiDi driving by their own insurance. DiDi-Premier drivers are supposed to prepare apt cars, pass an examination and interview, dress up in required attire when driving, and upload photos of themselves and the car’s condition before driving. DiDi-Luxury drivers must fulfill the following conditions: good appearance; at least high school or university graduation; five years of driving

experience; a luxury car, such as an Audi A6 or higher, BMW 5 or higher, Mercedes-Benz E or higher; upload six photos every day (According to additional interviews in Beijing, the DiDi drivers are additionally required the following: possess a local licensed vehicle, price of the car over 70,000 CNY, and age of the car less than 8 years; have C1 or above driving license, and driving experience of more than three years. This was learned from additional interviews on 15th–24th in Appendix D).

Notably, DiDi drivers cannot reject customers who carry pet animals without any protection condition according to DiDi driver interviews. Even though it is not covered by the insurance, DiDi-Chuxing announced that it will cover all criminal damages to customers when using DiDi-Chuxing. DiDi customers prefer DiDi-X over DiDi-Pool because they feel that DiDi-X is safer than DiDi-pool even though it is a little more expensive than DiDi-pool.

DiDi drivers are required to have a driver's license, individual insurance, be under 55, a clean criminal record, and no tattoos. However, DiDi-Chuxing does not require a health check of the DiDi driver. During our interviews, we witnessed a case which differed between DiDi drivers in the platform and actual DiDi drivers of the car. We felt danger and canceled the booking. The DiDi driver should have stopped driving during high-traffic time. DiDi-Chuxing followed up with the customer and gathered customer information for customer safety. However, in the case of long-distance driving, many DiDi-drivers did not want to drive, and several times they required customers to cancel the calls in our interviews and experience, as there is no system that confirms any customer can come back in the same car.

In Beijing, DiDi-Chuxing started as a booking service for taxis, moved to car-sharing booking without a high complaint from the taxi industry, and received permission from the Beijing government, which has weak regulations on the sharing economy (Figure 3). In China, automotive complaints against DiDi-Chuxing were also weak because DiDi-Chuxing lets people buy cars to use on their own as well as for car-sharing. In DiDi-Chuxing, the responsibility of the DiDi driver is high regarding insurance, dress code, and car requirement because of the weak regulations of the government and the weak power of the taxi industry.

4.3. System Business Model and Open Innovation of DiDi-Chuxing

DiDi-Chuxing basically allocates calls from customers within 3 km, although the allocation boundary is being widened now. However, recently, DiDi-Chuxing added a destination basic allocation system in which DiDi drivers can announce a destination place and escaping place. DiDi-Chuxing allocating systems have two modes: the selection mode, which started in July 2018, allows the DiDi driver to select the destination, including long distance; the allocation mode allocates calls to DiDi drivers nearby. If a DiDi driver cancels the calls, stars which indicate the level of the DiDi driver decrease. DiDi-Chuxing tends to allocate DiDi-X to veterans and DiDi-pool to the beginning drivers according to our interviews.

DiDi customers use payment methods such as Wechat-Pay, AliPay, DiDi-Pay, and so on. DiDi customers can change the payment methods when they pay for any DiDi-Chuxing usage. The DiDi-Chuxing car-sharing fee moves from the customer to DiDi upon being sent by the customer. If the customer did not pay, he is supposed to pay the fee before next using DiDi-Chuxing. In the case of long-distance driving in Beijing, the DiDi system raises the fee up to 30% to cover the financial damage to the DiDi driver.

In the case of DiDi-Premier, there are differences between the in-advance announced payment amount and the real payment amount after driving. However, there were nearly small differences in these two amounts. The money may be paid a little late after driving even though the customer's money is directly allocated to the driver's bank account. More specifically, actual payment occurs two days after the customer's payment, or a one-time weekly payment is made. DiDi-Premier currently receives a distance fee, low-speed fee, and long-distance fee. DiDi-Luxury receives a long-distance basic fee and fast call allocation fee additionally. DiDi-Chuxing has a 3 km base call allocation system with a trend toward expansion of the allocation distance from over 3 km up to 10 km in the case

of DiDi-Luxury because of weak government regulations and medium-level public transportation conditions (Figure 3).

5. Business Model and Open Innovation of KakaoT

5.1. Revenue Business Model and Open Innovation of KakaoT

When we interviewed taxi drivers in Daegu and Seoul in May–June, we learned that taxi drivers earned at least 30% more revenue from KakaoT Taxi calls because most taxi customers call taxis through KakaoT [54]. Even though KakaoT introduced the first allocation call service if a customer paid one dollar (60% KakaoT; 40% taxi driver), until June 2018, customers nearly never used the payment call allocation system. KakaoT contains of a lot of revenue business models like Table 1, but most of them are free.

Table 1. Diverse revenue business model of KakaoT.

Category	Service	Revenue	Situation
Taxi	Taxi Call	Basic-Free Premium Call-1 \$	Premium Call is not vitalized
Black	Premium Taxi Call	Call-payment	Revenue small because service in Seoul and Incheon Reservation service added in January 2019
Driver	Substitute driving	Payment	Good platform now but not big service
Parking	Parking service	Payment	Not big revenue
Navigation	Road Guidance	Free	Skyrocketing but free
Car-pool	Ride-Sharing	Payment No Service Yet	Major complaints from the taxi industry
Food delivery	Platform and delivery	Payment	This service is not in KakaoT but in KaKao

Source: authors own by interviews in May–June and November–December 2018, and news on 28 January 2019.

According to an interview with the CEO of KakaoT, Jeung JuHwan, on 7 February 2019, KakaoT itself grew up and expanded its diverse business models through diverse merger and acquisition (M&A) or other open innovation channels, such as the merging of the KimKiSa navigation company in 2015, merging of ‘Parking Square’ parking reservation company in 2016, collaborating with Daum map, and the merging of ‘Luxi’, a car-pool company, in 2018.

Taxi drivers said that the waiting time for customers decreased, and they were able to receive calls even though the taxi went outside the downtown area through KakaoT. In addition, the increase of revenue of taxi drivers by KakaoT lets taxi drivers pay the revenue tax because measuring the taxi driver’s income became possible.

In Korea, in the situation of a strong taxi industry, a strong public transportation industry, and a strong automotive industry, KakaoT could not set up a real ride-sharing payment revenue system like Figure 4. In response, KakaoT prepared a new revenue business model, such as substitute driving, and it also faced the complaints of existing industries (Table 1). Diverse existing industries made it difficult for KakaoT to make enough revenue in the ride-sharing system. The pressure from the taxi industry to stop the ridesharing service of KakaoT is a hot topic. The growth of KakaoT call usage by taxis is not being motivated by KakaoT taxi drivers but the KakaoT taxi consumers. Consequently, even though taxi driver organizations try not to use KakaoT, because most customers of taxis call taxis by KakaoT, they do not have other choices.

Meanwhile, regarding the business of food delivery service, KakaoT is not operating a model even though it is popular in Uber and DiDi-Chuxing.

5.2. Responsibility Business Model and Open Innovation of KakaoT

A KakaoT call taxi driver can easily register at KakaoT with a taxi license and a photo without any health information, criminal reports, or financial reports, which are normally required for Uber and DiDi-Chuxing drivers.

KakaoT taxi drivers can only see the cyber phone number of the customer, which disappears after 30 minutes. Furthermore, the KakaoT taxi booking system does not give the customer a chance to book any taxi driver to protect the taxi driver’s business. At present, the KakaoT taxi booking system does not give any insurance service to taxi drivers to protect the driver and car from the customer.

In Korea, the taxi industry did not prepare an adequate responsibility model to protect drivers from customers, and the opposite is also true because the Korea Taxi industry did not have any rival industry until now. The responsibility business model of the car-sharing industry of Korea did not launch because a revenue business model of the car-sharing industry was not developed. However, the responsibility business model of car-sharing will be a new breakthrough in the process of developing the car-sharing industry (Figure 4).

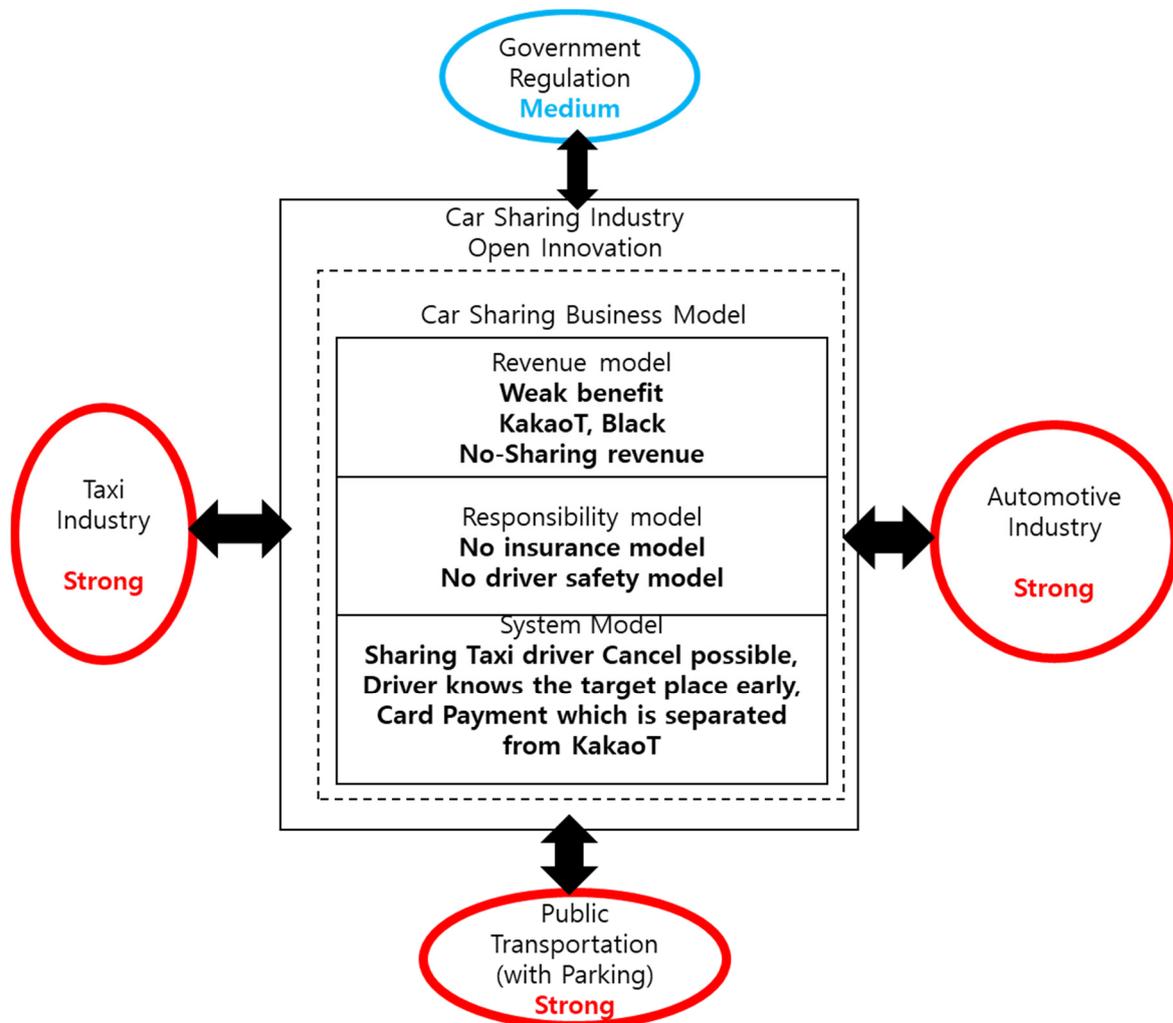


Figure 4. Business model and open innovation of KakaoT. Source: authors’ own.

The car-sharing industry is a possible solution for unemployment and low-income labor through Uber in San Francisco and DiDi-Chuxing in Beijing. The way to respond to the powerful taxi industry, high regulations, and the powerful automotive industry by the car-sharing industry was the fascination of the responsibility business model in the cases of Uber and DiDi-Chuxing.

5.3. System Business Model and Open Innovation of KakaoT

KakaoT taxi drivers can know the destination of the customer in advance and cancel the call if the destination is not a good route for the driver. This allows drivers to select customers in the KakaoT taxi system. KakaoT changed the customer's destination to blank for the driver one time. However, they had to let the drivers again know the destination of the customer because of high complaints from taxi drivers.

If 200–300 calls are accumulated for any taxi driver, an alarm signal appears in the system and the call opportunities to the driver decrease. Notably, there were many cancellations from KakaoT customers after calls because the cancellation from the customer was not subject to any serious penalty from KakaoT. However, if a KakaoT taxi driver goes to the destination without following the navigation or the customer requirements, a penalty is given to the driver if the customer complains. A customer complaint-based penalty to the driver is decided in this case. Similarly, the one-day one-time first allocation service to KakaoT taxi drivers can be useless if the call is cancelled by customers.

Until now, the KakaoT payment system does not have any dominant payment system, such as a credit card or electronic payment system.

The KakaoT taxi call system, which is the most popular in KakaoT and really operating, is in strong opposition to the strong taxi industry, a strong public transportation system, and a strong automotive industry without enough ride-sharing services developing in KakaoT (Figure 4).

6. Comparison of Three Firms and Discussion

6.1. Comparing Three Car-Sharing Firms in Different Economies

According to Table 2, government regulation goes the same direction with the responsibility model. For example, Uber is high in government regulation and responsibility model such as insurance for the driver. Contrary to this, DiDi Chusing is weak in government regulation and responsibility model such as no insurance for the driver by the sharing platform firm.

Table 2. Comparing open innovation and business models of 3 firms.

3 Car Sharing Firms in Different Economies		Uber	DiDi Chusing	KakaoT
Conditions of 4 open innovation channels	Government regulation	Strong	Weak	Medium
	Taxi industry	Medium	Weak	Strong
	Public transportation	Weak	Medium	Strong
	Automotive industry	Medium	Weak	Strong
Business model of Car sharing firms	Revenue model	Diverse, and Differential	High Revenue for Driver, Premium Taxi-by DiDi Chusing half direct	Weak benefit KakaoT Black, No-Sharing revenue
	Responsibility model	High-Uber Insurance High-Customer-accountability	All insurance by Drivers, No safety system for driver	No insurance model, No driver safety model
	System model	No target place in advance, Card payment good for Uber	Call allocation by Didi to sharing car, and taxi Electronic Payment (Wechat or Alipay)	Sharing Taxi driver cancel possible, Driver knows the target place early, Card payment which is separated from KakaoT

Source: authors own.

Second, if the taxi industry is strong, the revenue model is weak according to KakaoT. However, if taxi is weak, like DiDi Chusing, the model shows high revenue. So to say, if there exists strong industry, it is difficult for the sharing industry to make enough revenue without changing government regulations to protect existing industry.

Third, the system model goes same direction with government regulation according to Uber, and DiDi Chuxing. So, the system model of carsharing should consider government regulations in addition to factors influencing matching of ride-hailing services using machine learning methods [55].

Fourth, strong conditions of four open innovation channels deter car sharing business models according to Uber, DiDi Chuxing, and KakaoT. This means that strong, open innovation channels decrease open innovation and diminish the business model of the car sharing industry.

The differences of three car sharing firms are motivated by context elements of three different economies that are institutional, socio-economic, and cultural features. Though to completely answer “What extent may facilitate or impede these the development of sharing initiatives is another research topic?” is another research topic, we could discuss contexts factors of car sharing firms of three different economies based on participant observations, and deep interviews with car-share drivers.

First, in the case of institutional context, less permission for innovation is needed and application is possible in the US economy. However, in Korea economy, any innovation requires permission in advance. In China, permission for innovation can be processed fast according to the situation. This difference of institutional contexts of 3 economies has a high correlation with the growth of car-sharing industries according to our field research.

Second, in the case of socio-economic contexts, the US has a mature capitalism socio-economy, which has regulation standards for the sharing economy. However, China does not have a mature capitalism socio-economy and does not have regulation standards for the sharing economy. Korea has a late matured capitalism socio-economy and has wide regulation standards for the sharing economy.

Third, the US has a very diversity-oriented culture which gives motives of developing car the sharing economy in that nearly all Uber drivers enjoyed meeting diverse customers who have diverse cultures. However, because China and Korea have non-diversity-oriented cultures compared to the US, car sharing drivers did not enjoy meeting diverse customers according to our interview.

6.2. Discussion: Causal Loop Modeling of Business Model Dynamics of the Car-Sharing Industry

In our case studies, according to the power of the taxi industry, government regulations, the automotive industry, and the public transportation system, the car sharing business model can be different. First, a strong taxi industry can motivate developing responsibility business model(BM) and system BM, even though revenue BM is surpassed, as in the cases of Uber and KaKao-T. In contrast, a weak taxi industry motivates the revenue BM and system BM with a decrease in responsibility BM, as with DiDi-Chuxing. Second, strong government regulations can motivate responsibility BM and system BM, even though revenue BM can be harmed, as with Uber. However, weak government regulations can increase revenue and lead to a system model without responsibility BM, as with DiDi-Chuxing. Third, a strong automotive industry can decrease the revenue model indirectly with a direct or indirect increase of responsibility, and system BM, like KaKao-T. However, a weak automotive industry can motivate revenue and system BM directly and indirectly, with control of responsibility BM, as with DiDi-Chuxing.

From this case study, we developed a causal loop model of the car-sharing industry in Figure 5. Car-sharing business models are diverse and different from each other according to the market potential, urban geographical conditions, and other industries such as the taxi industry, knowledge conditions including regulations, and so on, as illustrated in Figure 5, which is not linear but rather a dynamic system with diverse loops [56,57].

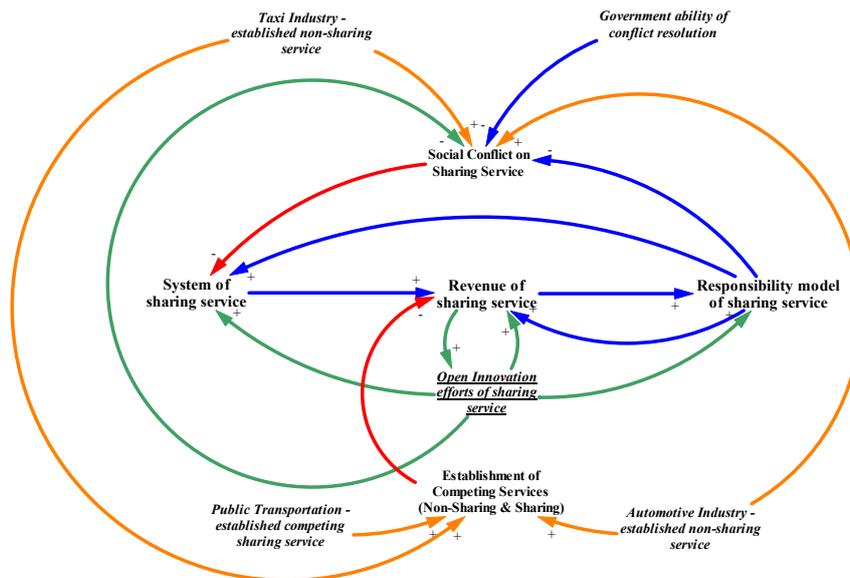


Figure 5. Causal loop model of the car-sharing industry

There are three basic components in the business model in the sharing industry: system, revenue, and responsibility. A mutual reinforcing loop exists between these three basic components of system, revenue, and responsibility. To start BM in the car sharing industry, at first, ‘System’ is required to start the business. The ‘System’ includes call allocation, payment, etc. ‘Revenue’ can then be earned by providing a sharing service through the ‘System’. With the ‘Revenue’ generated from the ‘System’, we can invest in a ‘Responsibility’ system. Increased ‘Responsibility’, such as insurance, safety, and maintenance, will again positively impact the ‘system setting’ and ‘revenue generation’.

- [Basic Loop 1] (Basic reinforcing loop between system, revenue, and responsibility) System of sharing service (System) → Revenue of sharing service (Revenue) → Responsibility model of sharing service (Responsibility) → System of sharing service (System)
- [Basic Loop 2] (Basic reinforcing loop between revenue and responsibility) Revenue → Responsibility → Revenue

‘Open innovation efforts (OI)’ has positive impacts on accelerating basic reinforcing loops between system, revenue, and responsibility. OI can has its positive accelerating effects through all of system, revenue, and responsibility.

- [OI-impacts—System] (Positive impacts of OI in accelerating basic reinforcing loop; through System) Open Innovation efforts of sharing service (OI) → System → Revenue → Responsibility → System
- [OI-impacts—Revenue] (Positive impacts of OI in accelerating basic reinforcing loop; through Revenue) OI → Revenue → Responsibility → System → Revenue
- [OI-impacts—Responsibility] (Positive impacts of OI in accelerating basic reinforcing loop; through Responsibility) OI → Responsibility → System → Revenue → Responsibility

‘Social conflict on sharing service (Social Conflict)’ can has very crucial and undesirable reinforcing relationship with the basic loop. This reinforcing loop can be a ‘Vicious Cycle’ that is destroying the entire sharing service business model. However, if we can manage the social conflict successfully, it can also be converted into a ‘Virtuous Cycle’ that can boost the sharing service, and social conflict itself will also diminish with the successful sharing service and its enhanced responsibility to protect the drives and passengers.

- [Social Conflict—Vicious] (Social Conflict Reinforcing Loop - When Vicious Cycle) Social Conflict ↑ → System ↓ → Revenue ↓ → Responsibility ↓ → Social Conflict ↑

- [Social Conflict—Virtuous] (Social Conflict Reinforcing Loop - When Virtuous Cycle) Social Conflict ↓ → System ↑ → Revenue ↑ → Responsibility ↑ → Social Conflict ↓

In fact, the above vicious cycle and virtuous cycle have exactly the same structure. It is only one single identical reinforcing loop that could not be differentiated, only the directions of the reinforcing effects are opposite. Here, for convenience of understanding, we nonetheless differentiated it into a vicious cycle and a virtuous cycle.

Because of the impacts of social conflict come through the reinforcing loop, if social conflict could not be managed in the early stage of sharing service emergence, the sharing service could not start and will quickly disappear. Therefore, managing 'Social Conflict' is very important and crucial in nursing the sharing service and sharing economy in an economy.

In managing social conflict, the government's role and ability to manage and reduce social conflict is very important in nursing the sharing economy and making the economy advanced, especially in the era of the fourth industrial revolution.

- [Government role and ability in Conflict Resolution—Virtuous Cycle Making in sharing Economy] Government ability of conflict resolution (Government) ↑ → Social Conflict ↓ → System ↑ → Revenue ↑ → Responsibility ↑ → Social Conflict ↓ → System ↑

Open Innovation (OI) efforts of sharing service also can have huge impacts on reducing and managing social conflict. It is one of the best advantages of being opened to the economy and the society not to be excluded but easily accepted by other society entities and stakeholders.

- [Positive effects of OI in Social Conflict Management] OI ↑ → Social Conflict ↓ → System ↑ → Revenue ↑ → Responsibility ↑ → Social Conflict ↓ → System of sharing ↑

Because of two strong, positive effects of OI, (a) basic reinforcing loop acceleration of sharing business and (b) Social conflict management, Open Innovation entails very important efforts that a sharing service provider must make to develop their service and business model to be vital and prosperous.

'Establishment of Competing Service (Non-sharing and sharing)' are important environmental conditions for sharing service necessity and prosperity. With the high availability of competing services, that is availability of 'Taxi industry', 'Public Transportation', and 'Automotive industry (owner driving)', the necessity and success possibility of sharing services are relatively small. On the other hand, when availability of competing services, that is, availability of 'Taxi industry', 'Public Transportation', and 'Automotive industry (owner driving)', is low, the necessity and success possibility of sharing services are relatively great.

- [Impacts of Competing Service—'High Availability' of Competing Service] Taxi industry, Public Transportation, Automotive Industry (owner driving) ↑ → Establishment of Competing Service (non-sharing and sharing) ↑ → Revenue ↓ → Responsibility ↓ → System ↓ → Revenue ↓
- [Impacts of Competing Service—'Low Availability' of Competing Service] Taxi industry, Public Transportation, Automotive Industry (owner driving) ↓ → Establishment of Competing Service (non-sharing and sharing) ↓ → Revenue ↑ → Responsibility ↑ → System ↑ → Revenue ↑

In the car-sharing industry, (1) establishment and availability of a competing non-sharing service, that is, the taxi industry and the automotive industry (owner driving), (2) establishment of competing sharing service, that is, public transportation, can be very important influencing factors for the necessity and success possibility of a car-sharing service. In addition, not just the system, but also 'price' is an important factor that determines the availability of a competing system. As an example, if a taxi system is well constructed but the price is too high, then we can conceive that the availability of taxi usage is relatively low because of its high price. In this case, the need and success possibility for a sharing car service with a relatively low price will be higher. The conditions of availability and establishment of

the taxi industry, automotive industry (owner driving), and public transportation differ by country. Also, social conflict resolution on the sharing service can differ by country.

In this light, we can expect the car sharing service will demonstrate different aspects of development, country by country, dependent on the establishment of competing service and social conflict resolution of each country. That is to say, developing a business model of the car-sharing industry can be a strategic selection among diverse levels of open innovation in the conditions of taxi industry, government regulation, public transportation, and automotive industry.

7. Conclusion—Implication, Finding, and Future Research Target

7.1. Implication—Environmental and Economical Sustainability

Diffusion of carsharing services and related industries can motivate environmental sustainability in several aspects [58]. First, according to car-share drivers, the carsharing industry can decrease the consumption of fossil fuels, which will cut down the emission of CO² in the air. Second, carsharing diffusion can decrease the consumption of cars, which will decrease diverse pollution from car production. Third, the increase of carsharing industry will cut down the expansion of public roads, which can destroy forests, and farms by diminishing cars on the roads.

The carsharing industry can also motivate economical sustainability in several aspects as follows [59]. First, this industry can be a new change for job creation in the fourth industrial revolution, which normally motivates economy growth with the increase of unemployment according to interviews of several car-share drivers [20,60,61]. Second, the carsharing industry can increase the revenue of a household without investing additional money to create new chances. Normally, in every household, they could earn money by working on their own time, and not using their own car similarly in US, or China according to our interview. Third, if caring sharing platform companies expand their role as employers such as (1) providing insurance to drivers, (2) giving balance between freedom and responsibility to drivers, or (3) paying taxes to the government platform, etc., the carsharing industry will create new chances for industry in the fourth industrial revolution [62,63].

7.2. Finding and Contribution of this Study

First, the business model of car-sharing firms such as Uber, DiDi-Chuxing, and KakaoT is dynamic in so far that business models of car-sharing firms are always changing in the interaction with four agencies, such as the taxi industry, government regulations, public transportation, and automotive industry as new learning mode of the fourth industrial revolution [64,65].

Second, the business model of car-sharing is also changing dynamically according to the open innovation level and strategy of the car-sharing companies [66]. So to say, the dynamics and differentiation of business models of the car-sharing firm depends greatly on the open innovation level and strategy of the firm, which are dependent of the power of the four agencies, and interactions with them. The powerful open innovation of car-sharing firms will produce creative business models in revenue, responsibility, and system BM.

The most important finding of this research is the dynamic characteristics of the business model of the car-sharing industry, which has an intensive relationship with the degree of open innovation of the car-sharing firm and the power of four agencies and the interactions among them.

7.3. Limits and Future Research Target

First, we should research the customer aspects of car-sharing industry because the possible differences between ridesharing companies may come from some level of differences in the number and situations of clients they reach. So, the research on customers of car sharing in diverse contexts will be the future research target.

Second, concrete and dynamic roles of the taxi industry and government regulation in developing the car-sharing business model were not analyzed. So, the study on the role of taxi industry and

government regulation in evolving the car-sharing business model should be studied as intensive case studies.

Third, in this study, we did not analyze the evolution of the carsharing business model. So, the business model evolution of each car-sharing firm will comprise another future research topic to understand the car-sharing industry business model more clearly.

Fourth, we did not study success factors of the car sharing business model in any concrete conditions. So, the dynamic success conditions and contents for the ride-sharing business model should be studied within the following research topic. As the core of the car-sharing industry is ride-sharing, we should focus on the ride-sharing business models and their dynamic evolution to understand the success factors of the carsharing business model in the next research target.

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Appendix A

Semi-structured questionnaire to interview car-share drivers (Uber, DiDi Chuxing, or KakaoT SW using car).

1. How did you become a car-sharing driver?
2. What kind of process does the car-sharing service require you to accept and maintain as the car-sharing driver?
3. What is the utilizing ratio of car-sharing for one month, and how many hours a day do you work as a car-sharing driver?
4. What is the revenue for one day and one month from the car-sharing service?
5. How does the car-sharing center arrange the call when a customer calls? Can you as the sharing car driver select customers?
6. What is the most frequently used payment method? Which payment method do you prefer?
7. Which functions do you prefer among those of the sharing car system?
8. What kind of safety related services, for example, insurances for driver, customer, car care, and so on, do you receive from the car-sharing company?
9. What is the weakest function of the car-sharing system that you think should be improved?
10. At what time do you drive the sharing car?
11. What kind of customers do you prefer?

In addition to posing these questions, we called the sharing car driver and measured the arrival time, their attitude, their payment requirements, and all the processes of using the car-sharing service provided by the sharing car.

Appendix B

Table A1. Interviewee list from KakaoT Taxi drivers and major findings.

Number and Interviewee	Day and Time	Major Finding		
		Interview Major Contents	Interview Situation	Improvement Proposal
1. Kim DaeKwon	2 June, 2018, 7:00–8:00am Seoul	Income increase with KakaoT, 30%	Average 11–12 KakaoT Calls One day	Smart Call distance limits 1–2 km Pay the points at the moment
2. Kim HaeJung	26 May 7:00–8:00 Seoul	Top driver, Priority allocation of customer is used when coming to Seoul or going back home.	One day 30 calls, one month 400 calls	Smart call points 2000–3000 is the requirement. Customer cancels too often. Opposite direction problem.
3. Jung KuBok	25 May 11:00–12:00 Daejeon	Old driver, does not use Kakao T, taxi driver income too small for younger generation to join	One day 3–10 calls, priority allocation of customer: 1 time	Car direction and customer direction opposite
4. Oh OkSea	25 May 7:00–8:00 Daejeon	Busy time (6:00–8:00), too many KaKao T calls. Select customers	5–10 calls per day After using KaKao T, income increased 20–30%.	Too many taxis in city. KaKao T increases the income of taxi drivers without a decrease of taxis
5. Oh YongMan	12 May 6:00–7:00 Seoul	Car-Sharing Taxi company and Individual Taxi disagreement. Taxi driver agreement Do not receive taxi call Penalty from Kakao T	Today 3 calls. On average, 10–15 calls per day. Priority allocation 1 time one day	If stars below 5, priority allocation 1 time per day disappears. This should be from driver, not customer.
6. Hang HyoSuk	19 May 2:00–3:00 Seoul	Priority allocation customer use when go back home	One day 6 calls One month 60–100 calls, Today 2 calls cancelled by customers	Taxi driver should be treated as a human. Service jobs. Kakao T can contribute to this
7. Kim MungSu	19 May 6:00–7:00 Seoul	Weekend KaKao T is useful to find customers.	Priority allocation to Kimpo airport in the morning is good. One day 7 hours working 3–4 calls is great	Map accurateness should be increased
8. Kim ***Min	27 November Wonju	KakaoT is double others in customer ratio	Cancel ratio is 40%	Call taxi a little far from main street.
9. Yu ***Ho	28 November Wonju	KakaoT driver is required to have taxi license	Driver can see in advance the destination of customers and select customers.	Card 1 st , 2 nd money, 3 rd KakaoT payment system
10. Kim ***Ho	3 December Wonju	Old taxi drivers, difficulty using KakaoT. However, majority of taxi customers use KakaoT and let all drivers use KakaoT.	Call KakaoT anytime.	Except special places such as bus terminal, central market, downtown, all use KakaoT.
11. Choi ***Suk	5 December Wonju	Taxi customers, young generation uses KakaoT. Nearly all taxi customers aged 60–70 age use taxi	Major payment by card, selection customer is impossible	A lot of customers going to and returning from work
12. Kim ***Hwan	9 December Wonju	Existing taxi call systems and KakaoT call are competing with each other	Location of customer and target place can be seen	Payment is under 30%
13. Lee *****	9 December Wonju	Select calls that can be approached easily by taxi	At, 7:00–9:00, 16:00–18:00, there are many student customers	Customer in apartment complexes cannot catch because too far and difficult to catch
14. Yu ***won	12 December Wonju	Does not use KakaoT, driver cannot earn additional money for his own benefits	KakaoT call accumulation 200–300 or customer complaint let driver star points decrease, and call allocation decreases	After card, the process from card to receiving money is long
15. Kim ***Kuk	13 December Wonju	The selection of customer standard; destination and the distance	Payment 90% card, the rest is cash	High cancellation rate by customers because no penalty
16. Jun ***Sun	13 December Wonju	No service from KakaoT to taxi drivers such as insurance, safety, car care	KakaoT customer ratio 70%, revenue from KakaoT 60%	No penalty system for canceling customers
17. Lee *** Bok	18 December Wonju	Decreasing waiting time of customers and high possibility to receive calls from customers even when in suburbs	No differentiation among customers	Customer cancel penalty increasing requirement

Appendix C

Table A2. Interviewee list from Uber drivers and major findings.

Number and Interviewee	Day and Time	Major Finding		
		Interview Major Contents	Interview Situation	Improvement Proposal
1 Mehdi Uber X	17 August 16:46	As university students, one day 4–8 hours Uber Drivers 16:00–22:00, good time to drive. Uber-Pool moves more than Uber X.	The way should be followed if no requirement from customers. Monday–Thursday 70 calls, \$100–200 bonus. Individual insurance. However, accident during Uber is paid by Uber.	Dislike drunken customers. The location of customer is not correct.
2 Melese Uber Black	18 August 10:00	Rides give message at the system to driver. Kind service, good communication, clean interior, good manners. He moved from taxi driver to Uber driver	\$7000–10,000 one month Every week Thursday payment, Uber Black 25% company, Uber SUVB 28% company	Uber black announces the expensive price in advance. Please do not show it in advance.
3 Nestor Uber express pool	18 August 20:44	When calling, announce my location. Walk to the designated place. Uber express and X nearly no difference.	Moved to Uber driver from truck driver. 5:00–17:00. Among 25 calls, Uber express 10 calls, Pool 10 calls, Uber X 5 calls,	Pool no meet case should pay the drive fee. We paid 5 dollars once.
4. Andre Uber-Pool	19 August 10:06	Part-time Uber driver for 1 year, from early morning 7–8 hours. Berkeley one day \$150, San Francisco one day \$200, Wife Uber driver.	After we are in the car, one woman joined our car. Moring time 4.30–7:00. mainly Uber X 60%, 20% Uber-Express, 20% Uber-Pool	One week 30 calls, +30 hours Uber \$30 bonus
5. Mike Uber-Select	19 August 19:05	At the starting time Uber Limousine Driver, before call, never knows the destination. Uber black commerce insurance, Uber Select regular insurance, 5 dollar airport fee paid by Uber	One day 5–6 hours, One week/\$1400, 2 ways for Uber car allocation, first, driver proposes the destination, second, the nearest driver	Income decrease from one day \$1000 to one week \$1000, too many Uber drivers, customer selects cheap Uber cars.
6. Yaser Uber X	20 August 10:00	Cook, 1 year without job, next week goes back to being a cook, payment every Wednesday, end of year total reports from Uber	Call allocation, after ride, we can know the destination. Students do not complain. Uber-pool majority, most of them students	Diverse customers, a lot of complaints from customers, System to take care of drivers needed
7. Andy,	20 August 11:42	Uber-Pool, 8 minutes waiting, Am 10:00–17:00 major working time as Uber driver	Income at midnight is high. One day 7 hours, one week 6 days, \$900–1800 income per week.	Uber-Pool, no co-rider.
8. Mohammed Uber-Pool	20 August 13:23	During destination, pick up co-rider at airport, and drop her at her destination during driving to destination. Mainly midnight Uber driver, likes to drive workers	One day Uber call 25, Uber-X 15 calls, Uber-Pool 10 calls, co-riding reject possible, but accept fast way usage, and incentive from Uber, 8 hours, driver will wait at airport to take to San Jose.	Female co-rider, normally Uber-Pool user, just uses Uber X when lacking time, Uber Lift same drive, Lyft better at long distances, Uber has more customers
9. Raul Uber-X	21 August 15:33	Switched from delivery job to Uber, 6 hour part-time job, 17:00–23:00, Friday, Saturday, Sunday working, 6 hours 10–15 calls half Uber-X, half Uber-Pool	Individual Insurance, Uber insurance All, Driver likes to meet people as Uber Driver, Near University Uber-Pool many	Before Uber driver, ID sending, allowing car, insurance check, driver license, Car Insurance, credit all needed.

Table A2. Cont.

Number and Interviewee	Day and Time	Major Finding		
		Interview Major Contents	Interview Situation	Improvement Proposal
10. Mamid Uber X	21 August 20:58	Electric car, \$7200 Prius New Car buying, from truck driver to Uber driver, Uber, Lyft same using, 70 calls \$200 bonus from Uber	One day 8 hours One month \$5000, Uber system one day 15 hours operating, One day 20 calls, Pool 15 calls, 5 X calls, customer drunken vomit Uber pays money to driver and receives money from customer	Uber drivers have 2 jobs normally, Uber license 1 year, extended afterwards. After call 10 minutes, cancellation possible, driver receives \$3
11. Akisha Uber express pool	22 August 2nd 11:31	Female driver, walked 3 minutes until appointed place, moved from security work to Uber driver, female drivers 5%, Uber-Eat, one week 5 times, \$3 per time, receiving a promotion of \$180—if then, stop working for the day, Uber drug also	Pool customer 1–2 times uses pool one day. Driver individual insurance, car damage including vomit, Uber payment and receiving money from customer, vomit pay 400 dollars, one week \$900, one day 7 hours	Uber map increasing at location needed
12. Brenda Uber X,	23 August 20:32	Female driver, driving in San Francisco, one week 80 calls, \$170–200, most customers in San Francisco are business men	One day 20 calls, half X, safe as female driver, customer rejection possible, baby without baby sheet rejection possible	After 60 calls, calls are not easy, Uber Navigation is not good
13. Martin, Uber XL	23 August 21:46	Uber XL, until 6 customers possible, Uber driver + financial job, Uber Select-XL, Uber black requires commerce insurance	One day 10–12 hours, one month 6000–10,000 dollars, Bay area, New York, LA, big cities have Uber-Pool, one day 20–28 calls	Before Uber driver, check security, insurance, license, car
14 Amare C. (Uber Black)	September 8 th , 2018, 18:15-	Very easy to apply for Uber driver and get started. It took him 2 days to become one.	Not knowing the destination of the customers before the pickup is the worst part of his job.	Many short distance customers are not welcome due to no money
15 Matt L. (Uber Black)	Sept. 21 st , 2018, 18:06-	I drive Uber part time. Regular work from 9am-5pm. Uber driver from 5:30pm to 8pm on Fridays and Saturdays.	Some customers are crazy or dangerous, so there needs to be a better customer filter app.	Vast majority of drivers are part time driver who works around 3 hours per day.
16 Alvie N. (Uber Select)	Oct. 5 th , 2018, 17:45-	Phone app does it all. But the driver cannot select customers.	Even though it is against Uber policy, he calls customers before the ride starts and ask for the destination.	For shorter distance, drivers lose money with fees going to Uber
17 Roger K. (Uber X)	Oct. 19 th , 2018, 18:43-	When in the known dangerous/crime-prevalent area, drivers turn off their app so that no ride can be given.	This driver pays attention to customers with star rating that is high, and who rate the drivers high	Drives Lyft as well, but don't like losing money to customers going less than 10 miles.
18 Tom A. (Uber X)	Nov. 20 th , 2018, 18:07-	Uber has pretty good car insurance.	He does not understand why destination is not be known before the pickup. This can be quite dangerous, or not profitable in short distance destination	High cancellation rate hurts the business
19 Abdul A. (Uber Select)	Feb. 2 nd , 2019, 20:20-	Easy to become a driver. No car care. Uber insurance for accidents during Uber business.	He was robbed at a gun point twice in downtown Philadelphia.	Too many Uber and Lyft drivers on the road.

Appendix D

Table A3. Interviewee list from DiDi Chuxing drivers and major findings.

Number and Interviewee	Day and Time	Major Finding		
		Interview Major Contents	Interview Situation	Improvement Proposal
1. Guo Yan Lin DiDi Express X	26 August 10:23	Wechat Pay main Payment system, individual insurance, if driver rejects customer, star grade decreases	5:00–17:00 maximum 12 hours, One day 20 calls, 2–3 pool, one month 5000–6000	Driver license, insurance, under 55, no tattoos, no criminal conviction, etc. required. Cannot reject pet dog carrying customer.
2. Wang DiDi Premier	26 August 19:13	DiDi-Chuxing-Premier driver should pass exam, 26% DiDi, 20% expensive than Express X, 20% bigger revenue than express X	One day 12 hours, 24–25 day, 10000, every day, dress code, photo, and car photo uploaded to the system, Wechat payment	Should have good individual car such as Honda Black
3 Tian DiDi Luxury	26 August 20:59-	Dress (white shirt and neck tie) Open door service, water, tissue, DiDi employment, welfare insurance by DiDi, handsome, experience of driving: 5 years or more, every day driver + 6 car photos, sometimes drive 20 km to meet customer	12 hours, total income 30,000, individual income 10,000, 5 times expensive than Express X, 3 times expensive than premier, one day 7–8 calls, short distance, total 200 luxury cars	DiDi pay insurance, a kind of DiDi Taxi, Audi A6 and upper, BMW 5 and upper, Venture E and upper,
4. Xhang Express X	2 August 27 th 11:01-	Cancel cost 13, Long distance one way is difficult, Allocation 2 way-choice, free allocation, Choice added for a Didi driver who does not have an address in Beijing to let him escape the police	Long-distance drive call several time, Fail, One month 5,000, one day 7–8 hours, One day 15–16 calls express X 12–13 calls, 2–3 pool calls, Start in the morning, dislike long distance	Real Driver and DiDi is not same, Cancel No Beijing address Didi driver in danger, so they should choose chose allocation mode
5. Yiheyuan Express pool	27 August 13:44	Pool but no co-rider, co-ride, time, and distance makes difference in driver income	12 hours, 10,000 One day 30 calls, 20 calls X, 10 pool, everyday payment, Alipay, Wechat pay	Express Pool, customer not move, driver moves to customer, Kia car, Express grade
6. Jiang, Express X	27 August 18:39-	22 calls one day, 70% X, 30% pool	One month, 22–23 days, 6:00–23:00, pure 12 hours, one month 10,000 One day 10 hours, 26 days, one day 400 9:00–0:00, sleep after lunch 3 hours, no appointment, no long-term customer	3–4 km allocation too far allocation
7. Ma Express X	27 August 20:13	Moved from delivery job to DiDi, Car buy for DiDi, DiDi call allocation in 3 km, 10 minutes if no traffic jam		DiDi driver is good way to meet strangers
8. Wang Express X	28 August 12:04	One day 3 times cancellation possible, stars decrease, from 4 times driver should pay money to DiDi, one day 20 calls, 95% Express X, the others pool	10 hours, 7:00–19:00, 22–23 days, one day 600, one month 10,000	Long distance DiDi not operate, receipt case pay tax, DiDi income decrease

Table A3. Cont.

Number and Interviewee	Day and Time	Major Finding		
		Interview Major Contents	Interview Situation	Improvement Proposal
9. Zhuang DiDi Premier	28 August 14:08	Female driver, 10% female driver, no danger for female drivers, Premier exam and interview, but X and under no need for exam or interview	10 hours, 20 days one month, 10,000, Express than X, one day 15 calls, allocation of 3 km changed to 5–7 km One day 7–8 calls, One month 20,000, Wechat Payment, Driver cannot talk to customer first, Short distance, long distance, no difference, Base fee 108 if long distance 13 hours, 6.30 until full time, 25 days or over, 14,000–15,000, 20 calls, 15 X, 5 pool	Luxury does not include Volkswagen, Premier and Luxury driver should not talk to customer first. Therefore, not good relationship with customers
10. Yu, DiDi Luxury	28 August 17:06-	Luxury car only book designated driver. High school +, driving skill, no criminal record, Luxury 20% self-owned car	Driver cannot talk to customer first, Short distance, long distance, no difference, Base fee 108 if long distance 13 hours, 6.30 until full time, 25 days or over, 14,000–15,000, 20 calls, 15 X, 5 pool	DiDi maintains 200 luxury cars
11. Liu DiDi X	28 August 19:21	Move from truck driver to DiDi driver When going to pick up customer, no pick up in 3 km, 3 CNY payments from DiDi,	Long distance allocation cannot be rejected because stars decrease, all taxies use DiDi app, when DiDi works for taxi, taxi earns large amount of money, taxi is not registered to DiDi	Daily payment from DiDi, allocation of 3 km, but it is too far
12. Liang Taxi driver	29 August, 10:07	Taxi driver, female driver, DiDi taxi calls not often, driver can choose choice mode or allocation mode, one month 8200, DiDi earnings 3000	3500 taxi company, 5000 drivers, among this 20% from DiDi, taxi is more expensive than express X	No incentive for DiDi, not many allocation calls
13. Li Taxi driver	29 August 13:49	DiDi no pension, 57, so drive until 60, one day 8 calls decreases to 3–4 calls	If DiDi driver is different several times, cancellation is possible, every Friday payment	Taxi driver income decreases from 7000 to 4000
14. Li Didi express X	29 August 14:37-	Car cleaning and DiDi driver 6 hours, DiDi exam car should stop after 8 years. Therefore, do not want DiDi exam	Liking civilized and polite customer who does not complain	Location accuracy should be increased.
15. Mr. Du JingQ1D0K9	December 2018	Full time driver from 6 am to 11 pm 5–600 Yuan per day	Platform order distribution	As commissions go up, earn less and less
16. Mr Ren JingKAR365	December 2018	Following up the trend and do some sideline work Not fixed but more than 2–3000 Yuan per month	Do more on weekends every week and do more on the way to and from work.	I like function to match recent customers.
17. Mr Wang JingABS181	December 2018	Requiring to C1 or above driving license for more than 3 years.	Do driving on free time after work.	I like the function to hitch a ride. Please activate the hitching function more.
18. Mr. Meng JingP7CS00	December 2018	Platform has solved the employment problem of some people, the platform takes too much from driver.	I can withdraw cash by reaching bank card.	The local government should regulate the platform for the right of driver more.
19. Mr. Chen JingP61058	December 2018	I am driving full time because I have no other job. 260–70 Yuan per day		I could not reject orders that are far away from passengers in rush hour.

Table A3. Cont.

Number and Interviewee	Day and Time	Major Finding		
		Interview Major Contents	Interview Situation	Improvement Proposal
20. Mr. Li JingQW58F5	December 2018	I do not use DiDi as fixing way. I use it 2–3 hours a day average. 100 Yuen per day.	I like clean customers most because I just use DiDi part-time job.	Sometimes the route which was proposed by the platform is not good.
21. Mr. Yang JingQ85XZ6	December 2018	I choose voluntarily DiDi driver. I drive several times one month about 4–5 hours a day.	I like customers who are less talkative.	I think sometimes that we drive our own cars and earn money for others.
22. Mr. Xu JingFBK895	December 2018	I drive DiDi every day from morning to evening. Earn about 10,00 Yuen a month.	I like service point system of DiDi most.	The commission is too high, and it is getting higher and higher.
23. Mr. Zhao JingN85AB8	December 2018	I used to be a so-called black car driver. After some colleagues started to work at DiDi, I joined.	DiDi software model has improved our efficiency.	The handing charge is too high for each order.
24. Mr. Li JingPC2Y00	December 2018	DiDi drivers generally do not mind the settlement method of customers.	This DiDi app can improve the utilization rate of cars and make us earn some extra money in spare time.	The location of DiDi's built-in map is not correct, and the route planning is not good.

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