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## Knowledge transfer and inter-firm relationships in industrial districts: the role of the leader firm

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### Abstract

In the literature, knowledge transfer is widely emphasized as a strategic issue for firm competition. In this paper, the knowledge transfer is investigated referring to customer–supplier relationships in industrial districts. The knowledge transfer process is described and a framework is provided to define the main components of the process. A model is proposed to analyse how a leader firm of an industrial district can modify the knowledge nature and adopt different types of supply relationship to increase the effectiveness of knowledge transfer. The model stresses that, when the knowledge transfer has to be fast and reliable between customer and supplier, knowledge has to be codified. However, as the codification level increases, knowledge can be easily shared with other district competitors. Then, the leader firm can also try to control the knowledge transfer by the reduction of the number of suppliers. Referring to the case of an industrial district, some considerations are made to show the practical implications of the knowledge control by the district leader firm. © 1998 Elsevier Science Ltd. All rights reserved.

*Keywords:* Knowledge transfer; Inter-firm relationships; Leader firm; Industrial district

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### 1. Introduction

In the literature, the organization's abilities to develop and exploit specific and critical competencies useful to succeed in a changing market have been the subject of growing interest (Barney, 1991; Prahalad and Hamel, 1990; Prahalad, 1993). The concept of "core capabilities", that can be viewed as a set of different production and organization skills, multiple and complementary technologies, values and norms, and the ability to manage them, has been introduced, providing the basis for the firm's sustainable competitive advantage within a particular business (Leonard-Barton, 1992). In this context, the knowledge has been recognized as the lowest common denominator that defines a firm's ability to handle the evolution of its competitive environment and uncertainty in general (Kogut and Zander, 1992; Nonaka, 1991, 1994). Thus, knowledge represents the main resource upon which competitive advantage is founded, and its transfer is widely emphasized as a strategic issue for the firm competition. In particular, this argument is

dealt with by Cohen and Levinthal (1990), who stress that knowledge transfer is a critical factor for a firm, necessary to rapidly respond to changes, innovate and achieve competitive success.

Knowledge transfer is important both within the firm and between different firms. The success of many companies can be based on their ability to transfer the knowledge embodied in organizational routines from one organization unit to another (Szulanski, 1996) as well as to improve their capabilities by assimilating new technology (Gilbert and Cordey-Hayes, 1996). From the inter-organizational point of view, knowledge transfer has been analysed as a key to explain the nature of the collaboration agreements that can greatly vary from licensing agreements to research contracts, joint ventures, etc. Some studies utilize patent citation data to track knowledge transfer between firms (Almeida, 1996; Mowery et al., 1996). Other studies analyse the degree of interaction between collaborating firms, pointing out the relationship between the nature of the knowledge exchanged and the level of organizational interaction (Steensma, 1996). The last approach, in particular, can be used to explain the evolution process of inter-firm relationships in many industrial districts.

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An industrial district is a system of small/medium firms located in a limited geographic area and devoted to the different production stages of a specific type of product. The local specificity has been traditionally considered fundamental for the success of an industrial district (Piore and Sabel, 1984). However, it has been observed that in the global competition industrial districts can be more vulnerable than large companies, and that the district survival and development seems related to its internationalization and to the growth of a leader firm (Albino et al., 1996). The leader firm's strategy can both influence and be affected by the inter-firm relationships and knowledge transfer which take place within the district, where customers and suppliers can be characterized by different levels of integration. When a more coordinated and integrated relationship between customer and supplier is requested, the transferred knowledge needs to be codified. However, as the codification level increases, knowledge can be more easily acquired by the other companies of the district, in particular by competitors. Then, companies tend to control the knowledge transfer by appropriate strategies.

In this paper, the knowledge transfer process is analysed on the base of a knowledge definition, pointing out its peculiar dimensions (Section 2). An analysis framework providing the main components of the knowledge transfer is proposed (Section 3). The knowledge characteristics and the inter-firm relationships in an industrial district are then presented (Section 4). A model to analyse the role of a leader firm in the evolution of an industrial district is proposed, pointing out the leader firm's tendency to codify the knowledge to be transferred and to control the knowledge spread in the district (Section 5). Finally, an example of an industrial district producing leather sofas in south-eastern Italy is presented, analysing the evolution of the relationships between the leader company and its suppliers (Section 6).

## 2. The knowledge transfer process

According to the cognitive science, knowledge can be defined as an abstract concept that is consciously or unconsciously built by the interpretation of a set of information acquired through experience and meditation on the experience itself, and that is able to give its owner a mental and/or physical ability in an "art" (Polanyi, 1962, 1966; Kim, 1993; Kolb, 1984; Johnson-Laird, 1993).

This definition points out that the knowledge has three characteristics: the structural, the process and the functional characteristic, which are tightly interconnected. From a structural point of view, knowledge is formed by information. However, knowledge is not a simple aggregate of information: while information, defined as a structural set of data, is neutral, i.e. not dependent on the owner (individual or organization), knowledge is a

set of information associated to a meaning by an individual or organizational interpretation process (Huber, 1991; Weick, 1979). This aspect is the process characteristic of the knowledge. The interpretation process concerns new or existing information by which both individuals and organizations develop new knowledge (Daft and Weick, 1984). Therefore, to deal with the concept of knowledge it is necessary to separate simple information from information associated to a meaning (i.e. the knowledge). Finally, from a functional point of view, all the knowledge owned by individuals or organizations defines their skills and core competencies, respectively, and enable them to carry out some tasks. In fact, every skill is always referred to a specific task defined as a goal that can be achieved in given conditions (Leplat, 1990). Thus, when the knowledge to be transferred is analysed, it is always possible to find a knowledge-related task. Then, when the knowledge transfer process is analysed, particular attention has to be paid to the transferred knowledge-related task (Wathne et al., 1996).

The knowledge transfer between two or more actors (individuals or organizations) can be defined as the process by which the knowledge of one actor is acquired by another (Cutler, 1989). It can take place by means of different ways, such as interaction of personnel, patent disclosures, publications, assets and services exchange, and so on.

These considerations of the concept of knowledge stress that the knowledge transfer process encompasses two dimensions. As depicted in Fig. 1, the knowledge transfer process can be conceptualized as the combination of two components: the "information system" and the "interpretative system", related to an operational and a conceptual level of analysis, respectively.

From an operational point of view, the knowledge transfer is a communication process with information processing activities. The knowledge owned by an actor (individual or organization), according to its specific characteristics, can be transferred to another actor by information flows conveyed by appropriate media. The typology of communication and its effectiveness and efficiency will depend on the media choice.

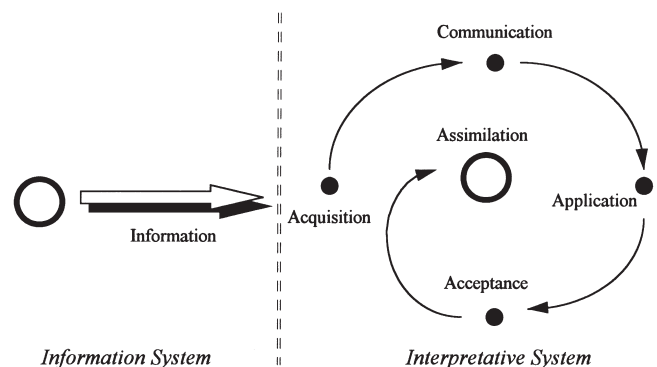


Fig. 1. The components of the knowledge transfer process.

From a conceptual point of view, the knowledge transfer is tightly connected to the concept of learning organization (Gilbert and Cordey-Hayes, 1996; Huber, 1991; Steensma, 1996). In fact, the information transferred to the receiving organization is not knowledge, since it must be submitted to an interpretation process within the organization itself to become knowledge. This process depends on the knowledge previously owned by the receiving organization and, in particular, its efficiency is strongly influenced by the receiving firm's relative expertise with similar knowledge (Teece, 1977). In particular, learning performance increases when the item to be acquired is related to something which is already known (Cohen and Levinthal, 1990). As a learning process, the knowledge transfer can be characterized by various stages, identified by increasing degrees of information internalization by the receiving organization (Baranson and Roark, 1985). Gilbert and Cordey-Hayes (1996) have proposed a conceptual framework to track the knowledge transfer within an organization. This framework is useful to manage the development of new knowledge within the organization. They identify five stages. The first is *acquisition*, related to the simple information acquisition from an external organization. The second is *communication*, that is the step of distributing the information acquired in organization. The third is *application*, by which the acquired and communicated information is applied in the organization and then retained. The fourth is *acceptance*, related to the individual acceptance of applied information. Finally, the fifth is *assimilation*, which represents the process of cumulative learning involving changes in individuals' abilities and organization's routines as a direct result of the use of acquired knowledge. Each of the above stages represents a rooting phase, that is a level of knowledge acquisition by the organization (Steensma, 1996).

According to Daft and Lengel's study (1986) on the internal organization structuring and information needs, it is possible to stress two complementary aspects that influence the success of the knowledge transfer. The first aspect is the uncertainty closely connected with the information processing activity. It is related to the qualitative aspects of the transferred information during a communication process. In particular, the knowledge transfer is uncertain if the transferred information is not qualitatively and/or quantitatively responding to effective communication. This happens, for instance, when information is affected by noise and/or it is not suitable to represent the transferred knowledge. The second aspect is the equivocality that originates from the ambiguity of interpretation of the transferred information. The equivocality, connected to the interpretative process, depends on the mental representation shared by the actors involved in the knowledge transfer process, so that it is generally lower if the actors operate in the same

context and have a common cultural background, cognitive framework and technical expertise.

### 3. An analysis framework for the knowledge transfer

On the basis of the theoretical model of the knowledge transfer process described above, it is possible to identify four components of a framework which, describing and influencing the knowledge interaction between two or more actors, can be used for the knowledge transfer analysis. These components are:

- the *actors* involved in the knowledge transfer process;
- the *context* where the interaction takes place;
- the *content* transferred between actors;
- the *media* by which the transfer is carried out;

*Actors.* Actors of the knowledge transfer process can be considered as either the organizations or the individuals. We adopt the social cognitive approach, which views the organization as a social system made of individual members who process information and develop knowledge. Hence, the observation of the knowledge transfer process is based on cognitive researches focused on the ways different individuals deal with knowledge.

Analysing the knowledge transfer and inter-organizational learning within a cooperative relationship, Wathne et al. (1996) suggest some key factors influencing the effectiveness of the knowledge exchange. In particular, they propose three main features characterizing the actors involved in the knowledge transfer: "openness", "trust" and "prior experience". In the organization learning literature, openness has been defined by different authors (Stata, 1989; Badaracco, 1991; Hamel, 1991) mainly as the partners' willingness to share knowledge in a collaborative interaction. According to Hamel (1991), it can be also defined as "transparency", in order to stress the attitude of the actors involved in the knowledge transfer of not hiding their knowledge, so that potential learning is facilitated. Wathne et al. (1996, p. 61), in particular, argue that "openness can be understood in terms of overall perceived openness of dialogue, the degree to which the partner representatives work closely together on a common task, and the degree to which the partner representatives perceive that the others withhold their knowledge", and also that a higher level of openness allows a more effective knowledge transfer. Strictly connected to the openness is the actors' trust. It has been recognized as a fundamental element for the success of the cooperative ventures (Ring and Van de Ven, 1994) and, more specifically, of the knowledge transfer and inter-organizational learning (Dogson, 1993). In fact, trust has a direct and positive influence on actors' openness (Wathne et al., 1996). The last factor influencing the actors' ability to exchange knowledge is

the prior experience owned by each actor. It influences the capability of both conveying knowledge through information and internalizing new knowledge. Cohen and Levinthal (1990) state that the actor's prior knowledge accumulated increases both the ability to store new knowledge and the ability to recall and use it. In other words, the breadth of the different knowledge owned and its connections affect the effectiveness with which new information can be acquired, used, and transferred. Then, it seems possible to claim that the higher the degree of actors' prior experience, the greater the effectiveness of knowledge transfer (Wathne et al., 1996).

*Context.* Referring to organizations, it is possible to distinguish two kinds of context that have a deep influence on the knowledge transfer: the internal and the external context.

The internal context corresponds to the organizational culture and is basically represented by a set of behaviors, technical skills and technology assets, attitudes and values belonging to and shared by the members of an organization. It is characterized, on one hand, by the receptive and absorbing capability of the learning organization (Seaton and Cordey-Hayes, 1993; Cohen and Levinthal, 1990) and, on the other hand, by the transmission capability of the organization, that is the ability of both making the tacit knowledge (individual know-how and organization routines) explicit and codifying all the informal knowledge present in the organization.

The external context can be defined as a set of variables representing the conditions in which inter-organizational relationships take place. It influences the nature of the knowledge exchanged and is characterized by two dimensions: the environment and the atmosphere (Lamming, 1993). The former represents the market characteristics in which organizations operate, such as the market structure, its national/international scale, the connected technology trajectories (Dosi et al., 1990). The latter can be defined as a combination of specific inter-organizational variables, such as firm cooperation, closeness, expectations and socio-cultural aspects.

The external context has a deep influence on some aspects of the internal context. For instance, firms that operate and cooperate in the same atmosphere (external context) tend to present similar cultures (internal context). The nature of the context, in particular, affects the equivocality associated to the knowledge transfer. The equivocality can be reduced if the actors share the same atmosphere and body of knowledge, i.e. if they have similar technical capabilities and culture. This is particularly true in industrial districts, where craftsmanship is widespread and the great number of contacts among different organization's members, combined with the specific socio-cultural features of the local area, favour the growth of a similar culture in all the district firms.

*Content.* The content of the knowledge transfer is the ability to perform a specific task. We have already stressed that the knowledge transfer process is associated with a knowledge-related task transfer. The knowledge transfer is then successful when the ability associated with the transferred knowledge (owned by the transferring actor) is assimilated by the receiving actor. A distinction can be made between two types of content associated with the transferred knowledge: the *instrumental* content and the *cultural* content.

The instrumental content is related to all the knowledge necessary to do or to coordinate a job. The object of such a kind of knowledge transfer in an inter-organizational network can be the improvement of the operational capabilities of the organizations. The task associated to this knowledge can concern individuals' ability (such as craftsmanship), product and technology knowledge, technical operations, intra- and inter-organizational procedures and rules.

The cultural content is associated with the knowledge capability of creating a specific organization's cognitive background. It involves organizational values and beliefs, individuals' culture background and the "language" used in the organization to communicate. Its transfer, within a network of collaborative agreements, enables the creation of a common inter-organizational culture. Thus, its task is to improve the understanding capability of the actors involved in the knowledge transfer process, for instance providing a common language, which increases the efficiency of the communication.

Together with the different attempts to develop a taxonomy that effectively characterizes the content's object, it is essential to stress a fundamental underlying trait of the knowledge transferred, i.e. the concept of tacitness (Polanyi, 1962, 1966). Tacitness can be defined as the degree to which a capability can be easily communicated and understood (Kogut and Zander, 1993, 1995).

As suggested by Daft and Lengel (1986), every task realized by an organization or by an individual is basically characterized by two dimensions: equivocality and uncertainty. The uncertainty of the task is related to the general lack of information regarding its accurate definition. It can be overcome by an increase of exchanged information. The equivocality concerns the ambiguity of the task, that is the existence of multiple and conflicting interpretations of the task (Weick, 1979).

Equivocality and uncertainty of the task enable characterization of the tacitness concept. In fact they can be viewed as the tacit dimension of the knowledge transferred with uncertainty which can be associated with the ease of communication or information processing, and equivocality which is related to the interpretation or to the understanding process.

*Media.* Media can be considered as every means useful for transferring data and information. From a structural point of view, media are characterized by two



elements: code and channel. The code is a particular representation of the information to be exchanged (Boisot, 1987). The channel is the means by which the code can be transferred. Some important characteristics of the channel are: the capability of immediate feedback, the number and typology of cues that can be used and the speed of cue processing.

The media characteristics depend on the combination of codes and channels. In particular, it is possible to stress two distinctive characteristics of media, which the effectiveness and efficiency of the knowledge transfer depend on: capacity and richness. The media capacity can be defined as the ability of the media to process information from the qualitative and quantitative point of view, that is without noise or information lack (quality) and with transferred information redundancy (quantity). The media richness is the capability of making the change of mental representations of the actors involved in the knowledge transfer process easy within a specific time interval (Daft and Lengel, 1984, 1986).

While media capacity allows to better cope with uncertainty, media richness facilitates equivocality reduction. Media with high capacity are all those useful for processing information at a high quantitative and qualitative level. These media rely on rules, forms, procedures and data bases, and use basically impersonal media sources, such as written and numeric documents, e-mail, telephone, fax and EDI. Media characterized by a high level of richness are personal and involve face-to-face contact between actors. In fact, the richness of the communication media depends on the channels' capability for rapid feedback, on the number and variety of cues processed by the channels, and on the language personalization and variety (Daft and Wiginton, 1979; Daft and Huber, 1987).

When the knowledge transfer content is very probably equivocal, the use of rich media, that tend to reduce the equivocality of the task, is preferred. Conversely, when the content is mostly uncertain, less rich media can be used and the knowledge transfer can take place through a formal system.

#### 4. Knowledge and inter-firm relationships in industrial districts

In the last decade, the relevance of local systems of firms such as industrial districts, playing an important role in the economic development of areas characterized by small and medium size companies, has been stressed in the management literature (Ciborra, 1993). In fact, companies of industrial districts have often shown a great competitiveness in the global scenario (Dioguardi, 1994).

The success of industrial districts in both national and international markets seems to be mainly based on the

flexible specialization of the production cycle (Piore and Sabel, 1984) as well as on a continuous process of organization learning and knowledge spread (Storper, 1992). In particular, the strategic importance of knowledge in industrial districts allows consideration of the district as a "cognitive laboratory".

Indeed, within industrial districts knowledge has always been a fundamental key. It usually has different characteristics in the various phases of the district evolution. For instance, industrial districts often originated from the development of production capabilities fundamentally based on the craftsmanship spread in a local area. A set of typical socio-cultural knowledge and craftsmanship capabilities is thus often at the basis of the first economic development of industrial districts. Afterwards, the firm industrialization and specialization generate the development of learning processes based on the knowledge codification and on a stronger interrelation among the district firms, so that a socio-cultural and craftsmanship knowledge is replaced by a more relational one (Albino et al., 1996).

Most industrial districts at present are characterized by two types of knowledge: an *external* knowledge, originated by the continuous interaction of the district firms with the external environment, and an *internal* knowledge, generated within the industrial district and then considered as a genetic property of the district. The external knowledge can either assume the form of market information (Lombardi, 1994), such as demand volumes and mix, required product performance, etc., or it can be contained in products and services acquired by the external environment, where the knowledge is generated (Schiuma, 1997). The internal knowledge is usually a "practical" knowledge, that is an operative kind of knowledge generated by processes such as learning by doing and learning by using, autonomously developed in the district. The internal knowledge spreads among the district firms by people transfers as well as by individual relationships in extra-work activities, and characterizes the typical socio-cultural atmosphere of the district.

Recently, many studies have stressed that industrial districts are characterized by an evolution that seems to be characterized by two main features: the internationalization process and the growth of a leader firm (Albino et al., 1996). Both these processes are often strictly related. In fact, as many Italian cases have shown, the leader firm internationalization can be considered the main impulse for the district internationalization.

The district leader usually considers local factors as strategic resources in the global competition and tends to reinforce the local inter-firm relationships, in particular along the supply chain (vertical relationships). A more effective knowledge transfer is one of the tools that the leader firm can use to pursue outperforming client-

supplier relationships. Two fundamental aspects to be considered by the leader firm in order to conjugate its global and local strategies are then inter-firm relationships management and knowledge transfer within the district (in particular, the knowledge transfer with its district suppliers).

With its local inter-firm relationships, the leader firm looks for production volume flexibility, specific competences, and close control of the district capabilities (i.e. technology and product innovation). The leader firm can choose to select either internal (inside the district) or external (outside the district) suppliers. In the first case, the leader firm strategy is more oriented to exploit the benefits of the local area, and this strategy also enhances the development of the industrial district. In the second case, a process of production delocalization takes place, reducing the relevance and the growth of the local industrial area. The leader firm can also promote cooperation or competition among its suppliers, depending for instance on the characteristics of the technology, innovation, competition of specific market scenarios and company strategies.

The knowledge transfer and spread within the district and between the leader firm and its suppliers is considered strategic for the competition of the district leader in both the global and local marketplace. The knowledge spread within the district, which takes place also by socialization processes, enables the growth of the industrial atmosphere supporting the development of the district's core competences (specialized know-how, craftsmanship capabilities, common values and specific socio-cultural context). On the other hand, the leader firm promotes an intense knowledge exchange with its supplier firms to achieve higher performance in terms of innovation, efficiency, quality, time, and therefore competitiveness. In particular, the knowledge exchange in customer–supplier relationships can concern planning and control activities, technology, management techniques and quality standards.

However, the leader firm also has to protect its strategic knowledge from becoming widespread, to avoid district competitors obtaining undesired advantages. Therefore, the leader firm has to drive the knowledge transfer carefully, choosing how and when to share its core knowledge. Knowledge sharing can be reduced or biased taking strategic decisions about the control of the employee mobility, of the knowledge codification and of the cooperative vs competitive supplier relationships. Customer–supplier relationships in the district are thus influenced by the choices adopted by the leader firm about the control of the knowledge transfer process.

## 5. An interpretative model

The previous considerations allow to infer that the characteristics of the components of the knowledge

transfer process can influence inter-firm relationships. In particular, if the firms (i.e. the actors of the knowledge transfer process) are characterized by a high level of openness, similar prior experience and internal contexts, and operate in the same atmosphere, sharing culture, values, technical and operational knowledge, the knowledge transfer basically takes place with low equivocality. This is typically the case of industrial districts, characterized by widespread craftsmanship, by firms operating in the same atmosphere and by frequent interactions among individuals working in different firms. This peculiarity of industrial districts generates a sort of homogeneous cognitive map and behaviors of the district firms which, consequently, can transfer knowledge and its related task with low equivocality (Daft and Lengel, 1984, 1986).

Recently, the internationalization process of the industrial districts and the growth of district leader firms have produced a modification in the knowledge transfer characteristics as well as in the inter-firm relationships within the district.

The district leader often has a relevant role in the introduction of such a modification. In fact, it is usually a firm that coordinates the production activities carried out in the district by different actors. Production process automation, quality control, computer aided design are some of the activities that the leader firm tends to promote within its organization and to require from its suppliers.

The production cycle of an industrial district is usually characterized by fragmentation, and the district firms are usually characterized by flexible specialization. The leader firm has then to strongly rely on other firms to achieve high levels of competitiveness. The fundamental link between the leader firm and its suppliers involves a high level of interdependence that often makes the customer–supplier relationships uncertain (Daft and Lengel, 1986), stressing the importance of the coordination task. In order to establish more coordinated relationships with its suppliers, the leader firm can carry out a codification process of the knowledge to be transferred. In fact, the knowledge codification allows for a reduction in the uncertainty involved in the knowledge transfer process by the increase of the knowledge transfer speed, the exchange of more information and a clearer definition of the tasks. The codification process then reduces the need for media richness and allows a better use of media capacity.

However, while allowing a higher coordination of customer–supplier relationships, the knowledge codification also involves the problem of information control within the district. The risks associated with imitation, that is a peculiar aspect of the district, can be mitigated by the leader firm through the adoption of appropriate strategies for the supplier network management, which can also be suitable to support the coordination process.

For instance, the leader firm can reduce the number of district suppliers by selecting the most competitive firms of the district and, especially, the most reliable ones. Favorite relationships between the leader firm and some district firms, as well as the acquisition of firms operating in critical phases of the production cycle (verticalization process), can then be established. This phenomenon can be more evident if the knowledge codification level is particularly high (for instance, due to specific technologies or production organization characteristics) or the district competitors are particularly aggressive.

Based on these considerations, a conceptual model can be proposed to depict the role of a leader firm in the evolution of inter-firm relationships in an industrial district, with particular reference to the effects of its actions on the knowledge nature and on its spread modalities.

The knowledge transfer speed  $S_T$  between two organization units grows with the knowledge codification level  $L_C$  (Fig. 1). This qualitative relation puts in evidence the two sections A and B of the graph in Fig. 2 which could be associated with two particular situations of industrial districts, respectively. Section A, characterized by low  $S_T$  and  $L_C$ , depicts the typical situation of traditional industrial districts, where the craftsmanship characteristics of the production process generate a prevalence of tacit and informal knowledge, and its transfer is mainly carried out by face-to-face interactions. Section B, characterized by high  $S_T$  and  $L_C$ , depicts the situation of more developed districts, where the industrialization process, together with the process of automation, quality improvement and product technological innovation, causes the codification of a relevant part of knowledge.

As far as the relationships between the leader firm and the other district firms are concerned, the verticalization process of the leader firm and its supplier selection cause a reduction of the number of possible channels  $N_C$  of knowledge transfer, and in particular of the codified knowledge transfer towards to the district firms. It is possible to consider the ratio between the district firms

which are dedicated suppliers of the leader firm (e.g. those firms whose supplies to the leader firm overcome, for instance, the 70% of their total income) and the total number of leader firm suppliers within the district. This ratio can be defined “hierarchy degree” ( $H$ ) of the leader firm, since it refers to the control by the leader firm of its district suppliers, or, equivalently, to the dependence of the district suppliers of the leader firm on the leader firm itself.

In Fig. 3, a possible qualitative relation between  $H$  and  $N_C$  is reported, where  $H$  grows as  $N_C$  decreases. The importance of this relationship can be found in the tendency of the customer–supplier relationships towards the hierarchy, typical of many successful districts, which is due to, besides the choice of defining selected cooperative relationships, the need for controlling performance and information flows.

By analysis of the previous relationships, it is possible to stress how the leader firm, in order to improve its performance and to control the imitation process, can influence the knowledge spread by the knowledge codification ( $L_C$ ) and the hierarchy degree ( $H$ ). In fact, it can be affirmed that the spread speed  $S_S$  of the knowledge flowing from the leader firm to the other district firms depends on both the speed of knowledge transfer  $S_T$  and the number of possible channels of knowledge transfer  $N_C$  (in symbolic terms,  $S_S = S_T \times N_C$ ), from the previous relationships it can be inferred that the dependence of  $S_S$  on  $L_C$  and  $H$ .

This relationship model also allows to stress the evolution of the nature of the typical district firms. Changes in the knowledge transfer within an industrial district and, therefore, in the learning and knowledge sharing processes modify the traditional nature of the information spread in the district. In Fig. 4, a possible representation of the different types of production firms, referring to both the average number of possible knowledge transfer channels  $N_{AC}$  from a firm to other firms and the knowledge transfer speed  $S_T$ , is reported.

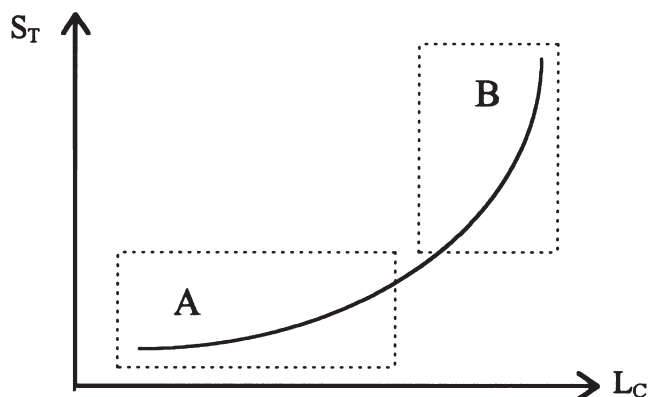


Fig. 2. A qualitative representation of the relation between the transfer speed  $S_T$  and the knowledge codification level  $L_C$ .

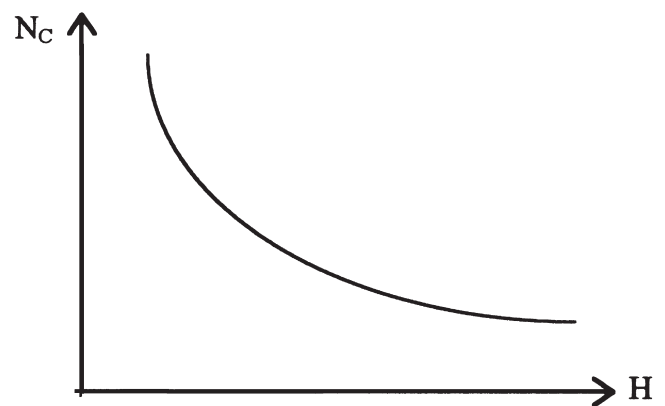


Fig. 3. A qualitative representation of the relation between the number of possible knowledge transfer channels  $N_C$  and the hierarchy degree of the leader firm  $H$ .

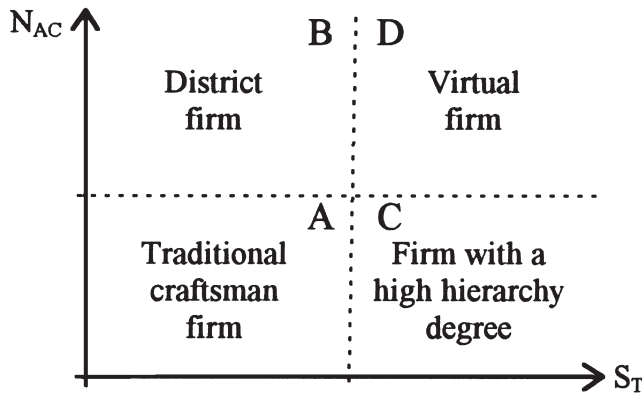


Fig. 4. Types of production firms according to the knowledge spread modalities.

Four possible types can be outlined. For low values of  $N_{AC}$  and  $S_T$  (Sector A in Fig. 4), the typical firm is the traditional craftsman producer, that carries out internally most of the whole production process and fundamentally makes use of tacit knowledge, with low transfer speed. When  $N_{AC}$  is high and  $S_T$  is low (Sector B in Fig. 4), the typical firm is the traditional industrial district enterprise, where the specialization and the socialization generate many information connections among the actors, based on prevalently tacit knowledge transfers. Within the traditional industrial district, the action of a leader firm, equipped with superior organizational and entrepreneurial capabilities, can also emerge.

The knowledge codification process, generated for instance by the industrialization and internationalization processes, induces an evolution of the district characteristics, such as a rise of the knowledge transfer speed. In particular, when  $N_{AC}$  is low (Sector C in Fig. 4), the typical firm of the district is characterized by a high hierarchy degree  $H$ , i.e. the district firms usually adopt dedicated supplier relationships inside the industrial district. When  $N_{AC}$  is high (Sector D in Fig. 4), on the contrary, usually there are “final” firms that coordinate, by market mechanisms, specialistic production firms. Among the main capabilities of these final firms, which periodically build transient firm networks defined “virtual” firms, there are the supplier network coordination and the interface with the final markets. This situation can take place, for instance, when the district leader does not limit the codified knowledge transfer towards the other district firms, so that knowledge is widespread and there is no reason to establish long-term relationships with dedicated suppliers.

The four typical firms reported in Fig. 3 can be associated to particular district situations. In particular, it is possible to interpret the district evolution process by the shift of the typology of the production firm which characterizes the district to another one. For instance, the progress from the traditional district firm (Sector B) to the firm with a high hierarchy degree (Sector C) or to

the virtual firm (Sector D) is associated with a change in the district characteristics, such as the growth of a district firm assuming the role of district leader and limiting the knowledge transfer or a process of knowledge codification without knowledge spread control within the district, respectively. The action of the leader firm, in particular, is very influential in the district evolution process, because it is more able to modify the transfer knowledge processes.

## 6. The case of an Italian industrial district

One of the most important industrial districts of the south-east of Italy, called “*distretto murgiano*”, world leader in the production of leather sofas, has been investigated to stress the role of the leader firm in an industrial district. In particular, attention has been focused on the district leader firm’s capability for modifying the knowledge nature and spread within the district to obtain a higher competitiveness in local and international markets.

The district evolution has been characterized by some fundamental events. From a typical craftsman phase, characterized by small firms operating with logistic and financial difficulties and by a prevalently local final market, the industrial district has grown and developed competitive capabilities through export in foreign markets. This internationalization has taken place, since 1970, mainly due to the action of a firm (Natuzzi) that later became the world leader in leather sofa production. In fact, the internationalization and the relevant increase of the district activities have been driven by the leader firm’s export growth.

The growth of the leader firm in the international markets raised the need for the production process industrialization as well as for more integrated customer–supplier relationships, achievable by a more effective and efficient knowledge transfer process. Two specific examples related to the industrialization process and to the supplier integration can be considered: the design of the templates required for the leather cut and the implementation of a quality control system.

The template design consists in the drawing and definition of the dimensions of the templates that have to be used to cut the leather for the sofa covering. This operation requires the definition of flat areas starting from the tridimensional forms of the real prototype of a new sofa. Experience has always been at the basis of the template design, whose dimensions are affected, for example, by leather cut and sew problems. The tacit knowledge of the specialists has been codified defining a CAD tool able to automatically create template forms and dimensions. Considerable improvements have been carried out, concerning for instance the product development time, which is particularly critical for a firm that,



on average, produces a new sofa model every four days, and the information transfer from the leader firm to its suppliers, which can be carried out by Autocad files instead of physical template transports, with a relevant increase in coordination efficiency.

The implementation of a quality control system has also allowed a great improvement of the Natuzzi production performance. For instance, the quality control of final products, which is considered very important — besides other aspects — for the additional costs of rejected items to be replaced or adjusted (about 90% of the firm income is made by foreign orders), was once based on the experience of workers, while it is now carried out by a codified control procedure, specific for each production phase and sofa model according to their technical characteristics, which is now also adopted by the supplier firms.

These examples are useful to show how the aim of improving both the production process efficiency and the supplier coordination has induced the district leader to deal with the knowledge codification process. By the codification process and the consequent higher knowledge transfer speed, the leader firm has been able to improve the knowledge communication and acquisition processes. In other words, the leader firm has reduced the uncertainty and equivocality of the transferred knowledge-related tasks.

However, the codification process has also made the technical and organizational knowledge more easily acquirable by the other district competitors. The district leader has then been obliged to adopt strategies aimed to limit the knowledge spread and to be protected from potential competitors' imitation. Among the possible actions to be undertaken, the company management stressed the need for company verticalization towards some production phases (such as leather tanning and polyurethane production) and the selection of more dedicated and reliable suppliers. The last action is aimed at improving the coordination between the leader firm and the suppliers (for instance, this is particularly important for the development of a new sofa model) and, increasing the hierarchy degree of the leader firm, to reduce the number of possible transfer channels from the leader firm, and consequently from the firms connected with it, to the other district firms. This tendency is also stressed by two other medium-size companies of the district, Calia and Nicoletti, that are the main district firms competing with the leader firm.

In particular, empirical analyses have shown that almost all 60% of Natuzzi's suppliers is dedicated (i.e. more than 70% of their income is supplied by Natuzzi orders, that does not hold the equity control of these suppliers). This behavior has been mainly motivated by the company management, from one side, by the need of limiting the information flow from the leader firm to the other firms of the district, and, from the other side, by

the search of flexibility instead of pursuing the company verticalization towards other production phases. A similar behavior, even if less evident, can be observed for the other two main firms of the district, that, in particular, hold the equity control of all their suppliers.

The district evolution therefore seems directed towards a codification of its characteristic knowledge, with an increase of the knowledge transfer process and a gradual verticalization of the main firms towards some production phases. In addition, the industrial district tends to be characterized by few leader firms with a high hierarchy degree, that try to control the codified knowledge spread by establishing inter-firm relationships with a small number of dedicated district suppliers.

## 7. Conclusions

In industrial districts, the growth of a leader firm acting as a strategic reference, due to its capabilities and scale economies, for the other district firms, in particular for its suppliers, can produce relevant effects on the knowledge nature and transfer within the districts.

Based on the knowledge transfer process interpretation, an analysis framework aimed at investigating the characteristics of the knowledge transfer in the inter-firm relationships has been proposed, with specific reference to the industrial district context. In particular, the role of the knowledge transfer in the relationships between the leader firm and its district suppliers has been analysed.

The need of establishing a deeper coordination between the district leader and its suppliers to achieve better performance and international competitiveness pushes the leader firm to activate knowledge codification processes. Consequently, the knowledge transferability increases as well as the need for better control of the knowledge spread within the district, so that the leader firm tends to define strategies aimed to design its own dedicated network of district suppliers. This behavior induces a modification of some typical characteristics of the industrial districts.

An interpretation model has been proposed to point out some evolution trajectory of the industrial districts, based on knowledge nature and transfer considerations. For instance, the model points out how the district leader firms can be induced to reduce the number of possible knowledge transfer channels, causing the rise of the hierarchy degree in their supply relationships. The industrialization and internationalization processes can also lead to a different transformation of the traditional industrial district, such as that leading to the rise of virtual firms, where no control of the codified knowledge transfer is pursued.

Referring to the case of an Italian industrial district, two examples of knowledge codification related to the

industrialization of activities which were originally crafts made have been described, stressing the impact of these actions on the client–supplier relationship management.

## References

- Albino, V., Garavelli, A.C., Pontrandolfo, P., 1996. Local factors and global strategies of the leader firm of an industrial district. Proceedings of the Euroma Conference, London, June.
- Almeida, P., 1996. Knowledge sourcing by foreign multinationals: patent citation analysis in the U.S. semiconductor industry. *Strategic Management Journal* 17 (WinterSpecialIssue), 155–165.
- Badaracco, J.L., 1991. The Knowledge Link: How Firms Compete through Strategic Alliances. Harvard Business School Press, Boston.
- Baranson, J., Roark, R., 1985. Trends in north–south transfer of high technology. In *International Technology Transfer*, eds N. Rosenberg and C. Frischtak. Praeger, New York.
- Barney, J.B., 1991. Firm resources and sustained competitive advantage. *Journal of Management* 17, 99–120.
- Boisot, M., 1987. *Information and Organizations. The Manager as Anthropologist*. Fontana/Collins, Glasgow.
- Ciborra, C.U., 1993. *Teams, Markets and Systems*. Cambridge University Press, London.
- Cohen, W.M., Levinthal, D.A., 1990. Absorptive capacity: a new perspective on learning and innovation. *Administrative Science Quarterly* March, 128–152.
- Cutler, R.S., 1989. A comparison of Japanese and U.S. high-technology transfer practices. *IEEE Transactions on Engineering Management* 36 (1), 17–24.
- Daft, R.L., Huber, G.P., 1987. How organizations learn: a communication framework. *Research in the Sociology of Organizations* 5, 1–36.
- Daft, R., Lengel, R., 1984. Information richness: a new approach to managerial behavior and organizational design. *Research in Organizational Behavior* 6, 191–233.
- Daft, R.L., Lengel, R.H., 1986. Organizational information requirements, media richness and structural design. *Management Science* 32 (5), 554–571.
- Daft, R.L., Weick, K.E., 1984. Toward a model of organizations as interpretation systems. *Academy of Management Review* 9, 284–295.
- Daft, R.L., Wiginton, J., 1979. Language and organization. *Academy of Management Review* 4 (2), 179–191.
- Dioguardi, G.F. (ed.) 1994. *Impresa, territorio e mercati*. In *Sistemi di imprese. Le nuove configurazioni dell'impresa e dei mercati*. Etas, Milano.
- Dogson, M., 1993. Learning, trust, and technological collaboration. *Human Relations* 46 (1), 77–95.
- Dosi, G., Pavitt, K., Soete, L., 1990. *The Economics of Innovation and International Trade*. Harvester Wheatsheaf, New York.
- Gilbert, M., Cordey-Hayes, M., 1996. Understanding the process of knowledge transfer to achieve successful technological innovation. *Technovation* 16 (6), 301–312.
- Hamel, G., 1991. Competition for competence and interpartner learning within international alliances. *Strategic Management Journal* 12 (SpecialIssue), 83–103.
- Huber, G.P., 1991. Organizational learning: the contributing processes and the literatures. *Organization Science* 2 (1), 88–115.
- Johnson-Laird, P.N., 1993. *The Computer and the Mind. An Introduction to Cognitive Science*. William Collins Sons and Co. Ltd, London.
- Kim, H., 1993. The link between individual and organizational learning. *Sloan Management Review* Fall, 37–50.
- Kogut, B., Zander, U., 1992. Knowledge of the firm, combinative capabilities, and the replication of technology. *Organization Science* 3, 383–397.
- Kogut, B., Zander, U., 1993. Knowledge of the firm and the evolutionary theory of the MNC. *Journal of International Business Studies* 24, 625–645.
- Kogut, B., Zander, U., 1995. Knowledge and the speed of the transfer and imitation of organizational capabilities: an empirical test. *Organization Science* 6, 76–92.
- Kolb, D.A., 1984. *Experimental Learning: Experience as the Source of Learning and Development*. Englewood Cliffs, Prentice-Hall, NJ.
- Lamming, R., 1993. *Beyond Partnership — For Innovation and Lean Supply*. Prentice Hall International, UK.
- Leonard-Barton, D., 1992. Core capabilities and core rigidities: a paradox in managing new product development. *Strategic Management Journal* 13, 111–125.
- Leplat, J., 1990. Skills and tacit skills: a psychological perspective. *Applied Psychology: An International Review* 39 (2), 143–154.
- Lombardi, M., 1994. L'evoluzione del distretto industriale come sistema informativo: alcuni spunti di riflessione. *L'industria* XV, 3.
- Mowery, D.C., Oxley, J.E., Silverman, B.S., 1996. Strategic alliances and interfirm knowledge transfer. *Strategic Management Journal* 17 (WinterSpecialIssue), 77–91.
- Nonaka, I., 1991. The knowledge-creating company. *Harvard Business Review* 69 (6), 96–104.
- Nonaka, I., 1994. A dynamic theory of organizational knowledge creation. *Organization Science* 5 (1), 14–37.
- Piore, M.J., Sabel, C., 1984. *The Second Industrial Divide. Possibilities for Prosperity*. Basic Books, New York.
- Polanyi, M., 1962. *Personal Knowledge — Towards a Post-Critical Philosophy*. Routledge and Kegan Paul, London.
- Polanyi, M., 1966. *The Tacit Dimension*. Doubleday, Garden City, NY.
- Prahalad, C.K., 1993. The role of core competence of the corporation. *Research-Technology Management* Nov–Dec, 40–47.
- Prahalad, C.K., Hamel, G., 1990. The core competence of the corporation. *Harvard Business Review* May–Jun, 79–91.
- Ring, P.S., Van De Ven, A., 1994. Developmental processes of cooperative interorganizational relationships. *Academy of Management Review* 19 (1), 90–118.
- Schiama, G., 1997. Un approccio cognitivo per l'analisi dei servizi per l'innovazione: un modello teorico e primi risultati di una ricerca empirica. atti del Workshop AiIG 1997, Genova, May, pp. 154–166.
- Seaton, R.A.F., Cordey-Hayes, M., 1993. The development and application of interactive models of industrial technology transfer. *Technovation* 13 (1), 45–53.
- Stata, R., 1989. Organizational learning — the key to management innovation. *Sloan Management Review* 17, 63–74.
- Steensma, K.H., 1996. Acquiring technological competencies through inter-organizational collaboration: an organizational learning perspective. *Journal of Engineering and Technology Management* 12, 267–286.
- Storper, M., 1992. The limits to globalization: technology districts and international trade. *Economic Geography* 68 (1), 60–93.
- Szulanski, G., 1996. Exploring internal stickiness: impediments to the transfer of best practice within the firm. *Strategic Management Journal* 17 (WinterSpecialIssue), 27–43.
- Teece, D.J., 1977. Technology transfer by multinational firms: the resource costs of transferring technological know-how. *Economic Journal* 87, 242–261.
- Wathne, K., Roos, J., von Krogh, G., 1996. Towards a theory of knowledge transfer in a cooperative context. In *Managing Knowledge — Perspectives on Cooperation and Competition*, eds G. von Krogh and J. Roos. Sage Publications, London.
- Weick, K.E., 1979. *The Social Psychology of Organizing*. Addison-Wesley, Reading.



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