

**Knowledge sharing and innovation
in complex, dynamic and uncertain relational contexts:
The cases of Teledomotics and ICT Security**

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Abstract

In contexts characterized by a high level of complexity the individual strategy of a company is overcome by cooperative agreements (Teece, 1989), that express the growing necessity for a collective strategy and for conjoint strategic action.

Every relationship is interconnected in a complex way and each node of the network develops interactions with other companies in order to exchange information, share experience and develop the properties of their own resources. Among their resources knowledge plays a key role.

Knowledge is considered the strategic asset of a company (Grant, 1996); it is the result of the collaborative behaviour of companies and it cannot be created in isolation. Through interaction, the accumulation of knowledge based on the strategy and history of a company can be integrated with other companies' knowledge and experience.

In this perspective a close relationship between knowledge and innovation emerges: complementary knowledge is required to breed innovative ideas for products and services.

In complex, dynamic and uncertain contexts, particularly, collaboration capability plays an important role as strategic asset, as it helps companies create and transfer knowledge in order to innovate, thus improving economic performance (Miles et al. 2000, 2004).

Collaboration among actors could also compensate companies that try to innovate from a technological point of view without the necessary technological resources (Tyler, 2001).

Starting from these considerations, the aim of this working paper is to understand if, and at what conditions, knowledge sharing can generate innovation in networks.

Two industries characterized by a high level of complexity, uncertainty and dynamism have been chosen for this study: the industries of Teledomotics and ICT Security.

This study highlights that, when competition is considered more important than cooperation, trust and commitment, facilitating communication flows and inter firms information exchange, don't represent effective means to grant knowledge sharing and, consequently, innovation: other mechanisms are required. In the Teledomotics case trust arises in a "natural way", since all the actors perceive the benefits of collaboration and knowledge sharing; in the ICT Security, instead, the perceived risk of opportunistic behaviour leads contractual means to represent the only way to create a gradual process of trust building, reaching in the long term collaboration and reciprocal benefits. In both the situations innovation is generated from knowledge sharing, but with different modalities and different implications.

Key words: network, knowledge sharing, innovation, trust, complexity.

1. Introduction

Starting from the assumption that “no business is an island” (Hakansson, Snehota 1995), the creation of cooperative and coordinated relationships with other actors allows a company to access to resources that it could not obtain on its own.

Companies interact with other organisations characterized by specific resources, abilities and competences, in order to cope with modern competitive contexts distinguished by increasing complexity, uncertainty and dynamism. They develop relationships with actors defined by different core activities, information sharing, knowledge, technology, and other critical assets.

If we consider that in the economy network competitiveness is based on continuous innovation, collaboration capability can be considered as a central strategic element (Blomqvist and Levy, 2006).

Collaboration capability has been defined as the “*actor’s capability to build and manage network relationships based on mutual trust, communication and commitment*”. The role of this capability is accentuated in situations of high uncertainty (Tyler 2001).

According to different studies, shared values and information are functional to develop and maintain inter-organizational relationships and networks (Morgan and Hunt 1994; Wilson 1995; Achrol 1997). Interaction provides the basis for receiving new knowledge (Hakansson, Snehota, 1995), thus creating the possibility for companies to improve their professionalism through experience and joint learning.

Interdependence among actors can be referred to both as resource and knowledge ties. “If, in Modern Economy, knowledge is everywhere, it is not important to recognize its absence/presence (intensity) or to measure its quantity, but to classify its quality and analyse its coherence to the process it belongs to. These conditions support knowledge productivity and, consequently, the ability to generate value” (Rullani, 2004: 149).

A company is therefore seen as a cognitive system based on knowledge and that at the same time creates knowledge, through continuous learning processes. If complexity is considered as a gap between “owned knowledge” and “required knowledge” in order to develop a task, or to play a special role, it is necessary to access to new knowledge.

If we consider that companies use immaterial resources also in the interaction with other organisations that operate in external value chains (Grandinetti, 1993), the challenge is to develop competencies by transferring and integrating knowledge from external sources into the organization's knowledge base (Almeida et al. 2002).

As far as these preliminary remarks are concerned, the main aim of this working paper is to investigate if and how in complex, dynamic and uncertain contexts knowledge, sharing can be considered as an antecedent of innovation.

Generally, trust and commitment are essential to resource sharing, as they play a key role in network coordination (Dwyer et al. 1987; Morgan and Hunt 1994; Wilson 1995; Achrol 1997).

At the same time relationships among companies follow a complex logic of interaction, and include both cooperation and competition, the so called “coopetition” (Bengtsson, Kock 2000). When competition logic overcomes cooperative logic, there can be a negative trade-off.

In order to combine knowledge and to reach competitive advantage, opportunistic behaviours should be limited (Normann, 2002).

So, how can knowledge sharing overcome opportunistic behaviour?

The first hypothesis is that the possibility to generate innovation through knowledge sharing is strictly related to the way in which actors perceive the context in which they operate.

In very competitive contexts, particularly, the possibility to share information and knowledge increases perceived uncertainty.

The second hypothesis is that in complex, dynamic and uncertain contexts, trust and commitment are not always sufficient means to share knowledge and, consequently, contractual mechanisms have to be introduced.

The two cases presented in this study, one still in course, refer to Teledomotics and Security ICT: both industries are characterized by a high level of complexity, fast technological changes, processes of convergence and uncertainty.

The first case underlines how it is feasible to realize innovation by means of knowledge sharing among actors, using trust and reciprocity as coordination mechanisms. In the second case, resource sharing requires external coordination mechanisms and contracts, diminishing, as a consequence, potentialities for innovation in the short run. This more formalized approach could be considered as a first step in the process of trust building, necessary to obtain collaborative innovation in the long run.

2. Companies in complex, uncertain and dynamic contexts

Today companies have to face more structurally complex, uncertain and dynamic environments, due to an increase in competition, deregulation, globalisation and dematerialisation of the output. Complexity is related to the expanding division of labour with its simultaneous need for more information; it is possible to distinguish between structural, that concerns the properties of a system at one point in time, and dynamic (Boschma and Lambooy 2002), referred to the behaviour generated over time by system rules.

The great complexity that has been characterising the environment, as a matter of fact, is due to the increased number of variables (variety), and their evolution (variability) (Vicari, 1991).

In this perspective, complexity is generated by the number of elements that have to be considered in order to solve a problem and by the variety of data and differences in problems, the variability of facts, the instability and inconsistency of problems and, finally, the uncertainty of the context.

In fact, the interdependences between actors and environmental variables create uncertainty about future events, about partners' reactions to these events and also about the incapacity to affect the nature of relationships (Svensson, Göran, 2004).

The management of interdependency in an uncertain environment generates transaction costs; in this perspective, trust could be an important way of limiting uncertainty and its relative costs, as the need for governance and negotiations decreases (Das e Teng, 2002).

Moreover, the continuous process of market placement and changing, the entrance and exit of actors and the creation and dissolution of relationships, lead to an increase in its heterogeneity, in terms of roles, positions and resources (Snehota, 2004: 27).

Experts say that instability is becoming a structural characteristic of business networks (Easton, Wilkinson, & Georgieva, 1997; Halinen, Salmi, & Havila, 1999). A visible effect of the dynamism of business contexts, with a breaking-down of traditional boundaries, is represented by industrial convergence, that is due to transversal technologies which can be transferred from one sector to another.

Companies try to manage changing environments and to satisfy the variety of customer's needs adopting more and more cooperative strategies. Collaboration is accentuated in situations of high market or technological uncertainty, dynamic environment, technological or organizational complexity, resulting in a great need for information and knowledge creation (see also Tyler 2001).

According to this view, the strategic positioning is defined by the organisation's ability to activate interactions that support resource sharing and combination in order to generate value. Thanks to relationships actors develop knowledge and loyalty, creating the basis for a process of adaptation.

The importance of intangible assets, like knowledge, is expanded; they assume a central role in the organizational effectiveness and represent differentiating factors that give the organization its distinctive identity and allow to obtain competitive advantage (Vicari, 1988).

3. Knowledge, a crucial company resource

Resources can be identified as means through which actors develop their activities (Hakansson, 1987) and, at the same time, activities are processes which are developed in order to transform the resources created during interaction.

Resources can be physical (product and production facilities) and social (organisational units and relational units) (Hakansson, Waluszewski, 2002).

Products are created in direct and indirect interactions that influence their property, while production facilities support a better use of resources, reduce costs and have latent features that can be activated only through interaction.

On the other hand, socially complex resources are difficult to imitate as they are complicated to influence and manage systematically (Barney, 1995).

Through relationships companies can share different kinds of resources that, in a Resource Based View, generate competitive advantage (if we consider that the organizational dimension is not like the environmental-economic dimension) (Lipparini, 1998). In this perspective, based on the combination of resources (Boschetti, Sobrero, 1996), the differences among competitors concern the selection of resources and organizational competences.

In other words, companies are a bundle of commitments to technology, human resources, and knowledge-based processes. The coordination of this bundle by entrepreneurs allows them to be heterogeneous and difficult to imitate (Alvarez, Busenitz, 2001).

Resource heterogeneity is the basic condition both for the Resource Based Theory (Barney, 1991) and for entrepreneurship (Kirzner, 1997). Heterogeneity is about cognition, discovery, pursuing market opportunities and coordinating knowledge that lead to different outputs. Resource based logic has tended to focus on resources heterogeneity, while entrepreneurship theory has tended to focus on heterogeneity in beliefs about the value of resources (Alvarez, Busenitz, 2001).

The knowledge-based theory represents an evolution of the resource-based view. It affirms that "both on individual level and on company level, knowledge is seen as a basis for company-level capabilities and as a source of competitive advantage" (Kogut and Zander 1992; Grant, 1996).

Knowledge is a social resource that is becoming the most precious asset and a source of crucial competitive ability (Zhuge, 2006: 571).

If knowledge is considered as a strategic asset for companies, it will be crucial to individuate how to share it, so as to allow the development of company competences.

From the capacity to integrate this knowledge derives the ability to transform "dispersed, tacit and explicit competences into a wide body of organizational knowledge" (Lorenzoni & Lipparini, 1999: 320).

Relationships are at the basis of the outlining of inter-organizational platforms to generate new knowledge from new combinations of existing knowledge, and transfer it to partners.

For this reason it is important to consider the interconnections between the use and value of knowledge.

Valuable knowledge provides a source of sustained advantage as it can be replicated, yet not imitated. Replication and imitation typically go hand in hand.

However, a high level of knowledge complexity could complicate its reproduction, while simple knowledge may be easily reproduced.

Therefore, if knowledge is potentially everywhere, a source of competitive advantage could be to recognize and classify its quality and coherence to the process it belongs to. These elements define knowledge production, its capacity to generate value (Rullani, 2004:149).

4. Knowledge and networks

Companies have both formal and informal structures that influence the degree to which actors interact with each other (Sorenson et al., 2006:1010).

Each actor in the network supports the access to resources which are controlled by other actors (Hakansson, Snehota 1995).

In this perspective actors share knowledge through interrelationships: the potentialities of knowledge can be extrapolated only through interactions. Sharing, as a net of action, is generated by and generates networking.

If relationships are based on trust and reciprocity, it will be easier to transfer distinctive knowledge and resources, because it will be more straightforward to accept the risks of spill over to competitors (Dyer and Singh 1998).

Trust is vital in order to maintain the process of knowledge transfer as fluid as possible; companies regularly test each other's integrity, moving from small, discrete exchanges of limited risks to more open-ended deals that expose the parties to substantial risks (Lazerson, Lorenzoni, 1999).

The process of knowledge transfer can be supported by establishing close, long-lasting social ties through personnel transfer and low managerial turnover.

Without a logic of interaction, many barriers to knowledge sharing across network members (Helmsing 2001) may arise: the necessary condition for creating this logic consists in the belief that cooperation can create reciprocal value.

Particularly, common value, goals and strong relationships seem to be crucial in the creation, diffusion and use of dispersed and tacit knowledge (Nonaka, Takeuchi 1995).

The presence of conditions that allow cooperation, together with the company culture, can be decisive for the company capacity to absorb new knowledge (Cohen e Levinthal, 1990).

The generation and propagation of knowledge outlines a knowledge flow that represents its passage between nodes according to certain rules and principles. So, knowledge logistics concerns methods and procedures which provide the right knowledge to the right person at the right time (Zhuge, 2006: 572).

On the contrary, knowledge intensity is defined as the power to drive this knowledge flow and reflects the cognitive and creative ability, determining the node's rank or reputation.

It is useful to define the integration of knowledge in the network and the characteristics of networking activity:

- direct knowledge sharing (where knowledge is passed between nodes in a pure peer to peer networking mode);
- hybrid knowledge sharing (where all flows occur through a central repository).

The knowledge flow network approach combines both codification and personalization strategy. In the first case knowledge is encoded and stored in documents, while through a personalization strategy, with a person to person approach, knowledge is created, used and shared peer to peer and it is supported by appropriate communication facilities.

Finally, it is central to consider that in the network context and in particular conditions, limitations and barriers to knowledge flow and knowledge transfer could arise.

5. Opportunism and knowledge sharing

Starting from the assumption that networking has grown in importance as companies have become more concerned with the proper balance of competition and cooperation (Ford, Håkansson, Johanson 1990), the equilibrium between them could affect the availability of knowledge transfer. In the “market for knowledge” inefficiencies and lack of information may generate asymmetries (Davenport & Prusak, 1995: 40-41).

When information is considered as a “personal” property, scarce communication could damage the entire network and not promote innovation.

Relationships can be considered as a mechanism for knowledge coordination and for information sharing.

Although individuals try to use resources better, the incomplete availability of knowledge and information limits their cognitive capacity and their rationality (Snehota, 2004).

The different ways of perceiving and interpreting the business context could create a limitation in communication and knowledge transfer among actors. The cognitive structures that guide interpretations evolve continuously (Snehota 4, 2004); therefore companies need to put effort in sharing their identities, trying to understand the deep mechanisms of transferred knowledge (Nahapiet & Ghoshal 1998).

The necessity to develop a common language makes learning possible through more efficient communication and interpretation.

Shared identity among organizations reduces the cost of communication and the fear of opportunism, and furthermore provides tacit rules and values for efficient coordination and learning (Kogut, Zander 1996).

But an asymmetric power between partners, as far as their ability to control resources and tasks in relationships is concerned, often occurs. This could generate opportunistic behaviours with negative effects on the whole network.

Opportunism can be related to the tentative of accessing the competences of another company, using them to obtain own benefits (Das, Rahman, 2001).

Mutual forbearance and a trusty and committed atmosphere could limit this behaviour. The companies' ability to transfer knowledge is strongly related to the partners' ability to build incentives to act transparently (Niemenen, 2005).

Furthermore companies should give evidence of positive results and of mutual benefits to cooperate in order to reduce opportunistic activities.

But in contexts which are characterized by a high level of variety, variability and competition, trust and commitment could not be a valuable coordination mechanism for knowledge transfer.

In these cases, when social relationships and open communication are not sufficient to build trust, different means are required.

More formalized planning tools are needed in order to maximize incoming results with positive effects on investments in technologies and innovation processes.

All at once contractual specifications and mutual hostages look like feasible ways of controlling the partner's behaviours in complex contexts (Parkhe 1998) but, at the same time, rigid contracts do not represent a useful system of knowledge transfer, as the exchange process is highly social and only part of this knowledge can be transferred.

We can conclude that, if relationships and alliances are interpreted as a “Trojan horse” (Dusaige et al., 2000), companies could perceive high risks about competitors' intentions to appropriate their knowledge, and so there could be a scarce incentive to collaborate and innovate.

6. Knowledge as a source of innovation

A network is a world in which an actor can make little things alone, but if a sufficient number of actors is mobilized, everything will become possible (Håkansson, 1987). According to the third network paradox, the actor's compliance is at the basis of loyalty, of knowledge sharing and of the development of innovative solution potentialities.

Innovation is a dynamic phenomenon which involves productive processes of cross fertilization.

The way in which technology is used and developed depends on the interactions among organisations in the whole network (Ford et al., 2003).

Particularly, high-technology industries, characterized by a high degree of uncertainty and by the essential role of skills variety, (Moriarty and Kosnik, 1989) are required to rely on their partnerships when they handle the large number of technologies in order to cope with the complex business environment.

Companies are influenced by existent relationships and receive benefits from investing in them, as resources can be easily adapted.

As a consequence, there is a strong relationship between collaboration and knowledge, and between knowledge and innovation.

Miles et al. (2000) point out that the ability to collaborate is a meta-capability for innovation. In this perspective collaboration and trust-based mutual communication are necessary to create and transfer knowledge that, in turn, can lead to innovation, which is a combination of the complementary knowledge of asymmetric actors (Bloomqvist, 2006; Miles et al. 2000, 2004).

The links developed among actors allow to maintain relationships in the long run, to transfer and combine knowledge, and to generate an innovation of processes and products.

If we consider processes, the actors' behaviour generates a new configuration of network, in which new relationships represent antecedents to the processes of changing.

On the other hand, as far as the innovation of products is concerned, innovating companies are characterized by a trend of going beyond the trade-off between products and services (Rullani et al., 2006). Innovation means working on the value of the ways in which solutions can be used and on the number of possible solution reuses.

Actually, the reproducibility of products and services creates new industries and new services. In the first case companies develop combined solutions (integrated products and services), in the second case companies replicate services in order to reach scale economy.

For this reason, we can say that knowledge plays an important role in the processes of innovation.

7. Methods

In order to answer our research question we have used a qualitative approach, investigating the phenomenon through observation. In grounded theory perspective, research design is continuously redefined on the basis of gathered information.

As for empirical evidence we refer to the case study method, which has commonly and successfully been used in the study of business networks, particularly in the IMP tradition (Halinen and Törnross 2004).

Yin (1994) suggests that case study research suits the examination of the reasons why and the ways in which contemporary, real-life phenomena occur very well, besides the moment in which the boundaries between the phenomenon and its context are not clearly defined or multiple sources of evidence are used.

So case study method is particularly useful to study networked structures which, in themselves, are hard to delimit (Jarillo 1993).

This allows to understand the dynamics of the studied phenomenon, providing a many-sided view of a situation or of an object of study in a specific context (Halinen and Törnross 2004, Easton 1995).

The main limit of its application consists in the fact that it provides little basis for scientific generalization (Yin 2003), but this risk decreases if one chooses an adequate number and typology of cases.

More in detail, the study of comparative cases provides the possibility to look at multiple cases at different stages of development, or in different configurations, and to compare them using a full set of data collection methods.

The comparative method, in particular, is very important to select cases in order to gain valuable insights towards theory from their comparison.

In this study comparative cases are developed focusing on the new industries of Teledomotics and Security ICT and we have considered two projects analysed in two different PhD researches. The case of the ICT security industry is still in course.

The attention is focused on actors and on their behaviour, assuming that the organizations are units of “*interlocking behaviours*” (Hakansson, Snehota, 1995:194) that can reach their goals only if these are shared and pursued by different actors.

The analysed cases present both homogeneous and inhomogeneous characteristics.

If we consider the homogeneous aspects, we will find that:

- they refer to emergent industries;
- they are characterized by complexity, because of the great variety and variability of actors and technologies, of the uncertainty of the relationships between action and reaction, and of the dynamism which concerns the rapidity of changes;
- the increasing component of services in the solutions that are offered to customers;
- the key role played by technology in knowledge sharing, and the innovation of products and processes;
- the appearance of new customer needs;
- the phenomena of convergence;
- etc.

The inhomogeneous elements, on the contrary, consist of:

- the observation of different objects: interaction among suppliers in the first case and customer interaction in the second case;
- the peculiarities of different companies;
- the analysis of different stages in the development of the project.

We expect that the case comparison will be able to produce more accurate information than in a situation characterized by a purely homogeneous selection (Knodel 1993: 35-50).

In order to build up the cases we followed two different approaches, considering the different nature of the research context:

- in the Teledomotics case, semi structured interviews, both off line and on line, were made to the three main actors of the project (that belong to the three main areas of architecture-building, automation and social context) and to ten industry experts (considering other projects analysed in this area);
- in the Security ICT case, reserved meetings were attended and semi structured interviews were made to five participants, to influential opinion leaders and industry experts.

Primary data have been completed with secondary ones.

The main issues which were deepened during interviews and discussions concern:

- the characteristics of the industry and of the projects;
- the perception of the network context;
- the advantages and disadvantages of knowledge sharing;
- the importance of a network coordinator;
- the possibility to generate collaborative innovation from the interaction among actors.

8. First case: the rise of the Teledomotics network

The development of new technologies supports the process of changes and innovation, influencing offers and the evolution of the industry.

The use of the same technologies in different sectors increases blur borderlines and processes of co-evolution among organisations characterized by different core activities.

New technologies are leading to the development of teleservices based on remote access and control. More and more solutions represent the integration between hard (products) and soft (services) elements.

This evidence has been individuated with reference to articulated sectors, characterized by a convergence process, as the home living context and the health context, in which actors try to manage complexity through networking.

In the home context the planning process, which is divided into preliminary, definitive and executive steps, requires coordination among different actors (Nardi et al., 1994), such as architects, planners, constructors, technicians, ICT providers, electricians, household appliances providers, home automation devices providers and inhabitants. The actors activate interactions in order to develop articulated solutions, realizing their core activities and satisfying the inhabitants' needs.

The introduction of new technologies in the home context has been generating the creation of Home Automation or Domotics, thus improving existing products and increasing provided services (Quaranta, Mongiovi, 2004). For a long time Domotics has been associated to gadgets, *for few* (ANIE, 2004). The introduction of ICT supports the evolution of Domotics in Teledomotics, that develops the two-way communication in the home context, and between the home context and the environment. This process, Homevolution (ANIE, 2004), is based on the rise of teleservices, which allow inhabitants to realize a remote control of their home: for example, they can support the activation of windows and doors thanks to sensors.

In this perspective, teleservices could be referred to both as security and safety means. In the latter we find telemedicine services that improve the patient's quality of life.

Through these services, home devices can improve the methods of rehabilitation therapy. A Web-based software, developed for the control of sensors, can gather the information from a sensor and manage it. This "soft" technology allows different actors to share patient-inhabitant data-information in order to realize, in the project, customised services in their core activity; at the same time the "hard" technology allows to support patient-inhabitant action or "home action". When the software finds a value which is out of the expected range, it can rise an alarm to medical staff.

More and more Teledomotics and telemedicine-telehealth networks are based on the same technology, that supports a process of convergence generated by different actors that co-operate to realize shared solutions.

The introduction in the health area of New Technologies has determined very important developments. According to Nora and Minc (1978), the convergence of Medicine, Computer Science, and Telecommunications, has created Health Telematics, that generates telemedicine-telehealth relationships. Telemedicine deals with the relationships between doctor and patient, or his/her caregiver, mediated by new technologies; it also concerns the relationship between organisations and patient in order to satisfy, by means of ICT, his/her health needs.

On the other hand Telehealth deals with the relationships among organisations in order to improve their process. In this case a patient can access through the web, in a remote way, to his/her clinical report (laboratory examination, medical report and diagnostic images, letter of discharge). As far as Telehealth is concerned, the Information System grants the sharing of data and information among different social health organisations. This supports the cooperation among actors involved in the health process. Technology allows the user (both medical staff and patient) to retrieve patient information (querying by key fields, i.e. name, photography) and the patient can use software through multimedia input/output devices, using touch screen, echoing the system messages via loudspeaker. Through telecontrol services for example, with a mobile and wearable unit, people can find environmental and physiological parameters, generating a call in case of emergency. This software can make the communication among medical staff, patients and hardware device easier.

The *Abri* Project: a safe place

In the home living context new technologies allow the realization of complex solutions that require the commitment and co-ordination of actors belonging to different areas. In the Italian context, at the end of the 90s, HB Group developed the *Abri* project (the French word meaning "a safe place") based on the building of two apartments of 45 sqm (TecHome and SofHome) for people with special needs. The main aim of this project is to realize a "gym" for young people with special needs, where they can learn and test the potentialities of new technologies for autonomous life.

The Automation in TecHome concerns safety (with anti-flooding sensors, gas and smoke detectors) and security (with a system of anti-intrusion). The automation supports the ability to use the home environment and the communication to/from the external context.

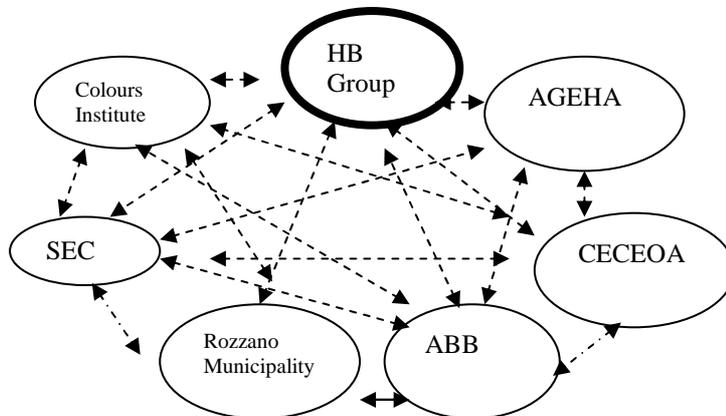
In SofHome the attention is focused on the environment and on the furniture that are in line with special needs. The lightness and colour are studied in order to increase home usability. Technology plays a key role in increasing the quality of life of people with cognitive and motion disabilities and supporting a better interaction between the user and the environment.

This project has been developed thanks to the support of actors belonging to different disciplinary areas such as the social-health area, the automation system, the furniture sector, etc.

The main actors involved (fig.1) are:

- HB Group: a group of planners who focus on projects for special needs;
- AGEHA: a parents' association that supports people with special needs;
- Cooperativa Edificatrice Case Operaie Agricole: a cooperative society for residential building;
- Rozzano Municipality: a local building trade authority;
- SEC - Serramenti e Componenti: it provides information to the fixture sector;
- Colours Institute: it develops activity research in the colour context;
- ABB: one of the first engineering groups

Fig. n.1 The main actors of the project



Thanks to resources sharing and to the development of relationships, actors realize solutions that support the experimentation of knowledge and of new technologies.

If we consider technological aspects, ABB provides iBus EIB. Particular attention is given to the realization of interfaces that permit to find better solutions for special needs. These interfaces are made up by a key, an infrared remote control, a dedicated remote control, a voice recognition system, a remote control by personal computer. The BUS System manages the electrical system (illumination), various automation systems (windows, doors, etc.), the heating system (thermostat, hot water heating, etc.), the waterworks (anti-flooding sensor), the antismoking sensors to avoid blazes.

This technology supports inhabitants with special needs in their daily activity. Particular attention is given to furniture, plants, equipment to support an easy management of the home environment.

The sensibility of CECEOA in the realization of the home context, supplying solutions for the real needs of users, has induced the organization to cooperate with the Municipality of Rozzano and with HB Group in the realization of this project.

Other actors (fig. 2) have sponsored the project and its implementation: Vimar, iGuzzini, Ideal Standard, IKEA, Confalonieri, Abet Group, Alberti, Dinamica Chiavi, PlanTronic, Ponte Giulio, DiTEC, Appiani, Ariostea, Dorma, Max Mayer, Rehau, Armonie, Mingardi Magnetic, Asa, Bocchi, Hesa, National Instruments. In this network relationships are less strong than in the first, for actors were more committed.

wide range of fields: rehabilitation experts, psychologists, sociologists, legal experts, engineers, etc. It offers the experience accumulated in several years of research and its activity ranges from product design to furniture and from architecture to public space design.

HB Group does not act as a controller but as a “middle man”, supporting the interaction among companies. This actor has also become a testimonial for Teledomotics benefits supporting the diffusion of information and knowledge sharing. In this context the complexity of the project has been managed through networking.

9. A running project for information and knowledge sharing in the industry of Security ICT

The complexity and uncertainty that characterize modern competitive contexts lead to an increasing need for data, information and process sharing. At the same time the interconnections among the different ICT infrastructures and the Internet diffusions are leading to continuously increasing risks that companies have to face.

The widespread interconnectivity has amplified the vulnerability of computer systems, and more importantly, of the critical infrastructures they support. Interconnection also determines new threats: malicious hackers, criminals and industrial spies. The level of uncertainty increases.

As a consequence the costs necessary to guarantee an adequate level of company protection increase. From 2004 to 2009 the Italian Security IT market is forecast to have an average growth index of 16,8%, while the IT industry is expected to grow by only 1,5-2% (Mastropasqua, 2006).

According to IDC researches, the complexity of managing security technologies is one of the highest challenges organizations will face over the next years.

In the past, traditional approaches to computer security, in particular the historical security model of threats avoidance, failed. In fact, it is possible to see the tendency among Italian companies to act and repair only after the security problem has emerged, following a “false security” approach, acting in a very disorganized way and spending much money.

The only way to face these vulnerabilities is through detection and response: the number of companies which are investing not only in single and isolated solutions (ex: antivirus, firewall, anti-spam, etc.) but also in more integrated ones (risks management, risks exposure, solutions aimed at guarantee business continuity, UTMS, etc.) is increasing.

The need for more integrated solutions will force secure content management (SCM) vendors to shift from a single type of protection towards broad defence and, more in general, to increase the level of cooperation within the network.

For customers the main difficulties in maintaining a strong security posture include budget constraints, lack of skilled staff, the increasing sophistication of attacks, the interconnectedness of modern systems, the complexity of security management, the compliance to new regulations, etc.

All these elements contribute to create many barriers in the customer-supplier interaction.

Concluding, Security ICT is a very complex and changing industry. In fact:

- on the supplier's side, new actors, such as telecommunication companies and traditional vendors, are starting to provide security products and services; old actors, such as big security vendors, are changing their business and introducing new security offers; distributors are starting to propose themselves as valued added resellers and many system integrators *have been acquired by* big companies;
- on the customer's side, more and more companies are demanding for security products and services; the situation is very confused and heterogeneous.

The ISAC (Information Sharing and Analysis Center) Project

Over the last years technical investment in single security solutions and a reactive approach to security problems have shown their limits.

The introduction of new isolated technologies is not enough to improve the level of information security of companies, an intermediate step is required. The challenge for companies is to develop the capacity to recognize their needs and to manifest them to the right solution providers.

A feasible, but not easy way of realizing it lays in the prompt data/information exchange and knowledge sharing among customer companies: the Information Sharing and Analysis Center (ISAC).

ISAC is a project based on a trusty net of collaborations that should allow participants to individuate threats as soon as possible, to communicate incidents, to manage emergency in a collective way, to distribute information about how to solve problems and about the best solutions, knowledge about products and processes, about providers, laws, etc.

ISAC's aim is to enable its participants to have a global and integrated view of security issues and problems, in order to overcome their limited information availability and competencies about this topic.

Communication flows take place between customers and the ISAC coordination centre, and not among customers in a peer to peer modality.

In Italy this typology of organization is perceived as very innovative and, as consequence, there are some difficulties in realizing it.

As a consequence, the Italian ISAC project is studied gradually. At the moment the ten biggest Italian telecommunication companies have discussed the modalities for taking part to the ISAC project, guided by an expert from the Ministry of Communication and very well known opinion leaders on security issues. The aim has been to get to know each other and to build a first informal trusty network. In the future, if there are positive results, small companies and companies from other industries will be invited to enter the ISAC or, hopefully, they will ask to join it.

From an organizational point of view, in its first phase the ISAC project will take place in a Ministry office, some people will be employed to work on them while participants should define internal persons that will manage the interactions with the ISAC.

Firms are now evaluating to sign a NDA (Non Disclosure Agreement) in order to guarantee the confidentiality of shared information. Anyone who releases information outside the ISAC will be expelled and obliged to compensate the damage in monetary terms.

As far as equipment is concerned, a big vendor will promote the initiative and provide computers, servers, machines, etc., and a security service provider will be individuated in order to guarantee the security of information and knowledge flow between companies and the ISAC centre.

When companies share security information, each one spends less on information security than doing it by itself. In an insecure environment nobody is safe.

ISAC will be able to play its effective role only if there is a strong spirit of collaboration among participants.

Notwithstanding secrecy makes everybody less safe, this project is very difficult to realize and there are problems in reaching an agreement among the participants.

These difficulties are strictly related to the fact that security processes are the core of company organization; companies are not very willing to share information about their vulnerabilities, about incident, about the solutions they adopted, as they fear that this weakness could be used by competitors in an opportunistic way.

Moreover, they are convinced that corporate image and reputation could be damaged if information about security incidents were diffused to final customers.

This provides an additional reason for members to renege on sharing security breach information with other companies.

This can create a negative trade-off, and so strong arguments are necessary to convince companies to accept the risks related to information spill-over towards the other ISAC participants, otherwise this mechanism will not work.

The effect is that this form of sharing could not be created in a voluntary way, but a *super partes* structure has to be created.

In practice, if there is free riding, members may under-invest in the development of measures of information security in anticipation of obtaining them for free from other ISAC participants and/or under-report breaches and attempted breaches of their computer systems.

In absence of information sharing, each company independently sets its information security expenditures at a level where marginal benefits equal marginal costs. It is shown that when information is shared, each company reduces the amount of money spent on information security activities. Nevertheless, information sharing can lead to an improved level of information security. From an economic point of view, the level of information security that would be optimal for a company in absence of information sharing can be obtained at lower costs when computer security information is shared.

In the long run the benefits which derive from the participation to an ISAC could consist in an improved level of awareness about ICT security processes, a higher level of competence and, subsequently, a greater ability of companies to communicate to solution providers their needs and to evaluate different offers.

In the long run this could have an impact on innovation:

- as far as customers are concerned, companies would be more committed to introduce new technologies and more predisposed problems and solutions, and the reduced uncertainty referred to the context dynamism and the other actors' behaviours;
- as far as suppliers are concerned, the relationships with customers would improve and become more fluent, particularly under a communication point of view, thanks to a more aligned knowledge about technologies and problems. This would give vendors new incentives to elaborate new products and would stimulate system integrators and service providers to improve their offer of services.

According to the Italian version, ISAC does not predict rigid mechanisms to function, in fact joining and reporting to Information Security Analysis Centres (ISACs) is voluntary, not anonymous, with no economic incentives to persuade full reporting and discourage free riding (such as subsidizing participation to the level of information provided).

The only weak contractual mechanism is represented by the NDA (Non Disclosure Agreement).

As a consequence both the Italian government and big vendors, such as Cisco and Microsoft, have the responsibility to encourage this initiative, to support it, to promote its benefits during events, on specialized press, using associations' activities (e.g. AIPSI-the association for security professionals), etc. They are putting much effort in reaching these objectives.

For this reason, contracts are the required mechanism to overcome the initial distrust and scepticism among actors, while in the long run trust is expected to become the effective means of coordination of the ISAC system.

10. Conclusions

According to Nieminen (2005), the nature and dynamics of the management of relationships in knowledge transfer is a primary question which affects the companies' ability to develop new competencies and strategies, to manage complexity and to gain competitive advantage.

Companies interact with organisations characterized by specific resources, abilities and competences, in order to survive in the competitive context; every relationship is embedded with other relationships, which are developed by, and with, other actors. The interconnections among actors are at the basis of knowledge sharing, by which innovation, in terms of product, solution and process changing, is generated.

In this perspective, in complex, dynamic and uncertain contexts, knowledge sharing often precedes network innovation.

Sharing information, both inside and outside companies, is fundamental to establish and maintain effective relationships. Strong relationships and information sharing can be more easily achieved if partners share corporate values as well. Shared value, goals and strong relationships are particularly important in the creation, diffusion and use of knowledge, that is more and more dispersed and tacit (Nonaka, Takeuchi 1995). At the same time, trust-based communication is crucial for knowledge transfer and for innovation (Miles et al. 2000).

Thanks to result sharing it is possible to decrease the costs of providing any given level of information, creating benefits for each company and for the whole network.

Therefore it is important to consider the role of opportunism and the related governance costs that can limit information and knowledge sharing.

In this working paper two case studies have been developed in order to investigate the ways in which knowledge sharing can become an antecedent of the processes of innovation.

If we compare the first and the second case, a common point is that knowledge sharing among actors determines benefits in terms of innovation.

When relationships are characterized by trust and commitment, innovation is easier and faster to realize, because the advantages of collaboration are clearly perceived by all actors.

In the case of Teledomotics industry, new technologies require organizations which recognize their potentialities in order to invest in their use and development. The key role of “testimonial organizations”, that experiment the benefits of new solutions and support their use by third parties, has been outlined. The realization of new products and services requires knowledge sharing between organizations and users (increasing final demand), but also among industrial actors (increasing collaboration). This has allowed to discover the potentialities of Teledomotics, which focuses on the needs for security satisfaction (in the home context) and safety satisfaction (as far as people are concerned). Testimonials can promote, by a word of mouth based on their own experience, the benefits of new solutions, thus increasing the attention of end users and potential partners.

In this context, an actor with a central position plays a key role since he/she co-ordinates different actions, intermediates among different languages (technical, social, and technological language) and competencies, in order to reach the objectives of the project.

In this perspective, knowledge transfer is related to the characteristics of knowledge, to the context of relationships, to the supporting organizational structures and to the learning abilities of companies.

The nature of shared information and knowledge, in particular, is really crucial. In the case of Teledomotics we can consider information about solutions, applied technology, previous projects and experience etc. The benefits which derive from collaboration are higher than those one would obtain if information and knowledge were kept secret. The evolution of the innovation of life is supported from a “prototype stage” to a “development stage”.

In this perspective the process of innovation, as a process of change, is based on actors' behaviour and knowledge sharing. The network strategic organization, and the network logic, support the introduction of innovative solutions allowing further information and knowledge sharing. In order to meet complex needs, different organizations of the home living context and of the health context cooperate to realize solutions based on hard (product) and soft element (services). They trust each other since they perceive the benefits of joining their knowledge and experience.

Organizations characterized by different core competences (architects, planners, constructors, technicians, ICT providers, electricians, household appliances providers, home automation devices providers...), are linked by corporate values, in this case the ethical dimension, which is at the basis of the process of trust building.

On the contrary, in the case of ICT Security industry, information and knowledge are very sensitive, reserved, private, tacit and this makes their sharing very difficult. Moreover, the context in which companies operate is seen as a very competitive one, and so the possibility to share information and knowledge about security incidents, technologies and processes could destabilize firms instead of “reassuring” them: the supposed collaboration increases the perceived uncertainty. Actors are not interested in the benefits arising from collaboration.

So, new mechanisms of coordination among actors, such as the ISAC, should be created in order to overcome the natural distrust among actors.

Risks that may derive from an opportunistic behaviour should not be considered as a barrier to innovation, but only as a feature that keeps the benefits of knowledge sharing slower to appear.

The introduction of some weak contractual mechanisms will encourage actors to communicate with the others, in a gradual way and through the ISAC, thus developing awareness and understanding, strengthening the interconnections and, in the long run, building the trust required to share the knowledge that will lead to innovation.

On top of this, information sharing allows each actor to increase the understanding of the identity and experience of other actors, modifying their network perception and their actions.

Particularly, the increased familiarity with the other ISAC participants has an impact on the perception of the whole context, which is no longer seen as competitive and insidious as it was first supposed.

Hence, in highly competitive situations actors should not be persuaded to trust each other but to trust a “third” organization, like the ISAC, which in practice means trusting every participant. Considering that opportunism is related to the relationship perceived between competition and cooperation, influencing the perception of participants is really important in order to make knowledge sharing and innovation possible.

In these circumstances, innovation, that involves both customers and suppliers, is the result of the improvement of relationships and requires a medium-long period of time to be realized. Yet, in the case of Teledomotics, the presence of trust from the beginning of the project allows to share knowledge that actors then decide to devote to innovative products and processes.

This trust is present also because actors need to trust each other in order to reach the project’s aim they defined since the beginning of their relationship: innovative solutions.

So, in the first case trust developed in the long term represents an antecedent of knowledge sharing which in turn generates “not planned” innovation, while in the teledomotics case the purpose to innovate, concretised in the Abri project, correspond to an antecedent of trust and knowledge sharing, and the innovative product and services are the realization of the initial purpose.

Trust and knowledge sharing are necessary conditions to realize innovation: necessary, but not sufficient.

In conclusion, both cases underline the double role of technology. On the one hand the availability of information and communication technology enables communication between the different interfaces, and makes knowledge sharing possible. As described in the case of Teledomotics, a particular software can gather information about patients and their needs and transfer it to other actors. On the other hand, in the security context a specific infrastructure has to be created in order to enable flows of communication among actors and to guarantee their safety.

At the same time technology is the element that allows to create new products, new services and new solutions; knowledge of technologies increases its potentiality when it is shared with other actors, who either belong to the same industry, like in the ISAC case, or to companies with different core activities, as in case of Teledomotics.

The main limit to the application of the method of this case study lays in the fact that there is little basis for scientific generalization, yet this risk is lower if an adequate number and typology of cases are chosen.

We think that in the future it will be useful to analyse other projects and cases in order to define a model of knowledge sharing in complex, dynamic and uncertain contexts, individuating, mediating and/or moderating the dimensions that affect the relationship between knowledge sharing and innovation; moreover, the role of knowledge, both inside and outside the network, will have to be further analysed and the implications on single actors will have to be explored.

References

Achrol R. S. (1997), Changes in the Theory of Interorganizational Relations in Marketing: Toward a Network Paradigm, *Journal of the Academy of Marketing Science*, 25(1): 56-71.

Almeida P., Song J., Grant R.M. (2002), Are firms superior to alliances and markets? An empirical test of cross-border knowledge building, *Organization Science*, 13, Iss. 2: 147-161.

Alvarez, S., Busenitz, L. (2001), The entrepreneurship of resource-based theory, *Journal of Management*, 27: 755-775

- Barney J.B. (1991), Firm resources and sustained competitive advantage, *Journal of Management*, 17: 99-120
- Barney J. B. (1995), Looking inside for competitive advantage?, *The Academy of Management Executive*, 9: 40-61
- Bengtsson M., Kock S. (2000), Coopetition in business networks—to cooperate and compete simultaneously”, *Industrial Marketing Management*, 29: 411-426.
- Blomqvist K., Levy J. (2006), Collaboration capability – a focal concept in knowledge creation and collaborative innovations in networks, Imp Conference
- Boschetti C., Sobrero M. (1996), Risorse e vantaggio competitivo: ricorsi storici o nuove prospettive di analisi (A critical review of resource-based approaches), *Economia e Politica Industriale* 23(91): 63-94.
- Boshma R.A., Lambooy J.G (2002), Knowledge, Market Structure and Economic Coordination: Dynamics of Industrial Districts, *Growth and Change*, 33 (Summer): 291-311
- Cohen W.M., Levinthal D.A. (1990), Absorptive capacity: a new perspective on learning and innovation, *Administrative Science Quarterly*, 35 (1): 128-152.
- Das T. K., Rahman N. (2001), Partner misbehaviour in strategic alliances, *Journal of General Management*, 27 (1): 43-70.
- Das T.K, Teng B. (2002) The Dynamics of Alliance Conditions in the Alliance Development Process *Journal of Management Studies*, 39: 725-746
- Davenport T. H., Prusak L. (1998), *Working knowledge – How organizations manage what they know*, Harvard Business School Press, Boston.
- Dyer J.H., Singh H. (1998), The relational view: Cooperative strategy and sources of interorganizational competitive advantage, *Academy of Management Review*, 23: 660–679.
- Dusaige, Garrette e Mitchell (2000), “Leading from Competing Partners. Outcomes and Duration of Scale and Link Alliances in Europe, North America and Asia”, *Strategic Management Journal*, 21: 99-126.
- Dwyer, F.R., Schur, P.H., Oh, S. (1987), "Developing buyer-seller relationships", *Journal of Marketing*, Vol. 51 pp.11-27.
- Easton G, Geoffery JW (1995), Methodology and Industrial Networks, In *Business Marketing: An Interaction and Network Perspective*, (edit) Kristian Möller and David Wilson: 411–492. Kluwer Academic Publishers: Boston.
- Easton G., Wilkinson I., Georgieva Chr. (1997) Towards evolutionary models of industrial networks. In Gemu“nden H. G., Ritter T, Walter A. (Eds.), *Relationships and networks in international markets*, Oxford: 273–293
- Federazione delle Industrie Elettroniche ed Elettrotecniche (ANIE) (2004), *Homevolution*
- Ford, D. (Ed.) (1990), *Understanding Business Markets: Interaction, Relationships, Networks*, Academic Press, London

- Ford D., Gadde L., Hakansson H., Snehota I., (2003), *Managing Business Relationships*, 2nd Edition, John Wiley, Chichester
- Grandinetti R. (1993), *Reti di marketing. Dal marketing delle merci al marketing delle relazioni*, Etas Libri, Milano.
- Grant, R. M. (1996), Towards a knowledge-based theory of the firm, *Strategic Management Journal*, Winter Special Issue, 17:109-122.
- Hakansson H., (1987), *Industrial technological development: a network approach*, Croom Helm, London
- Hakansson H. Snehota I.,(1989), No business is an island: the network concept of business strategy *Scandinavian Journal of Management*, 5 (3): 187-200
- Hakansson H. Snehota I (1995), *Developing relationships in business networks*, Routledge, London 1995
- Hakansson H., Waluszewski A., (2002), *Managing technological development. IKEA, the environment and technology*, Routledge, London
- Halinen A, Törnroos JA (1998), The Role of Embeddedness in the Evolution of Business Networks, *Scandinavian Journal of Management*, 14 (3): 187-205
- Halinen A., Salmi, A., Havila V. (1999), From dyadic change to changing business networks: an analytical framework, *The Journal of Management Studies*, 36 (6): 779-794.
- Helmsing, B. (2001), Externalities, learning and governance: New perspectives on local economic development, *Development & Change*, 32: 277–308.
- Jarillo J. C. (1993) *Strategic Networks. Creating the Borderless Organisation*. Butterworth-Heinemann: Great Britain.
- Kirzner I, (1997), Entrepreneurial Discovery and the competitive market process: an Austrian approach, *Journal of Economic Literature*, 35: 60-85
- Kogut B., Zander U. (1996), What firms do? Coordination, identity and learning, *Organization Science*, 7 (5): 502-517
- Knodel (1993) The Design and Analysis of Focus Group Studies, a Practical Approach, in Morgan, David L. (ed.) *Successful Focus Groups, Advancing the State of the Art*, Newbury Park, CA, U.S.A., Sage: 35-50
- Lazerson, M. H., Lorenzoni, G. (1999), The firms that feed industrial districts: A return to the Italian source, *Industrial and Corporate Change*, 8: 235–266.
- Lipparini, A.(Ed.), (1998), *Le competenze organizzative*, Carocci, Roma
- Lorenzoni G., Lipparani A. (1999), The leveraging of interfirm relationships as a distinctive organisational capability: a longitudinal study, *Strategic Management Journal* , 20: 317-338.
- Mastropasqua R. (2006), Security Conference 2006 di IDC: la sicurezza estesa per garantire il controllo dei processi delle organizzazioni a difesa del cittadino, IDC Press Release , february

- Miles R., Snow C., Miles G. (2000), TheFuture.org in *Long Range Planning*, 33, 300-321
- Miles R., Snow C., Miles G. (2004). *Collaborative Entrepreneurship. How Groups of Networked Firms Use Continuous Innovation to Create Economic Wealth?* Stanford, Ca: Stanford University Press, Forthcoming.
- Morgan R. M., Hunt S. D. (1994), The Commitment-Trust Theory of Relationship Marketing, *Journal of Marketing*, 58: 20-38.
- Moriarty R.D., Kosnik T.J. (1989), High-Tech Marketing: Concepts, Continuity and Change, *Sloan Management Review*, 30 (4): 7-17
- Nahapiet J., Ghoshal S. (1998), Social capital, intellectual capital and the organizational advantage, *Academy of Management Review*, 23 (2): 242-266.
- Nardi G, Campioli A, Mangiarotti A, (1994), *Frammenti di coscienza tecnica. Tecniche esecutive e cultura del costruire*, Franco Angeli, Milano
- Nieminen H. T. (2005), Successful Inter-Organizational Knowledge Transfer: Developing Pre-Conditions through the Management of the Relationship Context, paper presented at 21st Imp Conference, Rotterdam
- Nonaka I., Takeuchi H., *The knowledge creating company*, Oxford University Press, New York, 1995
- Nora S., Minc A., (1978), *L'Informatisation de la Société*, La documentation française
- Norman P.M. (2002), Protecting knowledge in strategic alliances, resource and relational characteristics, *Journal of High Technology Management Research*, 13: 177-202.
- Parkhe A.(1998), Building trust in international alliances, *Journal of World Business*, 33 (4): 417-437.
- Quaranta G.G., Mongiovì P.(2004), *L'abc della domotica*, Il Sole 24 Ore, Milano
- Rullani, E (2004), *Economia della conoscenza*. Carocci Editore. Roma
- Rullani E, Paiola M, Sebastiani R, Cantu' C., Montagnini F., (2006), *Innovare che passione*, Franco Angeli, Milano
- Snehota, I. (2004), Perspective and theories of market, in Häkansson H., Harrison D. and Waluszewsky A., *Rethinking Marketing* (13-32), Chichester (England): John Wiles & Sons Ltd.
- Svensson G. (2004), Vulnerability in business relationships: the gap between dependence and trust, *Journal of Business & Industrial Marketing*, 19 (7) : 469-483.
- Sorenson O, Rivkin JW, Fleming L. (2006), Complexity, networks and knowledge flow, *Research Policy* 35: 994–1017
- Teece D. (1989), *The competitive challenge. Strategies for industrial innovation and renewal*, Ballinger, Cambridge, Mass, 1987, Trad It., McGraw-Hill Milano
- Tyler B.(2001). The Complementarity of Cooperative and Technological Competencies. A Resource-based Perspective in *Journal of English Technology Management*, 18: 1-27.

Vicari, S. (1988). *Risorse immateriali e comportamento incrementale*. Working paper 1/88. Milan: SDA Bocconi.

Vicari S.(1991), *L'impresa vivente. Itinerario in una diversa concezione*, Etas Libri Milano

Wilson D. T. (1995), An Integrated Model of Buyer-Seller Relationships, *Journal of the Academy of Marketing Science*, 23(4): 335-345.

Yin R.K. (1994), *Case Study Research: Design and Methods*, 2 nd ed., CA, U.S.A., Sage

Yin R.K (2003), *Case study Research: design and methods 3rd ed.* London: Sage Publications.

Zhuge H. (2006), Knowledge flow network planning and simulation, *Decision Support Systems* 42: 571– 592.