

Conceptualizing inter-organizational learning: An emergent and process-based view of learning in organizational networks

Francesca Mariotti

Department of Management and Organization
University of Stirling, United Kingdom
francesca.mariotti@stir.ac.uk

Abstract

The concept of learning in networks has received scant attention within extant theories. Where learning has been applied to networks, different terms have emerged which have generated confusion and prevented the emergence of a clear-cut definition. Most importantly, the literature gives few insights into what inter-organizational learning is and how it takes place. This paper presents empirical evidence from the British and Italian motorsport industries to examine learning at inter-organizational levels of analysis by adopting a relational and multi-level perspective. Inter-organizational learning is here conceived as a complex phenomenon which is based on three inter-related processes: learning to collaborate, learning to share knowledge, and learning to create inter-organizational knowledge. These three aspects of inter-organizational learning occur simultaneously and can be regarded as 'deutero' learning processes.

Keywords: Learning; Networks; Knowledge.

Suggested track: The relationship between individual, team and organizational learning

1 Theoretical background

1.1 Perspectives on learning

Organizational learning has become a popular concept nowadays. But, although there exists widespread acceptance of the notion of organizational learning, no agreement has been reached within the various disciplines as to what learning is, and how it occurs (Cohen and Sproull, 1991; Crossan et al. 1995). As Cohen and Sproull (1991: i) have noted, “research in organizational learning suffered from conceptions that were excessively broad, encompassing nearly all organizational change...and from various other maladies that arise from insufficient agreement among those working in the area on its key concepts and problems”.

Notwithstanding differences in understanding what learning actually is and what the outcomes of this activity are, a review of the literature reveals that most of the theoretical approaches are centered around the functionalist paradigm (Burrell and Morgan, 1979) and adopt a predominantly adaptationist view. This is reflected in the underlying assumptions made. One of these assumptions regards an implicit acceptance of open systems theory coupled with a mechanistic or at best an organic metaphor that prioritizes stability over change. This is particularly evident in the organic metaphor which takes as its central focus the capacity of a system to survive. Such a focus precludes a fuller understanding of the self-organizing capacity of system states. Examples of the organic metaphor involve Nelson and Winter's (1982) evolutionary theory of the firm and their focus on routines. According to Nelson and Winter, organizational routines are the basis of firms' activities. Routines structure the firm's memory, they are a disciplining mechanism, they function as standards or targets along which to evaluate employee and firm performance and they provide heuristics for problem solving and innovation. The cognitivist perspective, on the other hand, is an example of the mechanistic metaphor. The cognitivists developed formal models of the cognitive system as a machine for information processing (Shrivastava, 1983; Huber, 1991). The concepts of organizational memory (Huber, 1991; Walsh and Ungson, 1991) and of routines and bounded rationality (Simon, 1991) reflect this vantage point. Strong emphasis on homeostatic processes aimed at preserving the organization is made. Simon (1991: 125) argues that although all learning takes place inside individual human heads, “...what an individual learns in an organization is very much dependent

on what is already known to (or believed by) other members of the organization and what kinds of information are present in the organizational environment". The underlying process of institutionalization is a means for organizations to leverage the learning of the individual members. Structures, systems, procedures, and routines provide a context for interaction. Over time, spontaneous individual and group learning become less prevalent, as the prior learning becomes embedded in the organization and begins to guide the actions and learning of organizational members. As can be noticed, there is a strong emphasis on homeostatic processes aimed at preserving the organization.

A second assumption implies some kind of differentiation between individual and organizational learning. Here organizations are often granted anthropomorphic characteristics they do not possess (Argyris and Schon, 1978; Simon, 1991; Weick, 1991; Argyris, 1993; Cook and Yanow, 1993; Weick and Westley, 1996). However, most often no attempt is made to justify the level of organizational entity chosen for analysis (Hedberg, 1981; March, 1991). The debate on this topic involves different positions. Weick (1991) states that individual and organizational learning are fundamentally different and require different, non-interchangeable conceptualizations. The defining quality of individual learning is a combination of same stimulus and different responses, which are incompatible with organizational learning; Weick (1991: 119) states, "...Organizations are not built to learn. Instead, they are patterns of means-ends relations deliberately designed to make the same routine response to different stimuli, a pattern which is antithetical to learning in a traditional sense". Cook and Yanow (1993), following a different line of reasoning reached the same conclusion. Cook and Yanow (1993: 378) reject Hedberg's (1981) notion that organizations are cognitive systems and say,

What organizations do when they learn is necessarily different from what individuals do when they learn. Specifically, we believe that organizational learning is not essentially a cognitive activity because, at the very least, organizations lack the typical wherewithal for undertaking cognition...To understand organizational learning we must look for attributes that organizations can be meaningfully understood to possess and use.

Argyris and Schon (1978: 9) instead claim that organizations and their members come to know different things,

It is clear that organizational learning is not the same thing as individual learning, even when the individuals who learn are members of the organization. There are too many cases in which organizations know less than their members. There are even cases in which the organization cannot seem to learn what every member knows.

This functionalist approach to learning ignores the fact the learning is an ongoing social accomplishment. Learning cannot be viewed as either individual or organizational, but is instead to be seen as a relational activity; a collective accomplishment residing in networks of relationships between individual, group, and organizational actors. This points at the dynamic and relational character of learning. Moreover, learning is essentially provisional and emergent from actors' interactions. The generative aspect of learning has been highlighted by Schon (1983: 68),

When someone reflects-in-action, he becomes a researcher in the practice context. He is not dependent on the categories of established theory and technique... He does not separate thinking from doing... Because his experimenting is a kind of action, implementation is built in his inquiry.

What stems from the above is that learning is necessarily situated in the relational activities of actors. Lave (1988) and Lave and Wenger (1991) found that learning is significantly influenced by the social and physical context in which it takes place; this is because learning often relies on situational clues or on local knowledge. Similarly Tyre and von Hippel (1997) showed that learning is situated in context. Studying the introduction of new production machinery into factories, they observed how technicians were able to solve the problems at hand by relying on the situational clues present in different physical contexts.

The relational character of learning also highlights the importance of analyzing learning from a multilevel perspective in order to capture its complex dynamics. As Inkpen and

Crossan (1995) note, most of the organizational learning theory fails to take a multilevel view and overlooks the different learning processes that are at work in each level.

1.2 Inter-organizational learning

As seen above, most of the literature focuses on learning within organizations. Little research addresses what Lane (2001) terms 'external learning'. This gap in research was also identified by Crossan et al. (1995) who noted that there was a developing body of literature on group or pairs of organizations that are proactively cooperating. This led them to propose a fourth level of organizational learning (adding to individual, group and organization-centered perspectives) which they termed 'inter-organizational'. In the same vein, Araujo (1998) criticizes the topographic view of organizations and learning and moves towards a conception of knowing and learning as a set of social and material practices situated in concrete physical settings. In his view, organizations are not simply containers of knowledge; they are collections of overlapping knowledge systems each of which may be embedded within a wider occupational community. Thus, instead of attempting to locate knowledge bases and learning inside organizations, the locus of knowing and learning becomes the heterogeneous network of social and material relationships that transcend and bypass organizational boundaries (Araujo, 1998).

A review of the literature reveals that inter-organizational learning is a complex phenomenon and no unified definition has been given. However, it is possible to summarize the work done in the area according to two distinctive perspectives. Such perspectives involve the following inter-organizational learning processes: (i) the creation of collective knowledge; and (ii) knowledge acquisition and transfer.

The creation of collective knowledge. Some scholars (Holmqvist, 1999; Dyer and Nobeoka, 2000) interpret inter-organizational learning as a process in which network members act jointly to create collective knowledge. Dyer and Nabeoka (2000) define network-level learning as: (a) knowledge development and acquisition that is useful in a specific network context; and (b) knowledge that is developed or resides within the network and that is codified by a network-level storage mechanism. This concept of collective knowledge is relatively close to Nonaka and Konno's (1998) description of 'Ba' as a shared space of emerging relationships, which concentrates and integrates all

the knowledge that can be created by an actor or group of actors, and acts as a frame in which knowledge is activated as a resource for creation. However, knowledge is not only collective but it is also dispersed among several actors. This has led Hedberg and Holmqvist (1998) and Holmqvist (1999) to define the concept of 'imaginary organization' as an arena for actors to build knowledge on a joint basis. In this study, inter-organizational learning is conceived as the process by which actors in imaginary organizations create collective knowledge by converting their individual knowledge into inter-organizational knowledge. This process leads to the creation of an inter-organizational 'memory' which maintains all the knowledge created and acts as a collective storage mechanism. As Holmqvist (1999: 427-428) describes,

To coordinate actions in imaginary organizations, not only must individual knowledge of the members be converted into the interorganizational knowledge, but also organization-specific knowledge of participating partners must be modified to the benefit of the collaboration. To create an interorganizational knowledge memory is fundamental to imaginary organizations' performance since the memory can counteract any sudden loss of knowledge due to partner turnover. Interorganizational knowledge thus consists of mutual knowledge, which is unique to the collaboration and independent of any single organization's knowledge. Imaginary organizations do not exist in any legal manner, but 'live' only through the interaction of actors.

Knowledge acquisition and transfer. Knowledge acquisition has been described in the literature as another process which generates inter-organizational learning. As Larsson et al. (1998) put it, inter-organizational learning is the collective acquisition of knowledge among a group of organizations. This knowledge acquisition can be achieved by complementing and transferring each other's knowledge and by creating new knowledge. In particular, through inter-organizational learning, firms can speed capability development and minimize their exposure to technological uncertainties by acquiring and exploiting knowledge developed by others (Lane and Lubatkin, 1998). Learning in networks is thus the ability to identify, assimilate and utilize a partner's knowledge. Lane and Lubatkin (1998) state three methods for learning new external knowledge that help to understand inter-organizational learning:

Passive: occurs when firms acquire articulable knowledge about technical and managerial processes, e.g. journals, seminars, and consultants.

Active: also occurs when firms acquire articulable knowledge in the form of benchmarking and competitor intelligence (observable knowledge). Readily transferred knowledge may guide capability development, but does not permit a firm to add unique value to its own capabilities.

Interactive: a student firm gets close enough to the teacher firm to understand not just the objective and observable components of the teacher's capabilities, but also the more tacit components. Learning such complex knowledge requires face-to-face interactions between the firms.

The literature on inter-organizational learning suggests there are a number of factors which facilitate learning. Four facilitators of inter-organizational learning seem to be particularly important: the ability to develop and sustain valuable resources; absorptive capacity; combinative capability; and trust.

First of all, firms must be endowed with assets that partners value and are fit for use. The basis of any exchange is reciprocity so in a collaborative arrangement involving two firms, both companies must possess such assets. Firms lacking assets will not be desirable alliance partners, as linkage-formation opportunities are known to be related to the possession of resources (Ahuja, 2000). Second, firms must have 'absorptive capacity'. Cohen and Levinthal (1990: 128) define it as "a firm's ability to recognize the value of external knowledge, assimilate it, and apply it to commercial ends." Van den Bosch et al. (1999) further suggest that it entails the evaluation, acquisition integration and commercial utilization of knowledge obtained from sources exogenous to the firm. Absorptive capacity is also mentioned by Lane and Lubtakin (1998), Levinson and Asahi (1995) and Nooteboom (2000) as an important foundation to promote inter-organizational learning. In this respect, Nooteboom (2000) claims that absorptive capacity allows firms to cross their cognitive distance and engage in joint learning processes. Third, firms need to develop a combinative capability. Kogut and Zander (1992) define combinative capability as the ability of a firm to synthesize and apply current and acquired knowledge to generate new applications and learn from an extension of their existing knowledge base. Finally, trust is an important facilitator of learning at the inter-firm level (Dodgson, 1993; Uzzi, 1996; Kale et al., 2000). For

example, Uzzi (1996) reported that trust acted as the governance mechanism of embedded relationships and as such facilitated the exchange of tacit knowledge and information. In particular, goodwill trust (Sako, 1992; Dyer and Singh, 1998; Dyer and Chu, 2000) promotes voluntary, non-obligating exchanges of assets and services between actors. Consequently, a significant outcome of trust is that it facilitates tighter social relationships and hence reduces uncertainty in the collaborative activities. Trust is particularly important in the process of learning in inter-organizational networks since it serves as the very foundation on which interaction takes place. Inter-organizational networks involve not only learning by individual partner firms but also inter-partner joint learning. Hence, it follows that trust is an important precursor to inter-organizational learning because it increases a firm's access to external knowledge and strengthens its ability to, in conjunction with its network partners, create new innovative ways of combining existing knowledge and resources.

1.3 Conceptualizing inter-organizational learning

This review of the literature reveals that inter-organizational learning, similarly to organizational learning, is mostly conceptualized in functionalist terms. The focus tends to be either on the mechanistic processes which allow organizations to process and store knowledge at the inter-firm level or on the potential positive outcomes of learning from inter-firm collaborations. In the first case, learning is identified with the creation of a network-level storage mechanism which contains all the relevant codified knowledge. In the second case, learning refers to the knowledge acquired by each partner. The aim seems that of giving guidance to managers on how they should choose learning partners, and how to best provide for the transfer of knowledge in terms of flows of information and skills (Hamel, 1991; Levinson and Asahi, 1995; Lane and Lubatkin, 1998). Moreover, the literature gives less insight into the learning processes themselves, or how knowledge becomes inter-organizational, but rather suggests provisions at an individual level to enable organizations to increase their knowledge (see Inkpen, 1997), or criteria for selecting partners who hold specialized knowledge (Lane and Lubatkin, 1998). These discussions clearly focus on the potential benefits of inter-firm collaboration for the single participating actors, rather than the collaboration process among a group of firms.

A developing body of literature instead shows that learning at the inter-organizational level is emergent and underpinned by social interactions. Powell et al. (1996) in a study of the biotechnology industry found that learning takes place in the context of an evolving community of partners, where the sources of innovation are "...commonly found in the interstices between firms, universities, research labs, suppliers and customers". In other words, learning is by definition a dynamic process of interaction and one that involves dissimilarly endowed partners. They also claim that as a result of this connections with others 'two processes of learning are occurring simultaneously and recursively' (Ibid.: 143). The first is the ability to use ties to access information from different sources. The other process is about the firm's ability to collaborate with others.

Inter-organizational learning, other than creating collective knowledge, has also been conceived as a process in which network firms create and define the rules of interaction. More specifically, inter-organizational learning occurs when network firms act jointly to create their inter-organizational practices. However, unlike in organizations, learning processes cannot be traced through evidence of changing formalized procedures, systems and policies at the network level. Instead, there are less formal indicators that can be used to track learning processes as Dyer and Nobeoka (2000) point out in a recent paper.

Building on this literature, the aim of this paper is to examine learning at inter-organizational levels of analysis by adopting a relational and multilevel perspective. Although some of the concepts developed at the intra-organizational level may be applied and extended at inter-organizational levels of analysis, this is not always straightforward and there is a danger of isomorphism. It seems more fruitful, instead, to rethink what inter-organizational learning is and how it takes place. As Easterby-Smith et al. (2000) noted, the field of organizational learning itself demands that future research efforts concentrate on how learning occurs across boundaries.

2 Research context and method

The motorsport industry is a high value-added and highly innovative business sector. The leading racing car manufacturers are centres of research, development and technology advancement. It is increasingly recognized, however, that individual firms do not have the range and depth of capabilities to compete independently in such

dynamic and competitive environments. Thus attention has progressively focused on how networks of collaborating firms can work together to develop new products. Collaboration among firms is an essential feature for knowledge transfer to take place.

The motorsport industry has only recently started to reap the benefits associated to such collaborative efforts. Up to the late 1980s relationships between racing car manufacturers and their suppliers were predominantly arm's-length, especially in Italy where major racing car manufacturers were vertically integrated and relied on suppliers for relatively simple, low volume components. In the UK there is some evidence of existing closer ties which gave rise to informal networks of relationships. Overall, formal ties were highly fragmented in both countries and motorsport companies had little history of network involvement.

During the 1990s the increased competition among racing car manufacturers to win races led to a growing complexity of the components used in their cars and the need for rapid technological advancements. To respond to the changing patterns of competition, racing car manufacturers both in Italy and the UK started to develop a number of close collaborative relationships with their 'preferred' supplier companies.

These close relationships have facilitated frequent interaction between racing car manufacturers and their suppliers and have fostered the development of trust. As a consequence, motorsport companies have been able to make significant improvements in car components and parts through the exchange of valuable information and know-how. Moreover, collaboration and co-development activities have provided opportunities for knowledge creation and learning.

2.1 Methodology

Consistent with an exploratory design, the study is essentially qualitative, based on data from in-depth interviews. Primary data have been supplemented with a variety of archival and historical records. The research was conducted between January 2001 and April 2002. The key players examined in this study are racing car manufacturers and suppliers of components and services. The companies selected operate mainly in

Formula One racing. Italy-F1a is regarded as the dominant Italian racing car manufacturer because of its predominant position in the Italian motorsport industry.

In total, 37 companies were selected (21 in the United Kingdom and 16 in Italy) and 59 interviews were carried out, 37 in the United Kingdom and 22 in Italy. In several companies, more than one interview was conducted. Interviews have been conducted with three categories of people: directors and managers, engineers (mainly in the area of product development) and other employees from the production/technical division responsible for production. The interviews were held with people at different organizational levels and performing different tasks to access multiple perspectives. Overall, given the number of interviews conducted, the range of firms involved and the different people interviewed the findings can be considered reasonably representative of the industry.

The reporting of the interviews was made anonymous. The objective of the in-depth interviews was to unveil and elucidate the rich experience and knowledge of the respondents in relation to the collaborative activities undertaken with other motorsport companies. The choice was made not to follow fixed cases in specific companies, but to look for the general reflections, experiences and insights of the respondents in connection with collaborative activities. All the interviews were transcribed and translated into English.

After transcription, the analysis focused on the identification of themes emerging from the raw data, a process referred to as 'open coding' (Strauss and Corbin, 1990). The goal was to generate descriptive, multidimensional categories which could form a preliminary framework for the analysis. The next stage of analysis involved the re-examination of the categories identified to determine if and how they were linked, a complex process called 'axial coding' (Strauss and Corbin, 1990). The discrete categories identified in open coding were compared and combined in new ways and a general picture started to emerge.

Although the stages of analysis have been described here in a linear fashion, in practice they occurred simultaneously and repeatedly. In particular, the research has

followed what Coffey and Atkinson (1996: 156) have called 'abductive reasoning' which consists of "a repeated interaction among existing ideas, former findings and observations, new observations and new ideas". The main goal was to return to 'enfolding' literatures (Eisenhardt, 1989) for triangulation and conceptual clarification of the patterns identified.

3 Learning in networks

The concept of learning at the network level has received scant attention in the literature. Where the concept has been applied, different terms have emerged such as 'inter-organizational learning', 'learning networks' and 'network-level learning'. The following sections will try to clarify what inter-organizational learning is and what are its underlying processes. In particular, the paper focuses on three inter-related processes - learning to collaborate, learning to share knowledge, and the creation of inter-organizational knowledge - which taken together constitute what has been termed here inter-organizational learning.

3.1 Learning to collaborate

Over the last ten years motorsport companies both in the United Kingdom and in Italy have put considerable efforts in structuring the inter-firm network of which they are part. Due to the patterns of competition and the growing complexity of the technologies used in racing cars, combined with the limited presence of previous embedded relationships and the lack of support from the government, racing car manufacturers in both countries had to develop the ability to interact with other companies to better manage their internal competencies. In particular, they had to move away from a vertically integrated structure and to encourage suppliers to participate in the early stages of product development. The Chief Production Manager of Italy-F1a comments,

Suppliers are involved from the concept stage or, if we have already thought about a concept, they are involved to give advice and technical support on the processes we want to apply. In such cases, we have innovative processes which are not developed in-house but can be developed at the supplier's premises and, therefore, the technology and core know-how reside with the supplier with which we must collaborate

In the United Kingdom a Senior Sales Manager of a supplier company commented on the importance of developing partnerships with racing car manufacturers in order to be able to communicate and develop a common understanding. He explains,

What we try to do here is to develop partnerships with our customers. So instead of being in what I would call a traditional relationship, where we have a customer, we have a supplier and there is no real technical interface – ‘these are the products, would you like to buy them?’ - what we try to do now is to work in partnership with the teams. So when they design a new car, we all sit around the table and when they look at the braking system or clutch system, we have a discussion about what their needs are to make that car better than anybody else’s car.

Racing car manufacturers have made serious efforts to create a network-like organization with selected suppliers and in which knowledge sharing and learning have become the primary objectives. Racing car manufacturers have deliberately acted to create a network structure where expertise is located both internally and externally. Network formation, however, seems to develop gradually as motorsport companies learn to participate and collaborate. The Chief Production Manager of Italy-F1a explains that participation has been encouraged gradually at the level of local suppliers which traditionally were kept more arm's length. He says,

Traditionally, for historical and cultural reasons, we have established more the first type of relationships [arm’s length] with our local suppliers in the area of [city close to Italy-F1a], all artisan companies; however, nowadays we are trying to help our suppliers to grow and to develop their expertise in order to have a proactive relationship. We do not want to have few suppliers, what we want is to have the best ones. Thus, our relationships are becoming more and more interactive every day.

In the United Kingdom, racing car manufacturer UK-F1 explicitly referred to its intention to create 'a pool of specialized suppliers', especially selected for their particular capabilities and reliability, and working almost exclusively for the team.

Racing car manufacturers have also tried to enhance collaboration over time by developing a sense of 'networkness' among supplier companies and by creating a network identity and rules for knowledge sharing. UK-F1 is trying to foster a sense of 'networkness' (Human and Provan, 2000) among its suppliers and to make them an 'extension of UK-F1'. Networkness refers to a sense of common identity by which member firms see themselves as part of the network and are committed to network-level goals. Hence, creating this identity means that individual network members feel a shared sense of purpose. More specifically, the identity, in this case, is defined by the shared goals and values, and by the patterns of interaction that give rise to a common understanding and to common working practices. As the Purchasing Manager of UK-F1 reports,

We're trying to get them [pool of suppliers] to work the way we do, understand the nature of our business, come around and have a look, see the activity, see how information flows from the design office to production and manufacturing, look at our processes and procedures. We go to see their factory, look how they work and they may be in the end an extension of [UK-F1], because the way they work suits us. We know that their components are made to our standards, we know the inspection is to our standard, we know they are made by people that understand the nature of our business.

This tendency to create a network identity is also present in Italy. Racing car manufacturer Italy-F1a's strategy is to select the best suppliers in terms of services and knowledge offered and then nurture a sense of community. The Italian racing car manufacturer has focused on the need to encourage participation as a way to share knowledge and experiences. The Chief Production Engineer explains the process in more detail,

Our aim is to have a pool of suppliers which collaborate with the company [Italy-F1a] towards achieving the best solutions for each project [...]; a group of suppliers which collaborate among themselves and with us - this has not been fully developed yet but it is a thing we are working on. So we are going towards an expansion of our working groups.

The set up of rules for knowledge sharing seems to be an effective mechanism to promote the sharing of knowledge in the network and at the same time to limit knowledge spillovers to non-member firms. Failure to comply with these rules may result in sanctions, such as the withdrawal of business. However, some respondents appeared not to be so concerned about the fact that their knowledge might leak to competitors. They observed that their knowledge will spillover to competitors but by the time it does they will have already progressed.

An important issue that stems from the above is that, in the process of creating networks, racing car manufacturers have learned how to gain access to, and share knowledge across the network by selecting and mobilizing suppliers' capabilities. They have also learned to locate themselves in network positions which enable them to keep pace with the technological developments within the industry. The Relationship Manager of Italy-F1a points out that its company has developed some partnerships with suppliers to conduct research into new materials; these partnerships involve a synergistic collaboration in terms of knowledge generation. In his words,

Among our partners, we have suppliers like [list of suppliers' names] which are all worldwide companies and which produce turbines, helicopters, and jets; here research into new materials and new metals is very advanced and we have a synergistic collaboration with them. [...] We exchange technological know-how and information.

The process of network formation is also influenced by the strategies undertaken by major first tier suppliers. Similarly to racing car manufacturers, some first tier suppliers, while participating in the network, have learned to select their customers on the basis of their capabilities and expertise. Moreover, in certain circumstances they may also

act as orchestrators of the network, especially when customers are heavily dependent on their knowledge.

In general, the findings suggest that network formation and evolution is emergent from the strategies and actions enacted by both racing car manufacturers and major first tier suppliers. This sheds light on the fact that networks are not static, but dynamic as motorsport companies learn how to participate in the network while collaborating. Hence, network development can be understood as an inter-organizational learning process which involves both learning how to interact and learning how to share knowledge with partner companies. These learning activities are concurrent and continuously overlapping. When motorsport companies begin to collaborate they develop experience at collaborating and reputation as a partner. Over time, motorsport companies develop capabilities for interacting with other firms. This means that motorsport companies learn which collaborations to pursue and how to manage their relationships. Experience at collaborating then provides a fertile ground for knowledge sharing processes to occur.

3.2 Learning to share knowledge

Over time motorsport companies both in the United Kingdom and in Italy have learned how to work together to undertake product development. This learning has taken place through four knowledge sharing processes – aligning efforts, the use of resident engineers, shared education and training, and shared equipment and facilities. The four knowledge sharing processes offer interesting insights into how motorsport companies are learning to share knowledge. In particular, the salience of these processes lies in their capacity to help motorsport companies know how to develop close relationships, know how to innovate and search for new ideas, and know how to develop capabilities for doing product development. An important thing to bear in mind when looking at these processes is that they do not occur in isolation, but need to be interpreted as interdependent. For example, when motorsport companies engage in collaborative agreements they are able to share knowledge to a great extent, building social capital through face-to-face interactions and the use of resident engineers while also establishing common training programmes. Therefore, learning to share knowledge is dynamic and relational; it is a social accomplishment in which network firms constitute knowledge while engaging in collaborative activities.

The first process to take into consideration is 'aligning efforts'. By involving suppliers in the early stages of product development and by aligning efforts, racing car manufacturers seem to abandon conventional arm's length arrangements and to progressively encourage a culture of 'working together'. In the United Kingdom the Programme Manager of a supplier company reports,

We will have a technical partnership with a Formula One team. [...] If we have a technical partnership we share our technology; normally if there's something which is a new process out of a specific partnership, exclusivity is given to the team for a pre-agreed period of time.

In this sense, they have made substantial efforts to develop close and intimate relationships with their suppliers. Moreover, they have actively encouraged knowledge sharing and they have involved suppliers in the application of new technologies and in the search for new ideas and solutions. The Chief Production Manager of Italy-F1a confirmed the efforts made by his company to involve suppliers and ask them to be purposive and work in teams. He states,

In the near future we will increase suppliers' involvement in our operations. [...] We are increasingly asking to our suppliers to be purposive and to work in teams with us to ameliorate and develop products.

In this way partner companies become an 'integrated part' of Italy-F1. The Racing Unit Manager of a partner company describes the relationship with Italy-F1a as 'quite unique'; it is very close and they work in team to develop new products and test them. He says,

It's a very close relationship with [Italy-F1a]. if they need certain features we will try to develop the product and then test it; our engineers will be at the test and they will review the performance - they work with [Italy-F1a] people to understand what the problems are and rectify them.

The second knowledge sharing process, the use of resident engineers, allows motorsport companies to get to know each other through the building and maintenance of social relations that generate respect and commitment. In the United Kingdom the Business Development Manager of a supplier company comments on the importance of having customer engineers on site because face-to-face interaction allows face-to-face communication. He also adds that working together with the customer helps in establishing good relationships and in exchanging data quickly. He states,

At the start of a project it is common for our engineers to spend some time with customers or customers come and spend some time with us; not always but it is quite normal. You can transfer data quickly [...]. We try to because it helps to foster the relationship [...]. We always refer to our customers as our partners and we like to create a good relationship; and a good relationship starts with working well together.

This builds network social capital, which provides the foundation for ongoing interaction and sharing of knowledge. In particular, it allows motorsport companies to rely on each other for help, advice, or ideas when needed. The Italian racing car manufacturer relies extensively on the exchange of personnel in order to learn and acquire capabilities together with its suppliers. This enhances its ability to share knowledge and engage in knowledge creation. As the Relationship Manager of Italy-F1a asserts,

People [suppliers] come to our premises as well as we go to their premises [suppliers] - there is a two-way exchange. It is more likely that our people go to their premises to operate, to study, and to look at new [things]; especially with companies like [suppliers' names] which do research on materials. In the world advances in technological development are based exclusively on new materials research; materials evolution allows us to improve the features of the car.

Shared education and training is another important knowledge sharing process. It generates a knowing how to develop capabilities for doing product development by

providing motorsport companies' personnel with ongoing education and development. It also contributes to foster social relationships and to build social capital. Extensive use of this process has been found in Italy. The dominant racing car manufacturer in Italy has recognized the importance of this mechanism to jointly develop practical experience and expertise. The Production Manager of Italy-F1a states,

This is one of the things we are insisting at, especially for the future; we have already some examples of resident engineering here [of suppliers] for a period of time, and we also send our technicians at our partners' facilities, if we think there are interesting areas of technology to develop. In the last two or three years we had several cases of resident engineering and stages at our suppliers' facilities for days and even months. Our technicians stay put at our suppliers' facilities to learn and gain experience about a particular technology or concept that is somehow diverse from what we know; in this way we can learn something new and we can understand a certain technology or a certain way of think about a new component.

Shared equipment and facilities, contrary to the other three knowledge sharing processes, appears to be seldom used by motorsport companies either in the United Kingdom or in Italy. However, it constitutes an important process because it has the potential to generate a knowing how to develop capabilities for doing product development by expanding motorsport companies' competencies and knowledge about production methods and technical processes.

On the whole, by engaging in the four knowledge sharing processes, British and Italian motorsport companies continuously improve their capabilities and build absorptive capacity. In this sense, collaborative activities play a significant role in the development of new products and in the fine-tuning of the competencies of partnered organizations. The progressive development and implementation of these knowledge sharing processes has occurred with the awareness that firms do not need to protect their core knowledge. As seen in the previous section, motorsport companies are learning how to preclude such negative factors not only by devising network rules for knowledge sharing, but also by collaborating extensively with their suppliers, by encouraging socialization processes and by fostering respect and commitment.

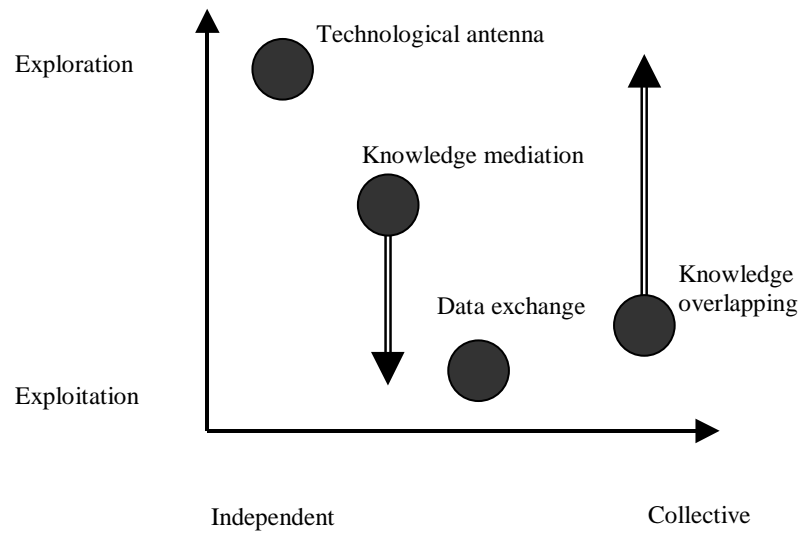
These findings offer a view of inter-organizational learning as a process through which network firms learn how to share knowledge, over time and recursively, by engaging in four different knowledge sharing processes. This second aspect of inter-organizational learning needs to be seen as complementary and works in parallel with the first aspect outlined previously, learning to collaborate. Together they constitute 'deutero' learning processes in that motorsport companies while learning to collaborate they also learn how to work together by aligning efforts, by building social relations and commitment, and by developing capabilities for doing product development. Through engaging in these knowledge sharing processes firms learn both jointly and individually and they improve their absorptive capacity.

3.3 The creation of inter-organizational knowledge

The continuous interaction among motorsport companies constitute an opportunity for them to recognize and appreciate each other's knowledge bases, values and routines and gauge the extent of collaboration. This, in turn, allows motorsport firms to develop a common understanding as to how their respective knowledges might be blended and leveraged in order to fulfil their shared goals. The empirical data indicate that motorsport companies, both in Italy and the United Kingdom, share knowledge in at least four different ways: through exchanging data and information, through mediating specialized knowledge, through overlapping specific knowledge, and through exploring new knowledge opportunities.

In general terms it is possible to differentiate ways of knowledge sharing on the basis of whether the purpose is *exploration* or *exploitation*; and on the basis of whether the process is primarily collective and *two-way*, or independent and *one-way* (see Figure 1).

Fig. 1. Forms of knowledge sharing



The exchange of data and information is a process through which motorsport companies share and exploit existing codified knowledge. Motorsport companies' involvement is limited to knowledge that is readily observable in use, articulable, and teachable.

The mediation of specialized knowledge, instead, involves the exploitation of knowledge through the (partial) sharing of unique organizational knowledge by an expert firm with a network partner. Through this process of mediation, racing car manufacturers and their suppliers share knowledge which is embodied in a product or knowledge which is at the interface between the car and the component supplied. However, the tacit knowledge which is embedded in the components usually remains with the suppliers. In Italy the Racing Unit Manager of a supplier company describes this situation in the following way,

They [racing car manufacturers] own a complete set of knowledge because in some cases they build most of the parts they use. Coming to brakes they mostly rely on our expertise, they do understand what we do, but they not do it internally; usually they outsource all the parts to [supplier name]. [...] There is a huge degree of hidden know-how on how we do things.

In this case, learning mainly occurs at the organizational level, where racing car manufacturers improve their overall knowledge about the components and suppliers obtain technical and context specific knowledge to produce better components.

Another way of sharing knowledge is the overlapping of specific knowledge, i.e. the bringing together and exploitation of existing knowledge by individual network firms. This process of knowledge exploitation often leads to further knowledge creation. In such circumstances, racing car manufacturers and suppliers work together to build shared knowledge at the interfaces between them. This creates what has been called 'inter-organizational knowledge', that is, collective informal knowledge. The Production Manager of Italy-F1b explains the particular efforts made in developing a state of the art technology and how they have been able to blend specific knowledge (casting of titanium),

The transmission in titanium is not something new. Barnard together with Ferrari was the first to introduce the transmission in titanium made of small pieces welded together. We have been the first to adopt the casting of titanium and this had a positive effect on the company, moreover, it has given visibility to the idea we developed with [supplier name]. [Supplier name] has done a lot of research in the production technology, and in the casting technology - this is the biggest problem because of the thinness of the components required in Formula One, our transmission is very thin and to weld titanium parts in such a small dimensions is not easy. Instead of using moulds made of wood, they [the supplier] have refined a method called 'micro-fusion' through the use of rapid prototyping; thanks to rapid prototyping, they have made the moulds for the casting and then they have started to look for a partner in the United States, helping them in the casting process. After trying many foundries, they found one - I think it is specialized in golf clubs, because the head of a golf club is hollow inside and requires being very thin - and together with this foundry, they have worked on the casting process.

The creation of inter-organizational knowledge is not a static process. The continuous exchange of knowledge before, during and after the races constantly modifies the collective body of knowledge held by the network of firms. The following example from a British supplier company illustrates how motorsport companies create inter-organizational knowledge and how they continuously modify it by interacting and collaborating to improve the existing knowledge. Collaboration is critical for the supplier in order to be able to see through the customers' demands and problems. This allows the supplier to make finer distinctions of the knowledge at hand and to contribute towards its improvement. The Business Manager of this company says,

When we talk to automotive people, they generally don't know enough about what's happening with their own engine in terms of what heat has been generated from oil or what heat has been generated from water; and we have to work with them to try and get them to understand what's happening with their own engine.

As the Business Manager further explains, through intense interaction and experience gained in action, the engineers in his company have developed a set of diagnostic skills which enable them to see through the problems, and make distinctions which for the customers are not readily evident. This knowledge includes not only the technical information about thermodynamics and heat transfer properties which is stored and codified in their organizations, but also informal knowledge, which can be both individual and collective. The inter-organizational knowledge thus created is continuously modified through both incremental improvements and the creation of new knowledge. As the Business Manager explicates,

When we get to the first three/four races in the season, we will get around each of the customers and we will start talking to them about the strengths and the weaknesses of the current design; and we will try to come up with some development work to try and overcome any of the weaknesses they've seen [...]. There's always development work going on like that [...]. Lots of chief designers think that it might be nice to have, for example, a curved cooler instead of a flat cooler, or a vary-angle shape, or the pins put

in at an angle (and not facing forward). There's always a lot of development work that we can do in collaboration.

The final way in which motorsport companies share knowledge is the exploration of new knowledge opportunities. Motorsport companies engage in a two-way exploration of new knowledge with the explicit intent to search for diverse streams of knowledge. Knowledge diversity appears to be particularly important for exploratory purposes, as opposed to exploitation. Motorsport companies bring in diverse knowledge by engaging in collaborations with companies that belong to a different domain of knowledge (e.g. aerospace companies). The integration of diverse knowledge streams allows them to co-develop products which are technologically superior and different from their original scope (e.g. ceramic components). As a result, the strategy that seems to emerge from these collaborations is the co-exploration and successful combination of different knowledge domains. This strategy also suggests that the lack of previous knowledge does not necessarily constitute an obstacle to collaboration. Motorsport companies, through the progressive strengthening of these relationships and the development of trust, may be able to learn from each other and build on their current know-how, thus creating absorptive capacity.

Overall, the creation of inter-organizational knowledge (both in terms of the exploitation of existing knowledge and the integration of somehow diverse bodies of knowledge) can be considered as a third aspect of inter-organizational learning in that motorsport companies jointly interact with the express purpose of learning together, from one another and from their interaction. In this sense, inter-organizational learning can be conceived as a process through which motorsport companies learn to manage knowledge jointly, continuously modifying and increasing the inter-organizational knowledge from which they draw. In addition to creating inter-organizational learning, knowledge overlapping also prompts further organizational and individual learning. By working together, motorsport companies may either modify or improve their working practices, their technical knowledge and their skills or they may change them. In other words, knowledge overlapping favours processes of both single-loop and double-loop learning.

4 Discussion

This paper has looked at the concept of inter-organizational learning and described the underlying mechanisms and processes that constitute it. Data analysis has presented a definition of inter-organizational learning which differs from previous conceptualizations. This study has described inter-organizational learning as a complex phenomenon which involves three aspects: learning to collaborate, learning to share knowledge, and learning to create inter-organizational knowledge (see Figure 2). These three aspects cannot be easily differentiated and separated because they emerge and develop simultaneously and they continuously overlap. The first aspect of inter-organizational learning is essentially learning about collaboration. Over time firms create linkages with other organizations and, while collaborating, they learn about such relationships and how to manage them. Most importantly, by participating in collaborative activities with other actors, firms learn how to become members of a certain network and, thus, to acquire a more prominent position. The second aspect of inter-organizational learning is about knowledge sharing processes. Learning in networks is not something achieved through the simple transfer of resources, but rather is an ongoing social accomplishment in which the networked firms constitute and reconstitute knowledge while engaging in collaborative activities. In order to enable these knowledge sharing processes, network firms have thus to proactively learn how to leverage external relations. Finally, the third aspect of inter-organizational learning is about developing inter-organizational knowledge, that is, a common repertoire of experiences and know-how from which the participating firms can draw.

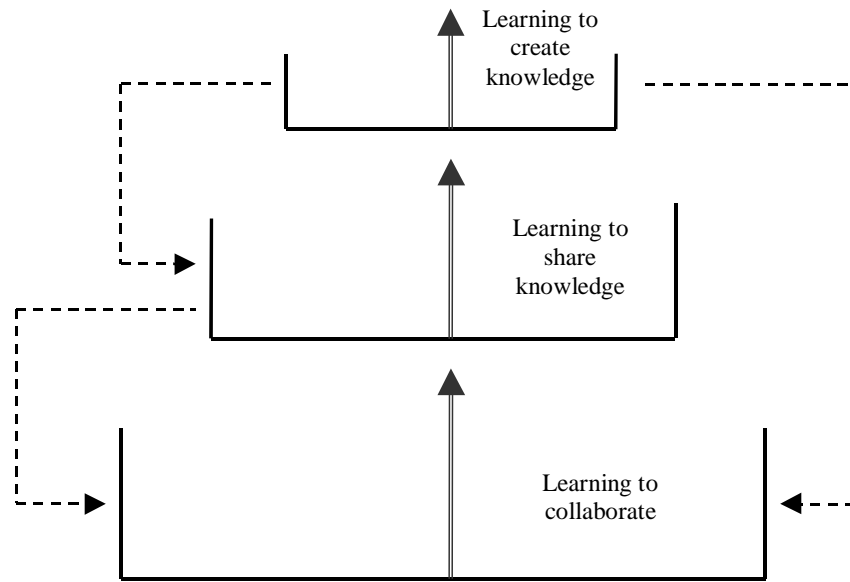


Fig.2. Deutero learning processes

The empirical evidence has shown that these three aspects are closely interrelated. Racing car manufacturers both in Italy and the United Kingdom have made serious efforts to create a network-like form of collaboration with selected suppliers, where knowledge is shared and created. This has fostered the three inter-organizational learning processes, while making it difficult for unconnected firms to pursue imitative practices and to appropriate confidential information. The progressive disintegration of the production process has led racing car manufacturers to involve external sources of knowledge. Reliance on inter-organizational collaboration, trust-based relationships and repeated interactions has provided access to distinctive competencies and to new sources of innovation. Collaboration and participation in the network have been enhanced over time by the creation of a network identity or, in Human and Provan's (2000) terms, a sense of networkness. Membership in the network has offered access to specialized knowledge distributed among the networked organizations and has facilitated learning through multiple knowledge sharing processes. Repeated interactions have also favoured the creation of a repertoire of practices and a body of collective knowledge among the interacting firms with significant effects on knowledge creation.

The three aspects of inter-organizational learning, as described above, can be conceived in terms of *deutero* learning processes (Argyris and Schon, 1978) because network actors learn how to learn together. In this way, network organizations while learning how to organize their relationships, also learn how to share and create knowledge and, by doing this, they locate themselves in network positions which enable them to keep pace with the technological developments within the industry. Therefore, following Powell et al. (1996), it is possible to assert that the locus of inter-organizational learning is found within a network of inter-organizational relationships, which provide access to dispersed knowledge, and where organizations simultaneously learn which collaborations to pursue and how to function within multiple ties.

The findings also suggest that inter-organizational learning is a multilevel concept which involves learning at four different levels, namely individual, group, organizational, and inter-organizational. This view contrasts with much of the organizational learning literature which sees learning as an attribute of either individuals or organizations (see for example Simon (1991) and Levitt and March (1990)). Learning, instead, has to be seen as a relational activity; a collective accomplishment residing in networks of relationships between individual, group, and organizational actors. This highlights the importance of analyzing networks from a multilevel perspective in order to capture the complex dynamics of inter-organizational collaborations (Liebeskind et al., 1996; Oliver and Liebeskind, 1998).

The findings of this study have given multiple examples of this multilevel perspective. For example, it has shown that motorsport companies learn both individually and jointly. Data analysis has identified at least four different ways in which firms share knowledge: through exchanging data and information, through mediating specialized knowledge, through overlapping specific knowledge, and through exploring new knowledge opportunities. The first two ways – exchanging data and information and mediating specialized knowledge – mainly foster learning at the organizational level, thus contributing to the development of firms' internal capabilities and competencies. The other two ways – overlapping specific knowledge and exploring for new knowledge opportunities – instead allow for a joint form of learning to occur. In this case, firms jointly interact with the express purpose of learning together, from one another and from their interaction. Joint learning is a participatory activity where network actors take part and share their expertise and knowledge in a collective way. Joint learning efforts

result in the creation of inter-organizational knowledge and in the integration of diverse streams of knowledge. This is a process where network actors confront, complete, and modify each others' knowledge in order to achieve something new. The main characteristic of these joint learning processes is, thus, integration. Network actors bring with them different expert knowledge which, when combined, gives rise to manifold ideas. This points to an important generative quality of collective activities where interaction and participation lead to new opportunities not considered or even feasible without such collaboration. Moreover, in these collective activities, emphasis is put on the relevant knowledge and distinctive competencies. That is to say, the domains of knowledge and the unique competencies relevant in the collaborative activities. Participation in the collaborative activities is, therefore, based on the relevance and distinctiveness of the participants' knowledge and expertise.

Other than learning at the organizational and inter-organizational levels, some interesting insights have also emerged from learning at the individual and group levels. The empirical evidence has highlighted the fact that firms, by working together, may either modify or improve their working practices, their technical knowledge and their skills. This prompts for both individual and group learning processes to occur. Overall, the findings are consistent with the multilevel approach to learning put forward by Crossan et al. (1995). This study, however, goes one step further in giving a detailed account of the learning processes which take place at each level and backed with empirical evidence.

5 Conclusion

In this paper it has been contended that learning is better conceived as dynamic and relational, embedded in the network of relationships formed by individual, group and organizational actors. Inter-organizational learning is a process through which network actors learn how to collaborate and how to share knowledge. These learning processes involve the establishment of norms of interactions, the fostering of embeddedness and social capital, and the development of a climate of mutual trust. More importantly, the involvement of an actor in multiple interactions with others provides it with opportunities to mediate, overlap and integrate knowledge and continuously create inter-organizational knowledge across a range of exploitative and explorative activities. It is this mediation, overlapping and integration activity, using different knowledge sharing

processes, that is fundamentally responsible for the creation of inter-organizational knowledge, another aspect of inter-organizational learning.

References

- Ahuja, G. (2000). The duality of collaboration: Inducements and opportunities in the formation of interfirm linkages. *Strategic Management Journal*, 21: 317-343.
- Araujo, L. (1998). Knowing and learning as networking. *Management Learning*, 29 (3): 317-336.
- Argyris, C. (1993). *Knowledge for action*. Jossey-Bass: San Francisco.
- Argyris, C. and Schon, D. A. (1978). *Organizational learning: A theory for action perspective*. Addison-Wesley: Reading, MA.
- Burrell, G. and Morgan, G. (1979). *Sociological paradigms and organizational analysis*. Heinemann: London.
- Coffey, A. and P. Atkinson (1996). *Making sense of qualitative data*. Sage: Thousand Oaks.
- Cohen, M. D. and Sproull, L. E. (1991). Editors' introduction. *Organization Science*, 2 (1): i-iii.
- Cohen, W.M. and Levinthal, D.A. (1990). Absorptive capacity: A new perspective on learning and innovation. *Administrative Science Quarterly*, 35 (1): 128-152.
- Cook, S. D. N. and Yanow, D. (1993). Culture and organizational learning. *Journal of Management Inquiry*, 2: 373-390.
- Crossan, M., Lane H., White R., and Djurfeldt L. (1995). Organizational learning: Dimensions for a theory. *International Journal of Organizational Analysis*, 3 (4): 337-360.
- Dodgson, M. (1993). Learning, trust and technological collaboration. *Human Relations*, 46 (1): 77-95.
- Dyer, J. H. and Singh, H. (1998). The relational view: Cooperative strategy and sources of interorganizational competitive advantage. *Academy of Management Review*, 23 (4): 660-679.
- Dyer, J. H. and Chu W. (2000). The determinants of trust in supplier-automaker relationships in the U.S., Japan and Korea. *Journal of International Business Studies*, 31 (2): 259-285.

Dyer, J. H., and Nobeoka K. (2000). Creating and managing high performance knowledge-sharing networks: The Toyota case. *Strategic Management Journal*, 21: 345-367.

Easterby-Smith M., Crossan M., and Nicolini D. (2000). Organizational learning: Debates past, present and future. *Journal of Management Studies*, 37 (6): 783-796.

Eisenhardt, K. (1989). Making fast strategic decisions in high-velocity Environments. *Academy of Management Journal*, 32 (3): 543-576.

Hamel, G. (1991). Competition for competence and inter-partner learning within international strategic alliances. *Strategic Management Journal*, 12: 83-103.

Hedberg, B. (1981). How organizations learn and unlearn. In P. C. Nystrom and W. H. Starbuck (Eds.), *Handbook of organizational design*, Vol. 1: 8-27. Oxford University Press: Oxford, UK.

Hedberg, B. and Holmqvist M. (1998). *Learning in imaginary organizations. Creating and sharing knowledge in virtual systems*. Draft paper.

Holmqvist, M. (1999). Learning in imaginary organizations: Creating interorganizational knowledge. *Journal of Organizational Change Management*, 12 (5): 419-438.

Huber, G. P. (1991). Organizational learning: The contributing processes and the literatures. *Organization Science*, 2 (1): 88-115.

Human, S. E. and Provan, K. G. (2000). Legitimacy building in the evolution of small-firm multilateral networks: A comparative study of success and demise. *Administrative Science Quarterly*, 45: 327-365.

Inkpen, A. (1997). An examination of knowledge management in international joint ventures. In P. W. Beamish and J. P. Killing (Eds.). *Cooperative strategies: North American perspectives*: 337-369. New Lexington Press: San Francisco.

Inkpen, A. C. and Crossan, M. M. (1995). Believing is seeing: Joint ventures and organizational learning. *Journal of Management Studies*, 32 (5): 595-618.

Kale, P., Singh H., and Perlmutter, H. (2000). Learning and protection of proprietary assets in strategic alliances: Building relational-specific capital. *Strategic Management Journal*, Special issue, 21: 217-237.

Knight, L. (2002). Network learning: Exploring learning by interorganizational networks. *Human Relations*, 55 (4): 4237-454.

Lane, C. (2001). Organizational learning in supplier networks. In Dierkes M., A. B. Antal, J. Child, and I. Nonaka (Eds.), *Handbook of organizational learning and knowledge*: 699-715. Oxford University Press: Oxford.

Lane, P. J. and Lubatkin, M. (1998). Relative absorptive capacity and interorganizational learning. *Strategic Management Journal*, 19 (5): 461-477.

Larsson, R., Bengtsson L., Henriksson K., and Sparks J. (1998). The interorganizational learning dilemma: Collective knowledge development in strategic alliances. *Organization Science*, 9 (3): 285-305.

Lave, J. (1988). *Cognition in practice: Mind, mathematics and culture in everyday life*. Cambridge University Press: Cambridge.

Lave, J. and Wenger, E. (1991). *Situated learning: Legitimate peripheral participation*. Cambridge University Press: Cambridge.

Levinson, N. S. and Asahi M. (1995). Cross-national alliances and interorganizational learning. *Organizational Dynamics*, 24 (2): 50-64.

Levitt, B. and March, J.G. (1990). Chester Barnard and the intelligence of learning. In O.E. Williamson (ed.). *Organization theory*: 11-37. Oxford University Press: New York.

Liebeskind, J. P., Oliver, A. L., Zucker, L. and Brewer, M. (1996). Social networks, learning and flexibility: sourcing scientific knowledge in new biotechnology firms. *Organization Science*, 7 (4): 428-443.

March, J. G. (1991). Exploration and exploitation in organizational learning. *Organization Science*, 2 (1): 71-87.

Nelson R. and Winter, S. (1982). *An evolutionary theory of economic change*. Belknap Press: Cambridge.

Nonaka, I. and Konno, N. (1998). The concept of 'Ba': Building a foundation of knowledge creation. *California Management Review*, 40 (3): 40-54.

Nooteboom, B. (2000). *Learning and innovation in organizations and economies*. Oxford University Press: Oxford.

Oliver, A. L. and Liebeskind, J. P. (1998). Three levels of networking for sourcing intellectual capital in biotechnology: Implications for studying interorganizational networks. *International Studies of Management and Organizations*, 27 (4): 76-103.

Powell, W. W., Koput K.W. and Smith-Doerr L. (1996). Interorganizational collaboration and the locus of innovation: Networks of learning in biotechnology. *Administrative Science Quarterly*, 41 (1): 116-145.

Sako, M. (1992). *Prices, quality and trust. Interfirm relations in Britain and in Japan*. Cambridge University Press: Cambridge.

Schon, D. A. (1983). *The reflective practitioner*. Basic Books: New York.

Shrivastava, P. (1983). A typology of organizational learning systems. *Journal of Management Studies*, 20 (1): 7-28.

Simon, H. A. (1991). Bounded rationality and organizational learning. *Organization Science*, 2 (1): 125-134.

Strauss, A. and Corbin, J. (1990). *Basics of qualitative research: Grounded theory procedures and techniques*. Sage: Newbury Park, CA.

Tyre, M. J. and von Hippel, E. (1997). The situated nature of adaptive learning in organizations. *Organization Science*, 8(1): 71-83.

Uzzi, B. (1996). The sources and consequences of embeddedness for the economic performance of organizations: the network effect. *American Sociological Review*, 61: 674-698.

Van den Bosch, F. A. J., Volberda H. W. and de Boer, M. (1999). Coevolution of firm, absorptive capacity and knowledge environment: Organizational forms and combinative capabilities. *Organization Science*, 10 (5): 551-568.

Walsh, J. P and Ungson, G. R. (1991). Organizational Memory. *Academy of Management Review*, 16: 57-91.

Weick, K. E. (1991). The nontraditional quality of organizational learning. *Organization Science*, 2 (1): 116-124.

Weick, K. E. and Westley, F. (1996). Organizational learning: Affirming an oxymoron. In S. R. Clegg, C. Hardy and W. R. Nord (Eds.), *Handbook of organization studies*: 440-458. Sage Publications: Thousand Oaks.