

Communities of Practice and Epistemic Communities: A Renewed Approach of Organisational Learning within the Firm

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1. Introduction

The need for the firm to change continuously has long been the central concern of organisational learning approaches. Following the development of Argyris and Schön's [1978] theory of organisational learning, it is widely agreed that learning consists of two major kinds of activity. The first kind of learning («single-loop learning») is obtaining know-how in order to solve specific problems based upon existing premises. The second kind of learning («double-loop learning») is establishing new premises (paradigms, schemata, mental models, strategies, representations, perspectives) to override the existing ones. From these two main dimensions of learning, the authors define a third degree of learning, the «delearning» which allows the organisation to learn how to learn. However, as noticed by Nonaka and Takeuchi [1995], despite the relevance of many theoretical traits, there are some critical limitations to be found in these theoretical approaches: *«Most of them are trapped in a behavioural model of stimulus-response. Second, most of them still use the metaphor of individual learning [Weick, 1991; Dodgson, 1993]. Third, there is a widespread agreement that organisational learning is an adaptive change process that is influenced by past experience, focused on developing and modifying routines and supported by organisational memory. As a result, the theories fail to conceive the idea of knowledge creation. The fourth limitation is related to the concept of «double-loop learning» or «unlearning» (Hedberg, 1981). Double-loop learning- the questioning and rebuilding of existing perspectives, interpretation frameworks, or decision premises- can be very difficult for organisations to implement by themselves. In order to overcome this difficulty, the learning theorists argue that some kind of artificial intervention, such as the use of an organisational development program, is required. The limitation of this argument is that it assumes that someone inside an «organisation» objectively knows the right time and method for putting double-loop-learning into practice»* [Nonaka, Takeuchi, 1995, pp 45-46].

The aim of the present paper is precisely to try to overcome some limitations of the traditional learning approaches by developing two main hypotheses:

- The first one is that learning within the firm is not homogeneous. However, considering the firm as composed by a mere set of heterogeneous learning individuals is not useful and

appropriate for the understanding of the complex process of collective learning. We will argue that the firm is composed of a multitude of overlapping «communities» (functional work groups, project teams, networks, communities of practices, epistemic communities), each of which presenting a dominant mode of learning and collective behaviour. The organisational learning results from a complex process of interaction between heterogeneous communities. As Brown and Duguid [1991] quoted, «*within an organisation perceived as a collective of communities, not simply of individuals, in which enacting experiments are legitimate, separate community perspectives can be amplified by inter-changes among communities. Out of this friction of competing ideas can come the sort of improvisational sparks necessary for igniting organisational innovation. Thus large organisations, reflectively structured, are perhaps well positioned to be highly innovative and to deal with discontinuities. If their internal communities have a reasonable degree of autonomy and independence from the dominant worldview, large organisations might actually accelerate innovation*».

- The second one is that the actual process of production and circulation of knowledge within the firm is the cornerstone of the formation of the organisational learning. The «cognitive architecture» of knowledge within the firm, the way knowledge is produced, stored, exchanged, transmitted, retrieved, between the different communities strongly influence the process of organisational learning. We will argue in this perspective that the tendency towards a knowledge-based economy and the related intense use of new ways to communicate and exchange knowledge will contribute to enhance the role of two specific communities, epistemic communities and communities of practices, in the formation of organisational learning within the firm.

The article will first sum-up the main results of the traditional organisational learning theories (part 2), then present the various forms of «communities» (or «cognitive entities») considered within the firm (part 3). Part 4 is devoted to the analysis of interaction between communities, and more specifically to the consequences in terms of organisational learning of the development of a knowledge-based economy. Conclusions and open questions as an agenda for future research are presented in part 5.

2. Organisational Learning

The main characteristics of organisational learning are: the existence of inter-individual, transversal, hierarchic relationships; the emergence of an organisational knowledge; the constitution of an organisational memory due to interactions. Nonetheless, whereas these notions give a cognitive account of the firm, it remains difficult to explore the different mechanisms that determine them at an organisational level. Indeed, the literature does not explicitly account for the different forms of knowledge playing a role in these different levels of learning, nor does it state who are the agents favouring them within the firm, nor what are the bridges between the individual and collective level.

Indeed, organisational learning, although widely used in the literature, appears nonetheless relatively blurred at first sight [Ingham, 1997]. One of the main first accounts has been made by Simon [1953] who stated that the structures of the organisation partly reflect the mental processes through which environmental forces are taken into account. From there, numerous works have been written about the subject and it is now impossible to synthesise them

[Dodgson, 1993; La Ville, 1998]. However, one can define organisational learning as a collective process of acquisition and elaboration of knowledge and practices taking part in the continuous reshaping of the firm's structures. More precisely, one of the main stream, namely the one stemming from the cognitivist tradition, sees organisational learning as a means for the firm to survive in uncertain environments [Fiol & Lyles, 1985]. A major contribution in this field of research has been made by Argyris and Schön [1978].

2.1 Theory of Action by Argyris and Schön

For these authors, organisational learning must take place whenever a gap appears between expected and actual results. Put in other words, a learning process is sparked when a difference between 'espoused theories' and 'theories in use' becomes evident. 'Espoused theories' are widely acknowledged by the members of the organisation and are the general framework of the expectations of the top management. An enterprise's project is a good example of such theories. Indeed, this allows the different actors of the firm to commit themselves to certain forms of actions. By contrast, 'theories in use' are actual actions. Most often, they are the outputs of exchanges of individual and collective experiences. They guarantee to the organisation the emergence of a basic consensus necessary to its collective functioning.

The gap between these two forms of theories can generate a questioning and even a correction of either of these theories. Hence, learning is a repairing process that set back a coherence disturbed by the surprise provoked when a question is grabbed [Dibiaggio, 1999; Shackle, 1972]. Such situations spawn different level of organisational learning since, according to the situation faced by individuals, the nature of their interactions evolves. Thus, several degrees of learning can be distinguished, according to the change made [Argyris & Schön, 1978]:

- The 'single loop learning' (also called 'learning by adaptation'): this first form carries the idea according to which individuals evolve with the changing contexts of the environment and of the organisation, by making corrections in line with the evaluation of the actions taken previously. This 'collective' evaluation supposes the identification of a mismatch between the effective result and the foreseen result. It might even entail new action to be undertaken to reduce this mismatch. By proceeding this way, individuals keep in mind the organisation's norms and values (the objectives) without questioning them.
- The 'double loop learning' (also called 'learning by reconstruction'): this kind of learning takes place in the same perspective as the previous one. Nonetheless, the complexity of situations forces the organisation to set new norms and values. Individuals thus proceed to a redefinition of their referential objectives. According to Argyris and Schön [1978], a complete updating of information is the element that triggers such learning processes. This idea supposes that individuals are able to interpret messages and stimuli from their environment and to act accordingly. By contrast, Hedberg [1981, quoted by Probst & Büschel, 1995] asserts that it is mainly 'unlearning effects' that lies at the heart of such learning processes. In each of these cases, certain individuals modify their objectives and transmit them to the whole organisation. Learning is thus organisational and several phases can be distinguished.
- The third degree of learning, the 'deutero-learning' (also called 'learning by social reflection') is the passage from a single loop learning to a double learning: it allows the

organisation to learn how to learn. In other words, according to Probst and Büschel [1995], the learning process of learning is the highest level of learning because it not only corresponds to the increase or transformation of knowledge bases, but also precisely allows this increase or transformation. It is thus the highest level of learning stated by Argyris and Schön [1978]; the organisation enhances its learning abilities and become able to think differently by constructing tools that enable it to create new objectives.

This theory gives an insightful explanation of what are the cognitive collective mechanisms implemented by the firm facing changes. Nonetheless, several reserves should be made in the light of recent developments in the economics literature. The next paragraph intends to review the different pitfalls which, in our opinion, exist within this approach.

2.2 Critical Analysis of the Theory of Action

According to the literature, the various reasons for which the theory of action does not fully account for learning processes mechanisms are the following:

First, in the face of the heterogeneity of the individuals in the firm and of their associated cognitive maps [Huff, 1990] it seems difficult to use Argyris and Schön's model to precisely account for the interactions existing among them. Indeed, this model overlooks the problems associated with social and cultural idiosyncrasies that act as barriers to knowledge exchanges. Indeed, this approach intends to apprehend the organisation at a global level whereas the firm is made of numerous different knowledge spaces ('ba', communities of practice, etc.) too heterogeneous to be dealt with in a uniform way [Nonaka & Konno, 1998; Brown & Duguid, 1991; Blackler & McDonald, 2000]. Thus, one can remain sceptical about the creation of a real organisational knowledge through the process of bridging the gap between theory in use and espoused theory.

In the same line of thought, the various forms of knowledge playing a part in this process of bridging as well as the processes of knowledge exchange are not defined. The importance of tacit knowledge highlighted by Polanyi [1966] is overlooked. One has the impression that in Argyris and Schön's model all the knowledge to be taken into consideration is of explicit nature. As a consequence, they see the firm as an 'information processor' rather than as a 'knowledge processor'.

As a consequence, the possibility of a shift from individual learning [notably Bateson, 1977] to organisational learning is sometimes difficult to grasp. Such a bridge between these two types of learning needs to be clarified by the definition of the mechanisms related to it. Note however that, according to Weick [1991], organisational learning is rare within organisations. This presupposes that the bridge we mention cannot occur in a regular or systematic manner. The mechanisms at work in the linking of organisational and individual levels are mainly made of communication, transparency and integration as well as cross-fertilisations, interactions of several types, sharing of experiences, problem solving, etc.

Lastly, in the view of Argyris and Schön, organisational learning can be seen as a process internal to an organisation spawning the emergence of a dominant coalition of members, developing the ability to identify the right moment to trigger changes [Duncan & Weiss, 1979]. These characteristics are consistent with what is at work in the mode 1 as described by Gibbons *et al.* [1994]. This model does not hold anymore in the Mode 2 described above. In

that case, the firm is less hierarchical and the knowledge exchange and creation concern all members of the firm organised in subgroups.

To sum up, the main pitfall of Argyris and Schön's theory is to fail to link individual learning and organisational learning. The specificity of individual learning is not acknowledged (members of operational groups and of top management do not have the same learning processes and are not concerned the same way by changes). It is thus difficult to apply this model in a uniform manner to any kind of individuals or structures. They lack an intermediary level of analysis.

3. Various Forms of Cognitive Entities («Communities») within the Firm.

According to us a firm is made of several types of entities. Certain of them are rather knowledge creation oriented and some other are action oriented. This part aims at presenting them following various key characteristics: the objective they pursue, the agents composing them, their dominant cognitive activity, their recruitment rule, their way of producing knowledge, their dominant learning mode and what holds them together.

In a first part, we present the most well identified forms of groups existing within a firm, namely functional groups, teams and networks. In a second part, two newer concepts will be presented: epistemic communities and communities of practice.

3.1 'Classical' Collective Entities

Functional groups are well known in functional structures of the firm as described by Chandler [1977]. They are places characterised by a specialisation by function, a concentration of resources, and a quite strong centralisation. They are present both in divisional structures and matricial structures. They are made of homogeneous agents thanks to a disciplinary specialisation. These agents communicate with one another with codes and local jargons developed in their functions. A person is brought into such a structure by a hierarchical authority. The dominant learning mode is learning by doing [Rosenberg, 1982] and the production of knowledge is unintended.

Teams are the second well identified entities. They have to fulfil a given task and are made of heterogeneous agents having particular disciplinary knowledge that they have to integrate with others' functional knowledge. These agents interact through collective routines they set in order to function together as a unit, without any negotiation. The members are recruited by the team's leader and are held together by a common goal and job requirements. The dominant mode of learning there is learning by interacting [Lundvall, 1992; Von Hippel, 1988] and the knowledge created there is not produced on purpose.

One important particular case is the project team [Giard & Midler, 1993; Midler, 1996]. This latter is set to fulfil one-shot goals and the decisions made during the process are irreversible. In addition, such a team faces a great uncertainty at each stage toward the objective. These particular teams meet the characteristics stated above, but, in addition, they have to reach their goals in a limited time.

Network is the last classical form of structure binding together individuals. Networks are complex techno-economics objects, whose function is to allow suppliers and consumers of certain goods and services to get in touch. The network is seen as an economic intermediation made concrete., an allocation of resources, whether this latter is due to market mechanisms or to the hierarchy of an organisation [Curien, 1992; Callon, 1991]. A network's objective is to allow a mutually negotiated specialisation. It is made of heterogeneous agents whose cognitive activity is to exchange knowledge. They interact together through informal and formal meetings and the recruitment rule is mutual trust. People are held together in networks by the need to gain complementary knowledge. The main mode of learning is learning by exchanging and the knowledge is produced either on purpose or not, depending on the kind of network considered.

3.2 Epistemic Communities and Communities of Practice

Epistemic communities and communities of practice are the most relevant types of groups for the purpose of this paper, since they are the place where the most dramatic knowledge creations are likely to occur [Creplet *et al.*, 2000].

The concept of "epistemic communities" has been developed noticeably in the realm of international relations (Haas [1992]; Haas & Adler [1992]). Using this concept to address the issue of codification of knowledge, Cowan *et al.* [1998] suggest that any codification activity implies the existence of codes that are understandable by the communicating actors. Following this approach, an epistemic community may then be concretely defined as a framework within which codification can occur. The concept of communities of practice has been introduced by Lave & Wenger [1991] who, by focusing on individuals' practices, identifies groups of persons engaged in the same practice, communicating regularly with one another about their activities.

Communities of Practice

Members of a community of practice essentially seek to develop their competencies in the practice considered. Communities of practice can then be seen as a means to enhance individual competencies, they are oriented toward their members [Lave & Wenger, 1991; Brown & Duguid, 1991]. This goal is reached through the construction, the exchange and the sharing of a common repertoire of resources [Wenger, 1998].

Wenger [1998] and Brown & Duguid [1991; 1998] state that self- organisation is an essential characteristic of communities of practice. According to Lesourne [1991], self-organisation is the ability of a system to acquire new properties by organising itself or by modifying by itself its own organisation [Lesourne, 1991]. Self-organisation confers to the system an adaptive ability to evolve without any constraint of authority nor any determinism. The system is then autonomous and sets a boundary with respect to the other functions of the firm. It creates a sort of 'organisational closure' in the terminology of the theory of self-organisation. This idea is important since it underlines the cross functional nature of communities of practice within the firm.

More precisely, autonomy and identity of communities, the key characteristics of self-organisation allow for collective acquisition and processing of stimuli from the environment [Wenger, 1998; Dibiaggio, 1998]. Identity and autonomy are essential for the agent to define

himself with respect to his or her environment and for the members of the community to behave collectively.

The self-consciousness is also visible in the mutual commitment of the community. It is built around activities commonly understood and continually renegotiated by its members. A community's member feeds it with his/her experience and, in turn, relies on the knowledge capitalised by the community to carry out his/her activity. These processes take the shape of 'war stories' [Brown & Duguid, 1998] that members tell when they gather. They thus develop a jargon understandable by the members only. It is thus a mutual commitment that binds agents in a social entity, ensure cohesion of the community and recruitment of new members.

Lave & Wenger [1991] interpret the practice of these communities as the vector of learning, that is in turn the building of an individual entity. Hence, the evaluation of an individual is made by the community of practice as a system and is focused both on the values adopted by the individual and on the progress made in his/her practice, the two being co-constitutive.

Within communities of practice, the privileged knowledge is thus essentially the know-how [Brown & Duguid, 1991], which is tacit and socially localised. The nature of knowledge is due to the objective and the structure of the communities of practice. As a result, the community tends to send no messages toward the outer world. Messages are almost exclusively exchanged among the members of such a community.

Epistemic Communities

Epistemic communities can be defined as small groups of 'agents working on a commonly acknowledged subset of knowledge issues and who at the very least accept a commonly understood procedural authority as essential to the success of their knowledge activities» [Cowan *et al.*, 1998]. Epistemic communities can thus be defined as a group of agents sharing a common goal of knowledge creation and a common framework allowing to understand this trend. The goal of epistemic communities is thus simultaneously outside and above the community's members.

What defines a community is thus the existence of a procedural authority that can be explicit or not. However, it must be different from the kind of authority held by a guru to ensure a certain autonomy of the members. Moreover, the procedural authority conveys the idea of a progress toward the cognitive goal set by the community. The belonging of members will thus be evaluated with respect to this procedural authority. Note that this procedural authority can *a priori* emerge from the interactions among members. In that case, the organisational closure is either realised, or imposed from the outside and then not realised. In the former case, the epistemic community will then be self-organised and then close in this respect to a community of practice. This remark is important since it shows evidence of the possibility for one form of community to evolve into the other.

Within an epistemic community, agents are bound together by their commitment to enhance a particular set of knowledge. The recruitment rule is thus defined with regard to the

contribution an agent makes to fulfil this goal (this goal is likely to be partly given and partly emergent [Blackler & McDonald, 2000])¹.

Epistemic communities are structured around a goal to reach and a procedural authority endowed by themselves (or with which they were endowed) to fulfil that goal. Notions of autonomy and identity are thus weaker than in the case of communities of practice, thus favouring the group's creativity [Kao, 1998; Leonard-Barton, 1995]. This way, the community increases its ability to catch future opportunities. This form of organisation spawns knowledge creation by favouring the synergy of individual varieties. We find here the principle of 'required variety' stated by Ashby [1956]. Individuals accumulate knowledge in function of their own experience. The quality of this knowledge depends on two factors. The first is the variety of individual experiences in interaction. The second factor is the 'knowledge of the experience'. This is consistent with the idea of a rational ability of experience feedback within which the validation is made according to the procedural authority: what is evaluated is the contribution of the agent to the cognitive goal with regard to the criteria set by the procedural authority.

Validation of the cognitive activity of an agent is made with respect to the procedural authority. What is evaluated is the contribution to the endeavour toward the goal to be reached, according to the criteria set within the procedural authority.

Because of the heterogeneity of the agents, the objective of knowledge creation for the sake of knowledge creation, of the lack of deeply shared values, it appears that the knowledge creation mode is much like a form of externalisation (conversion of tacit knowledge into explicit knowledge) in the sense of Nonaka & Takeuchi [1995]. The first task of epistemic communities is thus to create a 'codebook'. So, knowledge circulating within epistemic communities is explicit (but not codified since it remains mainly internal to the community [Baumard, 1999]).

We sum up what has been said above in the table below inspired by Snyder and Wenger's [2000] one.

¹ Note that epistemic communities emerge in uncertain context calling for the creation of a new paradigm (which is not the case for communities of practice) [Haas, 1992; Whiteneck, 1996]. We are then close to the community of young researchers overcoming the old paradigm in Kuhn's theory [1962].

	Objective	Agents	Cognitive Activity	Recruitment rule	Knowledge Production and Dominant Learning Mode	What holds the Community together
Functional Group	Ensure a given function	Homogeneous	Disciplinary Specialisation	Hierarchical	Unintended Learning by doing	Education Task definition
Team	Realise a given task	Heterogeneous	Integration of functional knowledge	Team's leader	Unintended Learning by interacting	Job requirements Common goals
Network	Mutually negotiated specialisation	Heterogeneous	Knowledge exchange	Mutual trust	Intended or unintended depending on the network Learning by exchanging	Need to access complementary knowledge
Community of Practice	Increase the skills in a given practice	Homogeneous	Accumulate knowledge about a given practice Circulation of best practices	Members who select themselves	Unintended Learning in working	Common passion for the practice
Epistemic Community	Produce knowledge	Heterogeneous	Construction of knowledge or language or messages Circulation of codified knowledge	By peers	Intended Searching	Respect of a procedural authority

4. Interaction between Heterogeneous Communities

As mentioned in the introduction, one of the major hypotheses of this article is that the understanding of the process of organisational learning cannot be disconnected from the cognitive architecture of the firm, in particular the way knowledge is produced and distributed within the firm. When considering the cognitive architecture of the firm, we argue that the evolution of communication and information technologies and the tendency towards a knowledge-based economy, lead to distinguish two historical modes of cognitive architecture within firms, that is two successive modes where organisational learning has to be interpreted differently:

- The first mode is a traditional vision of separation between the communities in charge of a deliberate production of knowledge and the communities in charge of using knowledge for the regular production activities. In this first mode the core of the formation of organisational learning resides in the interaction between the two 'hierarchical communities», the functional work groups and the multidisciplinary teams.
- The second mode relies on the hypothesis that there are less and less separation between the communities in charge of producing new knowledge and the communities in charge of using and transferring knowledge. In this second mode we will argue that the core of the formation of organisational learning resides in the interaction between the two «non-hierarchical» communities, the communities of practices and epistemic communities.

4.1 Mode 1: The Focus on the Interactions between Functional Groups and Multidisciplinary Teams

Most of the classical works on organisational learning [Argyris and Schön, 1978; Midler 1996] refer to a specific context, that we define by «mode 1». In this context, the focus is on the interaction between the two «hierarchical communities» (functional groups and multidisciplinary teams). The main problem at stake is the coupling between on the one side communities specialised in a given field of knowledge, and on the other side communities in charge of integrating different bodies of knowledge to accomplish specific tasks. For instance, intense discussions in the literature on matrix forms of organisation, and on the respective Japanese and western models of organisations referred to such a situation. «*The British approach is based on the principle of individual task and functional specialisation, and the product development cycle is managed on a sequential basis. The job boundary of the British engineers are much more narrowly defined within their specialist arenas and their role in cross-functional co-ordination is limited. The Japanese approach is based on the principle of undifferentiated job demarcation and decentralised horizontal co-ordination. The product development process is over-lapping. Japanese engineers are expected to engage in direct cross-functional liaison sand in scanning market information. Within this model, the co-ordination function becomes partly embedded in the role of engineers. In the Japanese firms, the ability to co-ordinate, to process and to share information is regarded as an important part of an engineers skills and role competence.*» [Lam, 1996]. In such a perspective, the problem of the diffusion of knowledge is not only the integration of different bodies of specialised knowledge by the multi-disciplinary teams, it is also the problem of «restitution» of the knowledge acquired by members of multi-disciplinary teams when they come back to the functional groups to which they belong to.

In mode 1 the role allocated to the other communities was in general a marginal one. Communities in charge of production of new knowledge (epistemic communities) are disconnected from the activities in charge of using knowledge. In the traditional vision of the firm the process of transformation of knowledge is viewed as evolving from separate departments in charge of producing new (deliberate) knowledge or handling and distributing information to the other departments that assimilated and used this new knowledge to improve their current activities. These latter departments could to some extent produce some new knowledge from their routine activities, but this was a non-deliberate form of production of knowledge that emerged as a by-product of production through learning by using or learning by doing.

The communities of practice naturally exist in the mode 1. Agents who share the same common interest for a given practice could be found within teams or functional groups for instance. However the circulation of best practices within a given community of practice remained essentially local. The absence of powerful links of communication between agents rendered the circulation, exchange and interpretation of best practices limited to some confined areas of the firm.

4.2 Mode 2: The Focus on the Interaction Between Epistemic Communities and Communities of Practice

We argue that the production system is progressively tending towards a mode 2, where the differentiation between deliberate and non-deliberate forms of knowledge production is becoming strongly blurred. In a knowledge-based context the essence of the coherence of the firm precisely relies on the ways the communities in charge of the production of knowledge

and the communities in charge of using knowledge are deliberately interacting and organising simultaneously the production and circulation of knowledge.

As Lundvall [2000] pointed out, the emergence of new forms of learning such as « experimental learning » makes the differentiation between « on-line » and « off-line » learning activities less and less relevant. This implies a complete reconsideration of the separation between epistemic communities and communities of practices. Experimental learning takes place « on-line », that is to say during the process of producing a good, and consists in deliberately experimenting during the production process. *« By doing so, one creates new options and variety. This form of learning is based on a strategy whereby experimentation allows for collecting data, on the basis of which the best strategy for future activities is chosen. For example, a professor can undertake pedagogical experiments; the craftsman can seek new solutions to a problem even during the fabrication process. The possibility of moving this type of learning in many activities represents an important transition in the historical emergence of the knowledge-based economy. In effect, as long as an activity remains fundamentally based on learning processes that are routine adaptation procedures and leave no room for programming experiments during economic activity, there remains a strong dichotomy between those who deliberately produce knowledge and those who use and exploit it. When an activity moves to higher forms of learning, and where the individual can programme experiments and obtain results, the production of knowledge becomes much more collectively distributed...With the emergence of experimental learning, the feedback and reciprocal links that tie « on-line » learning processes and in house R&D together- and whereby a potential creative activity effectively contributes to the production of knowledge- become crucial »*[Lundvall, 2000].

The ability to proceed to on-line learning affect all the types of communities that were not focused on the deliberate production of knowledge. However this ability, coupled with the ability to use intense forms of communication, will contribute to enhance the specific role of communities of practices, as triggers of organisational changes within the firm.

The management of the collectively distributed knowledge within the organisation that brings together epistemic communities and communities of practice is thus one of the cornerstones of the coherence of the firm in a knowledge-based context. The development of different modes of interaction between the two types of communities (that rely in particular on specific processes of codification of knowledge) become critical. They determine the problem of knowledge fit or integration across boundaries, by stressing the powers of longer term 'linguaging' devices. Thus, in the area of reconciling external and internal knowledge, they stress, for example, the role of informal networks (e.g. membership of associations, clubs) and 'boundary spanning' individuals (e.g. brokers and intermediaries, employee exchanges between firms). Along similar lines, [Nooteboom 1999b] emphasises the role of third party 'go-betweens' as vital brokers of innovation who help to sediment trust, maintain unique secrets, resolve conflicts, reveal mutual advantage and introduce innovation without destabilising established competencies within each firm. Sustained over time, these devices are able to help firms maintain a balance between development and replication of knowledge.

The language of replication, selection, imitation and variety helps in making a case for learning trajectories and in explaining the fine balance between path-dependency and renewal in organisational evolution. However, it does little in terms of revealing the fine grained processes through which learning occurs, in general and along particular trajectories, as a grounded and distributed process [Gibbons et. al., 1994]. Equally, it tends to under-emphasise learning as a process that involves trial and many errors, chance discoveries, mistakes, and open-ended experimentation. Ironically, it fails to take seriously the argument that firms are

'experimental learning machines' [Eliasson, 1994] which operate in uncertain circumstances because of both their bounded knowledge and the 'creative destruction processes of the experimentally organised economy' (p. 184). Thus the daily hazard is to 'act prematurely on a very incomplete information base' (p. 184). This is not to say of course that all is left to chance as we shall see below, but it does emphasise that learning, or any other condition of survival for that matter, is neither guaranteed nor that easily 'arranged' [Metcalf, 1998].

In many regards, the perils of failure at every turn are avoided through daily practices of interplay between procedural and recursive knowledge among individuals and groups within firms. This daily practice is the source of learning, such that knowledge can be said to be generated through practice, through social interaction, through action. It is time to visit anthropological understandings of learning processes in firms. In their seminal article on communities of practice, Brown and Duguid [1991] argue that learning and innovation only too often are situated practices in the everyday humdrum of interaction with one's peers and with the environment. They explain: « *Alternative worldviews, then, do not lie in the laboratory or strategic planning office alone, condemning everyone else in the organisation to a unitary culture. Alternatives are inevitably distributed throughout all the different communities that make up the organisation. For it is the organisation's communities, at all levels, who are in contact with the environment and involved in interpretative sense making, congruence finding, and adapting. It is from any site of such interactions that new insights can be co-produced. If an organisational core overlooks or curtails the enacting in its midst by ignoring or disrupting its communities-of-practice, it threatens its survival in two ways. It will not only threaten to destroy the very working and learning practices by which it, knowingly or unknowingly, survives. It will also cut itself off from a major source of potential innovation that inevitably arises in the course of the working and learning* » (p. 76).

4.3 Illustration of the Mode 2: The Linux Case

Linux is an operating system based on Unix. The first kernel has been developed as a student project by Linus Torvalds. But he soon released his work on the Internet, requesting for enhancements. Linux grew up rapidly to become a competitor for Windows NT. As Kogut and Turcanu [1999] state, Linux has been developed by a sub-set of the community of hackers, these experts programmers and network wizards [Raymond, 1999].

Hackers are individuals seeking first of all to enhance their personal skills and who, to do so, gather in community where cognitive resources are shared. Members are co-opted. They are chosen on the basis of their commitment and the inputs they provide to the community. One can say that this community is self-organised, since no external determinism acts upon its structure. It is the commitment to the hackers' culture that binds members together. This commitment is however subsidiary to the acquisition of competencies in programming. We see here the two notions of shared values and required individual competencies that we laid out in the case of communities of practice. The hackers' culture is a culture of gift giving and reputation. Nonetheless, what is given by members is evaluated by those having superior or equal technical skills. So, what is deemed is both the technical quality and the individual's attitude. In this community, there is an intense exchange of messages among members, but almost nothing leaks to the outside. To sum up, the hackers' community fully qualifies as a community of practice such as it was described above.

The Linux project has entailed important modification in this community. The Linux project was not intended to be a cognitive one in the first place. It had an operational goal: to create an operating system. People who were involved did not seek to improve knowledge in computer science, but were rather concerned with the improvement of their skills and the search for reputation. It thus remained a sort of community of practice in this respect. However, the objective was to create something both outside and above the individuals. In that sense, the community became similar to an epistemic one.

Although the Linux community emerged quite spontaneously and in a self-organised manner, they had to set a procedural authority to cope with the flux of inputs from the participants. Indeed, they had to create a committee to assess the value of the various contributions.

In the Linux case, the codebook and the objective to reach were conflated. Thus, in a sense, the internal and external messages merge. Moreover, the diffusion of Linux was not the primary objective. But the use of the Internet and the growing success of the product diffused Linux beyond the circle of the first adopters (who were actually the developers). One can say that the Linux community meets the characteristics of epistemic communities, but that this happened by accident.

Thus, the community of Linux developers stems from the broader community of hackers, which is a community of practice. It then tended to become epistemic thanks to emulation between members, to the role of the «top management» (Linus Torvalds' personality, according to Raymond [1999] played an important role in the success of the enterprise and to the change in the organisational structure (namely, the creation of a procedural authority). Eventually, it did not become fully epistemic, nor did it remain a community of practice. Rather it became a hybrid form between the two.

In the Linux case, both learning by working and learning by searching were at work. Learning by working occurred since people were still seeking to increase their own skills, independently of the sake of mere knowledge creation. And there was learning by searching because they were deliberately seeking the best solution for the product and because the number of participants, the nature of the media used and the fact that works were released very often allow for trials and experimentations. Moreover, this case is a clear example of what Lundvall [2000] calls the learning «on-line».

Thus, this exemplifies the shift from mode 1 to mode 2. Although this is a really particular example, we think that one can legitimately ask whether this type of processes are not becoming general, even in more conventional domains of activity. Kogut and Turcanu [1999] suggest at least that this could be implemented in the domain of software development.

5. Conclusion

The traditional vision of learning does not fully account for what actually occur within firms. It fails to acknowledge the importance of the complex cognitive structure of the firm from which stems learning processes. This is even more significant for the last years, due to the development of new technologies, notably of simulation and communication. Firms have shift from a mode 1 in which knowledge production and practices were neatly separated to a mode 2 where these two activities tend to merge. In this respect, the role of communities of practice

and epistemic communities as well as the relationships between them are of paramount importance and provide an important insight to understand learning processes at an organisational level.

Conceiving the firm as composed of overlapping communities brings forwards a renewed understanding of the process of organisational learning. This leads to significant changes in the ways to shape the management of the firm. For instance, Nohria and Ghoshal stress the architecture of communication as a central management concern in a system of de-centred learning. Such communication, however, is no longer a simple matter of information flow within and beyond a firm, as it is in the classical contract-based model designed to minimise transaction costs and other frictions impeding information processing. Now it is a matter of ensuring that there is effective communication between self-governing but inter-dependent units. It is crucially a matter of relational or cognitive proximity [Nooteboom, 1999a], implying linguistic and semantic equivalence, shared tacit knowledge, rapid flow and processing of information, trust or other conventions of negotiation. Indeed, perhaps the better word is interaction, with its active promotion and management as key management priority.

The task at end is now to try to articulate the notions of routine and competence developed within the framework of the evolutionist theory with the new understanding of organisational learning presented here. Indeed, communities may well be the loci of routines creation and maintenance. Moreover, it might also be the articulation of various communities holding specific competencies that gives rise to organisational competencies, the key resources for an organisation.

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