FIRMS' CAPABILITIES AND ORGANIZATIONAL LEARNING

A critical survey of some literature

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Abstract:

This paper proposes a survey of the recent theoretical literature concerning the analysis of the capabilities of firms and organizational learning. In a first part we examine the contributions of three approaches: the strategic management literature, the theories of organizational learning in the field of organization theory, and the evolutionary theory. In a second part we consider some major issues and open questions around four themes: the implications of analyses focused on knowledge instead of information; the meaning of organizational learning and capabilities; the problems of classification of capabilities and of definition of core capabilities; we shall then propose a few overtures on what we deem essential in order to further the comprehension of these problems : i.e. the taking into account of political and institutional dimensions of individual and collective learning process.

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INTRODUCTION

Even the most superficial observation of the economic world would show that firms do not all have identical characteristics and capabilities, including those within the same industrial sector. Indeed, it would appear that some of them are rather good in some sectors, and others in different ones, that they can seek competitiveness via various ways, and that some manage to improve and to develop faster than others. To sum things up, all firms do not have identical capabilities and do not seem able « to learn » in any given field at the same pace.

The questions that such statements raise have so far been largely ignored by most economists, because they do not quite fit the standard (micro or macroeconomic) analysis within which individual or global performances are accounted for by general factors (factor allowances, market structure, general organizational patterns…), without references to economic actors' (notably firms) specificities. Indeed, the heterogeneous nature of these actors is generally ignored. Moreover and independently from the questions related to organizations, the reference to capabilities and learning implies a radical break-off from the standard approach to economic behaviors.

Yet, the importance of such questions is largely acknowledged today. References to knowledge, capabilities and learning appear in numerous fields of economic thought, at different levels, from the analysis of individual behaviors to macroeconomics, as well as in organization theory and new theories of the firm; in the most theoretical literature as well as in the economic press and the management literature.

Beyond changing terminologies, the notions of capabilities, knowledge and learning are related to the fundamental questions concerning the way production develops in capitalist economies, through a complex array of individual and collective activities. As such, one may say that the notions of capabilities and learning are present in A. Smith, Babbage or Marshall's reflections. More recently, Chandler [1977, 1990, 1992] has considered them to be one of his major themes.

Numerous are the empirical and theoretical stakes that crop up when one refers to capabilities and learning. The crux of the matter is largely to offer an alternative to the firm's standard conception, from an economic as well as a managerial standpoint, with the aim of stressing the major facts typifying our societies' evolution : the importance of innovation processes and the role played by firms and organizations (and, if need be, by institutions, as we shall see later) in such processes.

The empirical approach consists in accounting for firms', as well as nations' or regions' performances, and more specifically in explaining why some firms (or countries) are, in the long term, more

successful than others, and also why, in identical sectors of activities, firms do not do things similarly. The latter question is the basis for the studies on strategic management that, following the seminal work of Edith Penrose [1959], aim at building up an analysis of the firm based on resources or competencies.

More fundamentally, the point at stake may be to set up a general and theoretical framework alternative to the standard microeconomics theory, based on the questioning of the neoclassical hypotheses on economic behavior and rationality. Such is the aim of the evolutionary theory which propose a conception of the firm et organizations, based on new foundations. This theory has been constantly refined from the seminal work of Nelson and Winter [1982], until the most recent works on organizational routines, learning and capabilities[1].It offers today key material for the understanding of these questions, together with the contributions of the behavioral approaches to organization theory, which constitute one of their backgrounds, and of the more recent competence-based theories.

Our aim here will be to highlight, through a survey of the existing theoretical literature, or at least part of it, the contributions of these different approaches and the basic questions linked to the complex notions of capabilities and organizational learning. We shall proceed in two stages. First, we shall examine the different types of theoretical approaches on learning and firms' capabilities (I). We shall then focus on some of the major problems posed by these analyses (II).

I - THE CAPABILITY AND LEARNING PERSPECTIVE

The literature on organizational learning and capabilities is varied, both in its origins and aims. Without claiming to be exhaustive, we shall focus on the theoretical literature produced by three different, though partially overlapping, fields of research.

1. Capabilities and competitiveness : the strategic management approach

[1] See for example Dosi and Marengo [1993], Dosi, Marengo & Fagiolo [1996], Cohen., Burkhart, Dosi, Egidi, Marengo, Warglien, and Winter [1996], Dosi, Nelson and Winter [1999].

The firms' analyses that are focused on capabilities undoubtedly have their roots in the studies carried out in the field of strategic management, defining a so-called « resource-based » perspective (Cf. Foss [1997a], Montgomery [1995]). This trend of thought was initiated by Penrose [1959], with his study on firms' growth, and Chandler's historical works [1962], before its later developments in the eighties (Wenerfeld [1984], Rumelt [1984] ; cf. Foss [1997b] for a re-issue of major contributions).

The main purpose of such works is to explain how some firms can acquire and retain a sustainable competitive advantage. Unlike prevailing approaches, such as Porter's, that lay the emphasis on firms' positions on markets and on the ways they use their market power, these analyses focus on firms' specificities and the internal elements accounting for their performances. The idea being that (i) there exists basic and sustainable differences between firms as regards the resources they control, and that (ii) such differences account for their differing performances. In other words, a firm draws a particular advantage, a rent, from the fact that it owns, or has a privileged access to, certain resources.[2] The main questions then concern the nature of the resources that may provide a firm with a competitive advantage and the way these resources may be created and appropriated. On the first point, the general image that emerges from the literature is that the resources that are likely to provide some kind of advantage should be :

- *specific to a firm.* For reasons still to be determined, only one firm has access to some resources or is able to benefit from them.
- *Difficult or impossible to copy*. Competitors cannot (easily) either imitate, obtain or create resources with identical properties.
- All this means that these resources *cannot be acquired on the market,* and that the firm must create them by itself, or assimilate them after a period of learning.

It ought to be noted that these simple elements imply a rather radical criticism of the standard vision of firms and competition. In a Walrasian world, where there are markets for all goods and factors of production, it seems obvious that there cannot be firms with different characteristics and performances. All firms are logically identical. On the contrary, the existence of differences between firms providing similar goods implies that there are necessarily some factors for which the market is either imperfect or non-existent. A major aspect of all the studies that have been made on firms' capabilities is the insistence on the non-market nature of the activities and procedures that are

[2] Those studies that are also based on a « competence-based » perspective, while having a slightly different aim, i.e. to build an alternative economic theory of the firm to contractual theories ought to be cited. Such a theory defines the firm as a « body of competencies », rather than as a « core of contracts », thus being likely to bring a different type of answer to the classical questions posed by firms' theories, notably to the explanation of a firm's frontiers or of the choice between different governance patterns. Such is the case when refering to Richardson's approach (cf. for instance Langlois [1995]. It is not our purpose here to develop these studies, that are sometimes akin to the evolutionist theory of firms.

characteristic of a firm. As Teece, Pisano and Shuen [1997] put it, « the very essence of most capabilities/competencies is that they cannot be readily assembled through markets ».

Moreover, according to Penrose and Chandler's dynamic approach, a firm's growth and success is supposed to lie essentially on an internal and endogenous creation and accumulation process of specific resources.

The transition to a theorization of the firm *based on capabilities/competencies* implies a supplementary hypothesis : among the various resources necessary to a firm, knowledge and capabilities play a major role. Indeed, *specific capabilities* account for firms' different performances. Such is today's prevailing viewpoint, corresponding to the more general approach according to which the society we live in is « based on knowledge » (cf. for instance OECD [1996]). The key position given to knowledge and capabilities is backed by two major ideas :

- Knowledge, as a resource, has its own specificities, which thoroughly distinguishes it from other resources (cf. for instance Grandstrand [1998]).
- An organization, and more particularly a firm, has its own capabilities, which are distinct from its actors'.

This leads us to focus our analysis on « organizational capabilities »[3], i.e. an organization's capability to do or learn certain things. More generally, organizational capabilities refer to the efficiency of problem-solving procedures in specific areas of application ; the ability to use and apply knowledge, to master technology as well as production and management methods, the intelligence of markets and demand… This concept implies that it is possible to identify a firm's capabilities that remain distinct from its members', and that do not correspond to their mere addition. It is an essential aspect which we shall come back to later.

The first question raised by such approaches is that of the exact definition of organizational capabilities and of their nature. Two points are at stake here. Firstly, the general concept of capabilities/competencies, both at individual and collective level, has not been explored in a detailed way, except in the works on organizational learning and in the evolutionist studies. Secondly, these specific questions relative to *an organization's* capabilities hold our attention. The approaches we shall

[3] « Organizational competence », or « organizational capabilities » : most texts do not make any difference between both of these. Both words will be considered synonymous in what will follow. Yet, a reference ought to be made to Christensen [1996], who defines capabilities as a « lower order functional or inter-functional technical capacity to mobilize resources for productive activities », and competence as a « higher-order management capacity of the firm to mobilize, harmonize and develop resources and capabilities to create value and competitive advantage ».

deal with later will enable us to be more accurate on this point, which does not always appear as particularly clear, if we consider for instance the rather vague vocabulary used in studies on capabilities/competencies[4], and the brimming imagination they have as regards the classification of competencies. Let us now insist on some of the most striking features of this literature.

The explanation of a firm's performances by its capabilities can easily become tautological. If the proposals included in such theories are to be taken seriously, it is necessary to define the nature of the capabilities likely to represent a competitive advantage. On this particular point, the existing literature wavers between very wide characterizations of a firm's capabilities and a much narrower approach of a firm's essential capabilities.

The scope given to the notion of a firm's capabilities can be more or less extensive. It must obviously go beyond mere scientific and technological capabilities, and we shall later come back to this aspect. Chandler offers a broader definition : « The organizational capabilities were the collective physical facilities and human skills as they were organized within the enterprise. These included the physical facilities in each of the many operating units - the factories, offices, laboratories - and the skills of the employees working in such units » (Chandler [1990], p. 594). Some others, like Leonard-Barton [1992, 1995], go so far as to identify, in what is probably the widest approach, four dimensions in firms' capabilities : (1) « Employee knowledge and skills » ; (2) « Physical technical systems » (equipment, software, data base, expert systems…) ; (3) « managerial systems » (organizational structure ; regulations, routines, decision procedures ; incentive systems) ; (4) « Values and norms » « systems of castes and status, rituals of behavior and passionate beliefs »). Similarly, Coombs & Hull [1998] link a firm's capabilities to three kinds of elements : namely « technology as hardware », that is to say the material and technical support ; the knowledge base (« shared mental framework of fundamental mental framework ») ; « the collection of routines which are carried out in the firm in order for it to conduct its regular business ». These reflexions essentially emphasize the complex nature of capabilities' determinants and raise the question of the various elements in which these capabilities are embedded.

Beyond these general characterizations, it is necessary to specify more accurately the nature of key capabilities in the determination of firms' performances. We do not think there can be one clear and univocal answer to such questioning. Yet, some privileged trends of thought should be recalled : the notion of *core competence*, the emphasis laid on *dynamic competence*, the importance of « *combinative capability* » (Kogut & Zender [1992], or « *integration capability* » (Iansiti & Clark [1994]). Before we come back to these notions, let us simply examine the existing literature on the subject.

[4] see Dosi, Nelson and Winter (1999) on this point.

(1) A firm's activity is based on very wide and diversified set of knowledge and capabilities. One of the main difficulties is to identify, among them, those that play a key role and those that actually condition a firm's long-lasting competitiveness. They belong to what Prahalad and Hamel [1990] call « *core competence* », and Leonard [1995] « *core capabilities* ». Though the expression is often used, an accurate definition and characterization of core competence is hard to provide[5]. According to Leonard [1995], core capabilities seem to to be defined as those that have a big strategic importance and that give to a firm a competitive advantage (In which case the fact of linking competitiveness to core capabilities becomes tautological). Prahalad and Hamel choose more general criteria in order to characterize them[6]. The references to dynamic and combinative competence undoubtedly help reach a better understanding of the relations between competence and competitiveness.

(2) It is possible to identify two versions of the approaches focused on resources or capabilities (Foss [1997]). The first studies were static, the problem being to grasp the conditions that make it possible for certain resources to provide a rent in equilibrium (Barney [1986]). The more recent works, that we are mostly concerned with here, imply a dynamic approach, and they question the phenomena of the creation and accumulation of capabilities. These later analyses are very similar to the evolutionists' (notably if we take Teece's works). In such an approach, the core concept is that of *dynamic capabilities*[7]. The emphasis is laid on the trajectories followed by competence development, and on their irreversible aspects. Each firm holds, at a given time, some specific capabilities, that are linked to its own history, and that condition its evolution and transformation. The conditions for the creation of knowledge and organizational learning then become crucial, as well as some of the specificities of the knowledge and capabilities thus created. They account for the difficulty to imitate and duplicate capabilities, which explains why firms achieve different performances.

(3) There is a third and essential aspect in the study of capabilities, i.e. the emphasis laid by several analyses on cross capabilities, more than on capabilities in specific areas (and technologies), *capabilities to control, combine, coordinate and integrate*, different skills and capabilities (particular technical capabilitites, technical and market capabilities…), and different activities (production, R&D,

[5] Prahalad and Hamel admit that ten definitions of « core competence » can easily be drawn from their article.
[6] « a core competence provides potential access to a wide variety of markets » ; « a core competence should make a significant contribution to the perceived customer benefits of the end product » ; «a core competence should be difficult for competitors to imitate. And it will be difficult if it is a complex harmonization of individual technologies and production skills » ; « core competencies are built through a process of continuous improvement and enhancement that may span a decade or longer » (op.cit.)
[7] Cf. Teece, Pisano & Shuen [1997], and the special issue of « Industrial and Corporate Change » [1994] on this subject.

marketing). Such capabilities are crucial, notably for Chandler[8]. The same idea will be later taken up, under different forms : the notions of "combinative capabilities" for Kogut & Zender [1992], of "integration capability" for Iansiti & Clark [1994], of "architectural competence"' (as opposed to "component competencies") : "the ability to *use* these component competencies – to integrate them effectively and to develop fresh component competencies as they are required", for Henderson & Cockburn [1994, 1999]. As Dosi et al [1999] mention, such an approach can be seen as close to the dynamic capabilities approach. These different analyses are also complementary. Indeed, the reflexions on dynamic capabilities lead to a pivotal question : how do continuity and changes combine in a firm's management of its capabilities (Dosi et al. 1999), and what are the factors of rigidity of organizational capabilities and the conditions for their renewal and transformation ? This key aspect will be found again later, in our analysis of other approaches. The works on combinative or integrative capabilities raise a question of a different nature : is it important, in order to understand firms'performances, notably long-term ones, to master specific capabilities, particularly in certain technologies, or more fundamentally in more cross and generic capabilities, in the ability to control, use, combine and renew a cluster of material and immaterial strategic assets ? This second approach implies a key position, in the analysis of a firm's capabilities, for the *managerial systems* and the « *values and norms* » that structure a firm. It also consists in considering the ability to develop *organizational innovation* as a key dimension in firms' capabilities.

2. Theories of organizational learning

The notion of organizational learning is to be found in different studies (notably in the evolutionary theory, as we shall see later). Yet, it has led to an abundant specific literature[9], which can be divided into two large categories. The first one, that has been developed by consultants, is prescriptive, practice-oriented, sometimes Messianic and most often devoid of critical meaning. The second one, produced by researchers, has been said to be skeptical, « non-prescriptive, and neutral with respect to its definition of learning – that is, open to the view that learning may be good or bad, linked or not linked, to effective action or desirable outcomes » (Argyris & Schön 1996). We shall insist on this literature here which deals with *the processes of organizational learning build- up*, with the specificities of knowledge and on its ability to transform itself and adjust to environmental changes. Beyond this general object, it appears extremely diversified and lacking in unity, as Hubert [1995] remarks. For its contemporary developments, an important part of this literature has been supported by

[8] « learned routines are those involved in functional activities –those of production, distribution and marketing, obtaining supplies, improving existing products and process, and the development of new ones. Even more important are those routines acquired to coordinate these several functions », Chandler [1992].
[9] And to numerous surveys, cf. in particular : Hubert [1995], March & Levitt [1995], Dodgson [1993], Weick & Westley [1999].

the works of the founders of the behaviorist theory of firms and organizations (March & Simon [1958], Simon [1962], Cyert & March [1963]), and by the firm's evolutionist theory since the early eighties (Nelson & Winter [1982]).

For a start, the core question underlying these considerations ought to be stressed. Indeed, the point at stake is the analysis of the process allowing the acquisition of a collective competence as the outcome of the learning of an organizational entity . This problem raises two kinds of questions, on the one hand those relative to the general features of learning processes and on the other hand those related to the specific aspects of *organizational* learning : how is it possible to pass from individual to collective knowledge, and what are the particular problems posed by the build-up of a collective knowledge ? The second of these two questions outweighs the first since the scope of organizational learning corresponds to that of the analysis of the passage from individual to collective cognition. The point at stake is to understand how « organizational knowledge […] emerges as a property of the learning system and is shaped by the interaction among the various learning processes which constitute the organization » (Marengo 1996). Yet, most of the existing literature remains extremely ambiguous on the notion of organizational learning. On the one hand, the question of the conditions for *individual learning within organizations* (rather than for organizational learning *as a whole*) is often dealt with. On the other one, the trend is to tackle both organizational and individual learning alike. The question of the possibility to speak of « learning organizations » remains present in the background and we shall have to come back to it later.

According to Levitt & March [1995], the analytical basis for the analysis of organizational learning is to be found in the following premises : 1) the interaction models between individual behaviors are made possible through *organizational routines* (Cyert & March 1963, Nelson & Winter 1982), which fits in with the evolutionist approach. In March's vision, it means that actions obey a *logic of appropriateness or legitimacy*, rather than a *logic of consequentiality or intention*[10]. 2) Organizational actions depend on history, which means that they are *based on interpretations of the past rather than on anticipations of the future*. The dynamics of organizational change thus appears as an incremental, adaptative process of past experience and knowledge. 3) Lastly, organizations have to reach goals and objectives and their behaviors thus depend on the relation between achieved and expected results, which implies *evaluation processes.*

In the light of contemporary work on the subject, whose volume and diversity have never stopped increasing in the last two decades, such analytical foundations appear as research programs more than as coherent knowledge material. We shall now examine the main components of organizational

[10]cf. March [1994] for further developments on this problem linked to the foundations of microeconomics.

learning theories, as well as the questions that we deem essential and that are dealt with in very contrasted ways by the existing literature.

The analysis of organizational knowledge implies the necessity of distinguishing what has been learnt (1), from the organizational supports recording learning and partly ensuring its reproduction (2), and the ways this learning process takes place (3).

(1) *What has been learnt*

The taking into consideration of what has been individually or collectively learnt within an organization shows two main aspects :

- a technical component, in which the appropriation of knowledge implies a know-how, a qualification and a job. This component is to be found in the analysis of the technical division of labour.
- A cognitive component that echoes the way individuals mentally perceive the organization itself as a whole as well as their own position within it. The theories on organizational learning lay the emphasis on this aspect of things. This component is large, hence the necessity to split it into at least three categories of knowledge :

a) *That knowledge linked to task achievement* and to the ability to overcome predetermined obstacles,
b) *that knowledge linked to the understanding of the organization itself*, the patterns, paradigms and interpretation frameworks of its history, culture and strategic development policy. In short, all that organizations use to develop collective understanding of their specific identity, and which represents the first type of technical and fragmented knowledge indispensable to individuals within an organization.
c) lastly, we believe a third type of learning ought to be considered, even though it has never been really developed in the existing literature : it is relative to the fact that *individuals learn behaviors linked to the organization itself.* They learn how to find their place, to protect themselves, to resist – through inertia or in an organized way -, or on the contrary to subscribe to a set of values ; goals and projects. In short, they learn conscious or unconscious, individual or collective, offensive or defensive behaviors within the organization. This approach reminds us of the incentive policies, and beyond

them, the decision making and power exercise procedures currently at work in a given organization (Nonaka & Johansson 1985)[11].

(2) *Learning supports and organizational memory*

These different types of learning are recorded and transmitted within the organization itself by various supports constituting repositories for organizational memory. Four categories of supports can be distinguished : a) individuals, who represent the living material for the recording of learning ; b)action procedures, routines and patterns containing the knowledge selected by the organization ; c) products that encompass technical knowledge and know-how, and beyond them, a history and culture of goods linked to the strategic decisions of this history ; d) lastly, the various artefacts relative to information processing : documents, records,…

These various supports show specific features : products and artefacts have a given and constant content of knowledge, whereas individual knowledge and routines can vary, thus representing higher potentialities, since they directly or indirectly proceed from human intelligence. In one word, they are « alive » and combine explicit and implicit knowledge.

Individual, as well as routine-supported knowledge, have differing contents, temporalities and ranges according to the organization. As regards its contents, individual knowledge is superior to that held by procedures. For Simon [1991], memory essentially belongs to individuals. Mobility constitutes the worst enemy of the availability and memory of organizational knowledge. On the contrary, if routines allow knowledge to be transmitted in spite of turnover phenomena, they are nevertheless impoverished in their contents and their diversity because of the selection procedures applied to them by the organization and of the cost represented by the recording of knowledge (Levitt & March 1996).

However, the themes of the selection of knowledge operated by the organization for recording in routine processes are not exhausted by the costs inherent in such procedures. They raise key questions focusing around the tension between the necessary centralization of knowledge in order to give it an organizational scope and thus constitute a common body, and the variety and decentralization of experiments, as a source of knowledge renewal and creation (Marengo 1996). This tension somehow represents the other aspect of the dilemma between exploration and exploitation, as mentioned by March [1991].

(3) The nature and forms of learning acquisition

[11] See also Argyris's defensive organizational routines [1995].

We are truly at the heart of the organizational learning theory. Two main forms of learning are taken into account : learning from direct experience and learning from indirect experience. So far, the first one seems to have been given more clout. Yet, we think the second to be just as important.

(a) An organization learns from direct experience via two main mechanisms : experimentation through trial/error and through the research activity it develops. Bateson [1977] divides the sequences of the trial/error learning process into four stages. The most striking example of direct experience shows up in learning by doing.

This mode of organizational learning poses the fundamental question of the role of *representations* and of organization's *interpretation of experience* mechanisms. Let us start from the general characterization of a learning process given by Marengo [1996], as noted by Holland et al [1986]:

(i) Learning takes place in a space of *representations*, where agents must build a representation of the world for themselves, a concept also expressed by Argyris and Schön, when they speak of « theory in use ».
(ii) Learning aimed at improved performances and which implies a system of *performance assessment*.
(iii) Learning is achieved through formation and transformation, a selection or setting aside of rules ; thus implying the assessment of the utility or efficiency of those rules.

All this entails two kinds of questions that are not always very clearly distinguished. First are those relative to the nature of individuals' representations and beliefs and their consequences on experience interpretation. Then essentially are the questions relative to organizational learning, linked to the *diversity of representations, interpretations and assessments*, as well as to the coordination problems and conflicts resulting from such diversity. Thus, the problems of organizational learning are partly due to individual factors (« inadequacies of human cognitive habits », Levitt & March, op. cit.), and partly to the organization's specificities.

The question of the collective interpretation of experience has given birth to an abundant literature, where skepticism is a major theme (according to Argyris and Schön). The crucial point lies in the fact that the interpretation of events and experience takes place in a pre-existing mental structure which is partly unconscious and prejudices the understanding of experience. Many consequences derive from this approach : the first one is that powerful innovations may remain peripheral to collective representations and thus not be taken into consideration (Argyris & Schön 1978, Beyer 1981, Brown 1978, quoted by Levitt & March 1996). In this way, the aim of protecting an organization's beliefs,

history, paradigms and mythology can prevail over the taking into account of information, even that of a very important nature (Sproull 1981). *Finally, what is learnt appears as being more widely influenced by the interpretation frameworks of history than by history itself* Fischhoff 1975, Pettigrew 1985).

The ambiguous nature of experience interpretation thus opens the way to interpretation conflicts *linked to the existence of differing interests* within an organization : the higher the aggregate level, the more complex it is to assess the success of an experience or of learning. Indeed, learning interpretation becomes heavy as the aggregate level increases, and the same goes for the ambiguity linked to collective interpretation mechanisms. This point is tackled by Levitt & March [1996], and they particularly insist on what they call « the ambiguity of success ». If at individual level, action assessment as success or failure remains subjective, thus leading to a systematically biased experience interpretation, at organization level, difficulties are even worse, for two main reasons :

- The first one being that when power, in an organization, is unstable or when it is confronted with individual or group dispute, the goals to be reached are ambiguous and the commitment to those goals is mistaken with the individual or collective interests that are at stake. In such a context, the assessment of results is a tool belonging to private interests within an organization.

- The second one is more objective : organizational success is generally defined as the relation between set goals and achieved performances. Yet, the goals to be reached vary with time in two ways. On the one hand, success indicators change and are redefined, whether they be related to accountancy, or of a more political or social nature. On the other hand, the degrees of wishing to reach such indicators also vary.

As can be seen, the assessment of organizational learning poses a problem since it implicitly implies : 1) the taking into account of the organization as a non-conflictual space of collective interest, 2) where the construction of a relevant collective interpretation is possible 3) within a static approach framework, since in dynamics, assessment criteria and indicators fluctuate.

Similarly, the existing literature emphasizes the importance of « superstitious learning » : « Superstitious learning occurs when the subjective experience of learning is compelling but the connections between actions and outcomes are mis-specified » [ibid, p. 523]. Generally speaking, superstitious learning leads to situations in which the subjective assessments of success are not influenced by effective actions.

(b) *An organization also learns from indirect experience*, which corresponds to the appropriation of the others' experience through the transfer of codified learning. From this standpoint, the mechanisms of the dissemination of knowledge through the relations maintained by an organization with its market and institutional environment are studied. The typology of those mechanisms currently used in the works on organizational learning is based on an analogy with disease epidemiology. Di Maggio & Powell [1983] distinguish three main categories of knowledge diffusion processes here :

- *a coercive diffusion* : rules are edicted by centralized institutions (government agencies, trade unions, professional associations…),
- *a mimetic diffusion*, either the dissemination of knowledge pertaining to routines that spread via the relations between organizations, consultants or else personnel flows,
- *a normative diffusion*, wherein routines are formally and informally disseminated via the education and training system, or else via the circulation of publications printed in great numbers…

The analysis of knowledge diffusion processes is linked to the specificities of innovation diffusion between organizations. In this context, much clout is given to institutions and their ideological pressure on organizations by the existing literature.
The studies on diffusion processes distinguish between their positive or negative effects on organizations, depending on whether they imitate or are imitated, and whether the diffusion concerns the search for technical efficiency or considerations on legitimacy. In the first case, diffusion obviously has negative consequences for imitated organizations. Contrarily, if it deals with considerations on legitimacy, this diffusion may have positive ones (Di Maggio & Powell 1983). The taking into consideration of those diffusion processes, the existence of mimetic behaviors and possible self-reinforcement phenomena such as those appearing in technological choices, are obviously essential to the understanding of organizational changes. They should also lead us to question the logics that entail the generalization of certain organizational models, beyond a mere explanation limited to their supposed efficiency.

The levels of organizational learning

Whether it learns from direct or indirect experience, an organization is faced with conditions under which it adjusts its knowledge to environmental changes. This question leads to the definition of learning levels which is at the heart of Argyris and Schön's analysis. It is also to be found, under a different approach, in the evolutionist analyses of routines, as we shall see later.

Marengo's presentation, as seen before, offers a clear definition of this problem. Each learning process is based on representations, performance and regulation assessment systems. How then, in such conditions, can those representations and assessment systems be modified ? This question implies the taking into account of a superior level of learning, which makes the revision of representations and assessment systems possible. Such processes are necessary, since world representations and assessment systems cannot be considered as unchanging data.

Argyris & Schön's analysis is very accurate on this point[12]. After explaining how organizational knowledge changes into « theories of action », that is to say into « systems of belief that underlie action », itself including an « espoused theory », the theory put forward to explain and justify a certain mode of action, and a « theory in use »[13] made up of values, performance standards and strategies for achieving values, they distinguish between three categories of organizational learning :

- the first one, « single-loop learning », allows the performance improvement of an organization's tasks. « By single-loop learning we mean instrumental learning that changes strategies of action or assumptions underlying strategies in ways that leave the values of a theory of action unchanged ».

- the second one, « double-loop learning », allows an organization to revise the values and criteria that are used to define and assess performances. « By double-loop learning, we mean learning that results in a change in the values of theory-in-use, as well as in its strategies and assumptions. The double-loop learning refers to the two feedback loops that connect the observed effects of action with strategies and values served by strategies. Strategies and assumptions may change concurrently with, or as a consequence of, change in values. »

- the third one, « organizational Deuteurolearning », allows an organization to improve its capabilities to previous learning processes. It can be considered as a variant of double-loop learning.

According to Argyris & Schön, problems are obviously concentrated at the last two learning levels. In their analyses, the problems met in organizational learning are largely due to the difficulties of questioning the « theory in use » or, more broadly, an organization's own vision of the world. This is explained by reasons linked to individuals' cognitive structures and to the cumulative aspect of learning processes, but also, and mostly, to the fact that this revision process tends to be accompanied by conflicts between individuals or groups of individuals within an organization. Argyris and Schön insist on this point : « double-loop learning » implies conflict solving patterns within an organization,

[12] See the first chapter of their latest book, Argyris & Schön [1996]
[13] When we speak of « theory in use » … « we mean the theory of action which is implicit in the performance of a given pattern of activity » [op. cit. p. 13].

whether they be interpretation or interest conflicts. It is worth noting that Argyris and Schön previously defined an organization as being first of all a *political* entity, though without taking into consideration the specificities of the different types of organizations, particularly of a firm. It would then be necessary to examine, in an explicit way, the political structure and the power system of a firm, and to see how it conditions learning processes and their outcomes. This still remains to be done.

Additionally, three main questions should be recalled from Argyris and Schön's theories.

(1) Who learns ? Is there a meaning in saying that an organization learns ? We shall deal with this point later.

(2) What are the links between learning and organizational patterns ?

Whether the emphasis is laid on the first or second vision, an organization's structure is closely linked to the learning processes. In the first approach, the question is to know which organizational patterns encourage individual learning and the dissemination of knowledge within a firm. This point has already been dealt with, notably in the various analyses on the Japanese firm, showing how labour organization there favours learning, or at least certain types of learning.

In the second approach, the emphasis should rather be laid on an organization's global structure and « culture ». A firm's capability to learn will depend on its organizational system as a whole, on the rules, routines and « theories-in-use » it includes at different levels, some of them having a more local role and some others concerning the whole organization (Argyris & Schön [1997]. It would then be interesting, in order to go further, to take into consideration the characteristics of the organizational structure, and particularly those of the capitalist firm as it is today. Yet, we do not think the existing theories on organizational learning ever go as far as this.

However, it is possible to go further in the analysis of one dimension of an organization : its centralization level. It should first be noted that an organization's learning capacity always lies both on its members' learning capacity and its own capacity to coordinate and integrate individual learning processes. This results in a tension between the necessity to encourage the autonomy and variety of individual learning processes on the one hand, and the constraints of organizational coherence on the other, implying frameworks and limits to their autonomy. Such a contradiction finds its expression in the tension between centralization and decentralization highlighted in Marengo's simulation model [1996], which makes the reinterpretation of the discussions on the Japanese firm's traits or on the reasons accounting for the multidivisional firm's advantage possible in the light of the problems of organizational learning. Yet, it should be added that this analysis remains focused on cognitive

coordination problems, and leaves aside the problems linked to individuals or groups of individuals' differing preferences and interests within an organization. The consideration of this essential aspect, to be found occasionally in March's or in Argyris and Schön's studies, makes the analysis of the links existing between organizational structure and learning even more complex.

(3) Are there fundamental limits to organizational learning ?

Weick and Westley's standpoint [1996] deals with this question, even if their approach can be regarded as extreme. Indeed, according to them : « Organizing and learning are essentially antithetical processes […] To learn is to disorganize and increase variety. To organize is to forget and reduce variety », which, in a way, corresponds to what has just been seen.

In fact, though differently, analyses often insist on the problems and limits of organizational learning, at least of direct experience learning. This clearly appears in the analysis of « competency traps » (Levitt & March [1996]) which puts forward the trend to specialization in action patterns and technologies that are not necessarily optimal. Argyris and Schön, for their part, insist on the difficulties of « double-loop learning », implying a change of theories in use. The question is thus to know, as Cohen and Sprull (1996) note, if organizational learning « reinforces existing action patterns or causes them to change ». The various approaches we have previously refered to lean towards the first alternative, as well as many remarks by Nelson and Winter [1982], or the other analyses of a firm's competencies already examined.

Besides, at least two other ways can be found to escape the fatalistic theory according to which an organization is prisoner of its action patterns and representations. The first one consists in searching organizational patterns allowing for internal competence and action patterns widening and renewal (see for instance Winter [1994]). It is possible to analyze in that perspective the creation of the functional and multidivisional forms, or the search of new modes of organization, like the network firm or the organization by project teams. The second one resorts to indirect experience learning : an organization, particularly a firm, is never isolated from the outside world. It would then be useful to analyze how its relations with the environment influence its capabilities and learning patterns.

According to March's famous analysis, the characteristics of organizational learning processes entail trade-off problems between variety and coherence, the exploitation of existing competencies and the exploration of new ones. The conditions for a firm to master this trade-off place at risk all its organizational choices, both in its internal and external relations, and strategies. Yet, here again, the study ought to be carried further in order to reach a better understanding of the links between organizational patterns, behaviors and performances.

3. Capabilities and routines : the evolutionary perspective

Organizational competence is a key notion in the evolutionist analysis. It was first elaborated by Nelson and Winter [1982] (as dealt with in Chapter 5). It is at the heart of the evolutionist theorization of firms and organizations. The evolutionists' goals are broader than their predecessors', and located at various levels. The aim is first to construct a general theory, an alternative to standard approaches, accounting for organizations' behaviors and performances as the consequence of individual and collective learning dynamics. From the firm's theoretical viewpoint, the key question underlying the analysis concerns the diversity of firms : « why firms do *persistently* differ in their characteristics, behavior and performances » (Dosi & Marengo [1994]). The answer is to be found in the analyses of firms' specific knowledge and competence accumulation dynamics. The research program grants a key position to the construction of alternative microeconomic foundations to the neoclassical rational behavior paradigm. Hence, we first have a theory of individual behavior, constructed after Simon and March's works, and summoning up a certain number of breakthroughs in cognitive sciences. This theorization also gives a key position to the analysis and formalization of learning processes (see, for instance, Marengo [1996], and Dosi, Marengo & Fagiolo [1996]). Secondly, there appears an organizational theorization, constructed around *organizational* learning, competence and routine categories (cf. Coriat & Weinstein [1995]). The latter aims at explaining a firm's behaviors and performances, as well as the consequences of organizational architecture on these elements, through their effects on the firm's learning capabilities. We shall come back to this later.

Key dimensions of the evolutionary theory

Let us first recall some essential aspects of the evolutionist contribution to organizational learning and competencies.

(1) *organizational learning* is fundamentally *cumulative.* In time, the repetition of activities and experimentation increase individual and organizational competencies. It is then largely *local and path dependent.* Technological as well as organizational knowledge is built on previously accumulated knowledge, which partly explains the persistence of differences between firms and of their own specificities. The fact should also be stressed that each firm tends to develop alongside specified technical and organizational trajectories which determine the scope of their capabilities. This aspect reminds us of the previously mentioned pivotal question : i.e. do learning processes within a firm reinforce existing action patterns or do they allow for their transformation ? The answer is generally

balanced. Thus, Dosi et al [1999], taking up the notions of core and dynamic capabilities, mention the « firm's ability to carry off the balancing between continuity and change in its capabilities ». Yet it seems that analysis often sways toward continuity. According to us, the identification of the factors that influence the trajectory in one direction or another is one of the key aspects that ought to be considered.

(2) *Organizational learning is intrinsically social and collective*, which means that organizational competencies matter more than individual ones. The latter depend on the individual's role within the group, as well as on the organization's ability at summoning them up.

The emphasis laid on the collective dimension of knowledge and learning processes, as well as on *organizational* knowledge and learning, implies various aspects and consequences :

- an organization's knowledge and capabilities correspond to something else than the mere sum of its members' individual knowledge. Most of an organization's capabilities are its own : « it is firms, not the people that work for firms that know how to make gasoline, automobiles and computers » (Winter [1982]).

- the knowledge and competencies belonging to each single member of an organization are fragments of the whole organization's knowledge (or more generally of a given group's knowledge), and these fragments are meaningful and efficient only in a certain context, made up of all the other members' knowledge and competencies and of the relations existing between one another. Thus, an organization's structure and the relations system on which it is based are a major component and a prerequisite for organizational competence. Yet, it should be noted that only one part of an individual's knowledge and competencies depends on the organization and is specific to it. A firm's knowledge and competencies are thus « embedded in its social structure » : its organization, rules and routines, culture… (see also Hodgson [1998]). Consequently, they are not immediately legible and transferable.

- Learning and knowledge creating processes, whether individual or collective, ought to be considered as social processes incorporating the dimensions of the formation and utilization of cognitive frames, codes, shared beliefs and representations. It is thus completely different from a process of production and acquisition of information.

- All this entails the questioning of the conditions of individual competencies and learning coordination, of the languages and procedures that allow collective learning : the constitution of a

common knowledge base, shared representations, performance assessment systems, coordinated problem-solving procedures…

A dominant cognitive dimension can thus be found in the evolutionist analysis, as in the previously reviewed theories of evolutionist learning. The institutional dimension is also largely present, even if strongly conditioned by cognitive presuppositions[14]. We shall have to come back to this point later.

(3) *Organizational competencies* represent « the problem solving features of particular sets of organization interactions, norms and – to some extent - explicit strategies » (Dosi & Marengo [1994]). They summarise « the effectiveness of firm-specific problem-solving procedures » (op .cit.).

The knowledge and competencies resulting from organizational learning are materialized and incorporated in *organizational routines.*

The notion of routines no doubt best characterizes the evolutionist approach of organizations. It can be considered as « a founding concept of an alternative decision-making theory to the neoclassical one » (Cohen et al [1996]). According to a recent definition, a routine is « an executable capability for repeated performance in some context that has been learnt by an organization in response to selective pressures » (op.cit.). Once the fact is admitted that organizations' actions cannot be understood realistically if they are treated as perfectly rational optimizing agents, the firm is considered as « highly inertial repertories, responding to – indeed perceiving - today's environment largely in terms of lessons learned from actions in days gone by » (op.cit.). The question is thus to understand how these « action repertories » (the routines) are « assembled, maintained and modified ».

Routines show a few major particularities :

- They have a stable and recurring character, they are repeatedly used by one or several individuals. Such a stability accounts both for their efficiency and limits.

- They are defined within a given institutional context. Each firm thus holds a specific corpus of routines, which are somehow akin to its genes.

- The notion of routines includes the idea of *automatic, non deliberative behaviors*. According to Nelson and Winter [1982], this notion accounts for the efficiency of routines. It is largely due to the mainly tacit nature of the knowledge that guides agents' actions. The importance given to tacit knowledge is a key element in the evolutionist approach, whether to elaborate a general decision-

making or action theory (in the behaviorist fashion), analyze technical changes or construct a theory of the firm and organizations. The tacit dimension of organizational routines is one of the major reasons accounting for the fact that competencies are firm-specific and non-transferable. Simultaneously, as we shall see later, the articulation between tacit and codified knowledge, as well as between automatic and deliberative behaviors, is essential for the analysis of a firm's competencies.

- They are *context-dependent* and non variant, in a given context, to fine-tuned changes of received information (Dosi et al [1995]), which explains their stability. The context notably includes all the aspects of a firm's relational system, its organizational structure, its incentive systems.

Last, but not least, routines have a double dimension : a cognitive dimension, as a problem-solving procedure, and a political one as a mode of control and governance (cf. on this point Coriat & Dosi [1994], Coriat & Weinstein [1996]).

Thus, the evolutionist answer to the questions : how to explain the differences between firms and why do some achieve better performances than others (in a given context) is the nature of the routines underlying their actions and somehow corresponding to their own heritage, that they have built up alongside their own learning trajectories.

Some questions

It is not our ambition here to review all the evolutionist contributions, but we wish to examine two major aspects. On the one hand, the relations between routines and competencies and on the other, the questions of the double nature of organizational routines, which is inseparable from the problems linked to the nature of organizations, and more particularly of firms. All this leads us to the questions relative to the relations between cognitive and institutional dimensions in the evolutionist program.

(1) One can start from Winter's proposal [1991] in his evolutionist analysis of competencies : a firm's core capabilities are based on " a hierarchy of practiced organizational routines, which define lower order organizational skills […] and higher order decision procedures ".

The idea of a *hierarchy of organizational routines* then appears as 'the key building block' for a theory of organizational competencies (ibid). Hence the indispensable reflexion on the categorization

[14] On this point, see Coriat & Weinstein [1995]

of routines may lead to two questions : can it be said that competencies are incorporated in routines alone ? and what sort of definition and accurate characterization can we give to routines ?

Routine categorization can be achieved in several directions. First, by considering « how the representation of the action is maintained in the organization » (Cohen et al [1996]), four modalities can be identified : 1) in individuals' memories, 2) by « locally shared languages », 3) by physical artefacts, 4) by organizational practices, 5) by « globally shared language forms » (ibid). One of the major stakes of such a classification is to appreciate the degree of variation and stability of an organization's action patterns. Another classification pattern, proposed by Winter (ibid) includes routines in the broader notion of « quasi-generic traits », identified by their *cognitive contents*. Winter thus distinguishes :

- *Routines as such* (in the broadest meaning), that can be divided into « complex, highly automatic (and at least in a sense « unconscious ») behaviours », and *rules of thumb* : "quantitative, relatively simple decision rules of thumb that are consciously invoked and require low levels of information processing".

- *Heuristics and strategies* : « concepts and dispositions that provide orientation and a common structure for a range of similar problem-solving efforts, but supply few if any details of individual solutions ».

- *Paradigms and cognitive frameworks* : « mental models that are so fundamental to the cognitive activity of the actor that they affect perception as well as problem-solving and other cognitive functions ».

Such fine-tuning of routine analysis entails several questions. Two major aspects ought to be considered.

(i) The first one deals with the relations between routines and organizational competencies. The starting point lies in this proposal : « routines are the building blocks of capabilities » (Dosi, Nelson & Winter [1999]). But capabilities cannot be reduced to mere routines. Narduzzo, Rocco & Warglien [1999] insist on the fact that routines, in their narrow meaning, that is to say as *tacit and automatic behaviors*, represent only a tiny aspect of the way competencies take shape : « all of them are embedded in more complex patterns of action in which interpretation, reasoning, more or less explicit manipulation of mental representation, deliberation and design take a relevant part » (op. cit.). Moreover, routines are meaningful only when restored in the context of a given architecture of individual skills, where representations and mental models play a key role.

This type of analysis first shows the diversity and complexity of action patterns and the factors likely to influence an organization's capabilities, as well as the necessity to clearly identify routines as such among all this[15]. It also points out the trend to over privilege all that concerns representations and mental structures when explaining organizational practices, which, once more, can be to the detriment of the role played by institutional determinants.

Narduzzo, Rocco & Warglien [1999] also insist, in their extremely fine-tuned analysis of the competence emerging process within a firm, on some key aspects :

- the necessity to examine the question of interrelations between individual and collective competencies, which refers us to the key notion of the nature of organizational competencies, to which we shall come back later.

- organizational capabilities cannot be reduced to routine collections. Indeed, they are basically linked to organizational architecture, as well as to the structure of the coordination system between routines and the other action patterns to be found within the organization.

This entails the necessity of take into consideration various organizations', and more particularly firms', traits of organizational structures and coordination patterns, which implies a questioning of the nature of the firm as a specific coordination pattern, as we shall see later.

(ii) The second important aspect is *the tension in evolutionist approaches between « automatic » and deliberative, intentional behavior.* It seems obvious that originally evolutionism, particularly with Nelson and Winter, essentially stressed the automatic aspects of behaviors, which goes hand in hand with the importance given to tacit knowledge. This can be understood in their desire to be differentiated from the standard vision focused on the rational, calculating agent. Yet, the analysis of organizational competencies implies a marked, if not radical, inflexion of such an orientation, because of the decisive importance, as we have just seen, of finalized, deliberative behaviors. It is precisely what Dosi, Nelson & Winter [1999] express when they construct the concept of organizational competence around the idea that : « capabilities fill the gap between intention and outcome », adding that : « The capability discussion relates specifically to a realm of behavior infused with intentionality, conscious deliberation, planning and expertise – as contrasted with the quasi-automatic character of performance of low-level operation routines ». It is thus essential to distinguish, at organization as well as at individual level, between different levels and types of actions, from repetitive ones in daily activities to behavior and top level decision rules concerning the choices to utilize and develop

competencies. Hence the opposition, as Dosi et al (op.cit.) stress it, between « the capability itself and the numerous instances of its exercise », without forgetting the necessity to make use of different types and models of competencies and learning.

It should also be added that it is possible to include action patterns with and without conscious deliberation in the routine notion, and such seems to be the prevailing approach among evolutionists[16]. One may wonder if their approach does not erase the main questions relative to the complex relations between fundamentally different action patterns, taking into account their genesis (how a routine builds up), and their exercise (what does it mean to apply a routine and why do agents abide by a given one ?). Anyhow, it seems necessary to reach a better understanding of how, on the one hand, repetition and continuity relations, and deliberation, intentionality and conscious ones on the other combine in individual and collective behaviors. This aspect is undoubtedly essential in the questionings of the conditions for *dynamic* capabilities.

Lastly, it should also be noted that the problem of the relations between automatic and deliberative behavior is linked to another one, i.e. the relations between tacit and codified knowledge, without both being completely mingled. Once again, our opinion is that if the evolutionist approach first stressed the importance of tacit knowledge (and we have seen how essential this dimension appears to explain how each firm builds up its own, non-transferable knowledge), it ought to pay more importance to the role of codified knowledge and practices, as well as to that of codification processes in organizational learning . We shall later have to deal with this crucial aspect, which will notably emerge in the analysis of the double nature of organizational routines.

(2) Nothing has been said so far of the nature of the firm. According to the broadest existing definition, proposed by the evolutionists, it is « a behavioral entity, embodying highly idiosyncratic, specific and inertial compromises between different functions, namely 1)resource allocation ; 2)information processing ; 3)incentives and individual performances ; 4)control and power exercise ; and 5)learning (Dosi & Marengo [1995]). The routine and competence analysis has so far taken only one function into consideration : learning, thus neglecting the problems linked to interest conflicts between a firm's members, and the way they are handled. In other words, no attention has been paid to incentive, control and power aspects. The taking into account of this central dimension in a firm (and in any organization), its *governance* pattern, should imply a reappraisal of the nature of organizational routines and competence analysis, as Dosi and Coriat do it [1998]. The analysis of Taylorism, more particularly highlights the double nature of organizational routines : « routines do not only represent

[15] regarding this point, see Dosi et al's discussion [1999], which insists on the difficulty of such an exercise.
[16] Cf. for instance Dosi et al [1999]

problem-solving procedures, but are at the same time control and governance devices ». Several key points are thus stressed :

- The importance of codification as a tool of knowledge *appropriation*, and as a means to transform individual knowledge and skills into organizational capabilities incorporated to a system of rules and routines.

- The way knowledge is disseminated within an organization is closely related to the distribution of power, and to its hierarchical structure. Close links thus exist between organizational structure, governance pattern and incentive and reward system, and the form of organizational competencies (the system of rules and routine) as well as of specific learning trajectories : « patterns of problem-solving and patterns of governance and control turned out to be intimately linked » op.cit.), which means that it is not possible to understand firms' capabilities and learning patterns without taking governance patterns into consideration.

- It is also very important to focus our attention on the institutional embeddedness of organizational and learning patterns. Routines and learning patterns are indeed conditioned by national (or international) institutional systems, such as those framing labor and financial markets or intellectual property. Moreover, Taylorism or Ohnism illustrate the importance of social and institutional processes in the codification of an organizational system, as well as in its national and international diffusion. This ought to lead us to insist on a key aspect of the understanding of the dynamics of organizations, and in particular of firms (Coriat & Weinstein [1998]) : while the evolutionary approach emphasizes the variety of firms and the fact that each one has its own specificities (accounting for its performances), it is also necessary to take into account the processes of *emergence and diffusion of some dominant organizational patterns*. This attitude also implies a higher importance given to the 'learning from indirect experience' and to the role of imitation in the way organizations behave and structure themselves.

The taking into consideration of the double dimension of routines should also undoubtedly deeply affect the analysis limited to a purely cognitive vision. Indeed, « we do not have on the one hand 'cognitive' regulations and routines and 'disciplinary' regulations and routines on the other […], the same routines, or routine systems, and the same organizational patterns structure learning, problem-solving surplus distribution processes » (Coriat & Weinstein [1998]). This should entail a reappraisal of the very nature of routines and other action patterns (at their various levels) and of the conditions for their intelligence, as regards their construction and emergence, function and action patterns. The particular importance of the complex relations between tacit and codified learning, automatic and deliberative behaviors should here be stressed.

The evolutionist contribution to learning and competence analysis has mainly been focused on the individual, and above all collective, cognitive dimension, on a fine-tuning of the understanding of collective problem-solving patterns and procedures. The increasingly frequent taking into account of the political dimension of organizations and of the institutional dimension no doubt means a noticeable evolution of the analysis.

II - MAJOR ISSUES AND OPEN QUESTIONS

Beyond their differences in perspectives and object, the various types of literature that we have reviewed meet or complement one another around questions dealing with the comprehension of what we may define as firms' capabilities and learning. We now intend to come back to some crucial aspects that we shall organize around four themes : (1) a return to the notion of *knowledge* as the central category of analysis, which will more particularly lead us to deal with the problem of codification ; (2) the tackling of the problem of firms' capabilities as such : to what extent can we talk of *organizational* capabilities and learning ?, then (3) the problem of classifying these capabilities and identifying core capabilities ; we shall then propose a few overtures on what we deem essential in order to further the comprehension of these problems : i.e. the taking into account of political and institutional dimensions.

1. Information and knowledge

At the heart of the different works that interest us here, we find the idea according to which knowledge is a central element in our societies and economic system. According to Winter [1987], in one of his major contributions, knowledge and competencies are *strategic assets*. It is then necessary to deal first with some basic aspects of the economics of knowledge.

The concept and different types of knowledge

First of all, it is important *to distinguish between knowledge and information.* This distinction is fundamental, insofar as it expresses radical oppositions, in the conceptualization of economic behaviors and coordination problems, between advanced neoclassical microeconomics and evolutionary theory or the theory of organizations.

The specific problems linked to the role played by knowledge in economic activities, whether it be scientific and technological knowledge or that related to agents' behaviors, have been tackled in the neoclassical approach by assimilating knowledge and information. That is by considering that all forms of knowledge could be compared to codified messages, self-existing objects, exterior to agents and likely to circulate like ordinary goods. Generally speaking, information encompasses well-established proposals that concern well-defined elements or sets (the states of the world, the laws regulating nature or behaviors, the characteristics of such and such an object or set…)[17]. The questions raised by knowledge as a factor of production were dealt with by Arrow [1962] in a seminal article. They mostly derive from the public good, or more accurately *non-rival good*, aspect of information, and of the importance of R&D externalities or of inventive activity. In such an approach, the neoclassical economists were mostly concerned with market failures and the ways to correct them. This leads them to focus attention on the question of *knowledge appropriation*, more particularly by intellectual property rights systems. It undoubtedly represents a major subject from a double standpoint :

- how different property rights systems orientate behaviors, and more particularly act on the incentive to innovate and the conditions of innovation (or more broadly of knowledge) diffusion,

- how firms utilize property rights systems to establish their market power and competitiveness (in various types of technological regime).

In another field of research, the theory of teams treats problems of organization by focusing on the distribution of information (Marschak & Radner, 1972; Radner, 1986)

It is not possible, however, with this kind of approach, to go much further in the field of firms' knowledge acquisition and creation, or to understand what can differentiate firms (besides the amount of R&D investment or the stock of information). The question of the firm's capabilities is not even raised. The analyses we are interested in here insist on the complexity of knowledge and the diversity of the knowledge patterns implied in the production process.

[17] cf. Dosi, Marengo & Fagiolo : information « entails well-stated and codified propositions about (i) states-of-the-world (e.g. « it is raining », (ii) properties of nature (e.g. « …A causes B… ») ; (iii) identities of the other agents (« I know Mr X and he is a crook… ») and (iv) explicit algorithms on how to do things »).

In its broader sense, knowledge can be seen from two angles :

(i) As a representation or an image, either purely abstract (mathematical) or related to a certain reality and considered as a valid (« true ») representation of this reality, based on some kind of justification. Knowledge then becomes a belief and a « mental process ». It also belongs to an individual or group of individuals, either as an external pattern, incorporated into supports, or into the agent himself : into an individual's mind (or body ?), or into an organization's structure. Knowledge may then be considered as an asset (Winter [1987]).

(ii) As a capacity to do certain things, to solve certain problems. One may then speak more specifically of competencies (skill, capability, capacity …).

Knowledge thus appears as a broad and multiform concept, which can be defined (Dosi, Marengo & Fagiolo, 1996) as including " a) cognitive categories ; b) codes of interpretation of the information itself ; c) tacit skills, and d) search and problem-solving heuristics irreductible to well-defined algorithms " […] " in his definition, knowledge includes tacit and rather automatic skills […] 'visions' and ill-defined rules of search ".

The transition from an information-based theory to a knowledge-based one implies a two-dimensional break-off. The first one is related to the importance given to *tacit* knowledge. It is a well-known concept and central to any analysis of competence and learning. The second one is undoubtedly even more important : knowledge is different from information in so far as it cannot be considered as a mere – more or less fine-tuned - description of a given reality, but constitutes a certain *constructed representation*. Knowledge appears as a social construction, including a belief and judgement dimension ; it is a "justified true belief " (Nonaka [1994]), it includes what Johnson-Laird [1983] calls "mental models" of the world. This aspect is essential to the comprehension of learning processes, mainly collective ones. It is to be found in all the variants on organizational learning theories, as well as in the evolutionary theory : the conditions in which representations, languages, framing processes are shaped, the effects of its representations and the difficulties to change them, are at the heart of learning problems. Thus, it is important to note that codified knowledge cannot be assimilated to information as it is processed in the standart economics of information, and that giving much importance to knowledge codification does not imply a possible return to the methods of the new neoclassical microeconomics.

Knowledge analysis first lies in the identification of different types of knowledge. This analysis was notably pursued by Winter [1987], in a taxonomy often used as a reference. He distinguishes between

different levels of tacitness, making the difference between tacit knowledge, that can be transmitted, and tacit knowledge that cannot be transmitted. He also distinguishes codifiable knowledge, that is effectively codified, from strictly non-codifiable knowledge. Furthermore, he introduces three other elements : *observability in use*, *the complexity level* of knowledge (the amount of information required in order to characterize a knowledge item) ; and the fact of being – or not - an *element in a system*.

Such a typology may be used as a basis for the study of different kinds of questions. First, the analysis of a firm's " knowledge base ", for the characterization of knowledge, and particularly productive knowledge on which firms' activities and efficiency rely. The major points are : what knowledge and competence assets should be acquired and developed, and *how* (via market acquisition, or free acquisition in the case of public knowledge, via internal or external learning, via reverse engineering…), and how a firm can effectively profit from such knowledge and capabilities, which raises the key question of knowledge appropriation. The study of the different types of knowledge and their specificities can also be used to identify different categories of sector-related innovation trajectories (Marengo & Orsenigo [1996]).

Other knowledge classification patterns can be found, partly overlapping the previous one. Grant [1996] offers a typology which highlights the key questions related to knowledge and competence management. He stresses three parameters :

- *Transferability*
- *« Capacity for aggregation »*, i.e. *the* possibility for knowledge to be efficiently assimilated and used by various agents. It also depends on knowledge characteristics, and notably on their degree of specificity, on agents' capabilities, particularly their 'absorbive capacity' (Cohen & Levinthal [1990]).
- *Appropriability*, usually defined as " the ability for an owner of a knowledge, or more generally a ressource, to obtain a return from that resource, equal to the value created by that resource in case of perfect appropriability " (cf. Levin et al [1987]). Here again, it should be noted that the appropriability degree depends on (1) the intrinsic characteristics of knowledge (degree of codification, facility of assimilation…) ; (2) other potential users' capabilities, (3) institutional environment (the intellectual property rights system, the information circulation conditions…)[18].

According to Nonaka & Takeuchi, [1995], knowledge classification can be made according to two dimensions : an epistemological one and an ontological one. The first one essentially concerns the distinction between tacit and articulated knowledge ; the second one revolves around the level at which knowledge is considered : individual, group, organization, group of organizations, society. This

[18] The existing literature offers multiple classifications, cf. for instance Faulkner [1994], Coombs & Hull [1998]). Machlup [1980] would identify 13 « elements of knowledge ».

raises the question of knowing to what extent one may speak of *an organization's* knowledge and learning (or more fundamentally of collective knowledge and learning). Before dealing with this aspect, we shall focus our attention on codification.

Tacit and codified knowledge

The distinction between tacit and codified (or articulated) knowledge is well-known. Attributed to Michaël Polanyi, it plays a key role in organizations' knowledge and competence analysis, and more fundamentally as the starting point for the criticism of the standard approaches of rational behavior or of technical change, notably by evolutionists.

- Purely tacit knowledge is implemented through the enforcement of rules that are not explicit and not necessarily known from those abiding by them. It is incorporated into individuals or teams, and is not easily transferable. Such tacit knowledge is expressed in the ability to perform certain tasks (driving a car, solving a maths problem), a worker's or chef's qualifications (skills, know-how), as well as a researcher's or engineer's expertise…

- On the contrary, explicit or codified knowledge, being objective, can thus be expressed in a formal and systematic language, it can be symbolically transmitted from one individual to another. Two things should be noted here : (1) codified knowledge is external to those who created it, which gives it its non-rival good specificity and allows its "transmission, verification, storage and reproduction" (David & Foray [1995]) ; (2) any codified knowledge results from a codification process and implies the existence, or construction, of a language (David & Foray [1995]) and a framing activity. All this should lead us to analyze codification patterns, their locations, raison d'être and consequences[19].

The tacit or articulated nature of knowledge will be of paramount importance in four types of questions :

- how knowledge is created or acquired and accumulated by an individual, an organization or a group ; this particularly concerns the question of knowing how an organization's memory builds up ;

[19] The literature on organizational learning sometimes uses another knowledge typology, derived forom Polanyi's, where the difference is made between declarative and procedural knowledge (see for instance M. Cohen & P. Bacdayan 1996). Procedural knowledge characterizes the individual knowledge expressing itself in competencies used both at action and cognitive level. Declarative knowledge corresponds to the knowledge of facts and proposals.

- how knowledge can circulate and be disseminated ;
- how knowledge can be combined and utilized ;
- how knowledge can be appropriated and valorized, and be a source of competitive advantage.

In almost all the works considered here, the importance of tacit knowledge explains that competencies are not easily imitable or transferable, and consequently the existence of firms' distinctive capabilities. It should also be noted that the tacit nature of a firm's knowledge or competencies is often compared with their specific or contextual features (Nonaka & Takeuchi [1995]). Yet, it seems that markedly tacit competencies may not be specific to one firm and that, on the other hand, certain codified knowledge is, in a way, strongly specific and non-transferable. This point may be important for the comprehension of what makes the specificity of a firm's competencies, and the links between organization and competencies.

Even if tacit knowledge has a privileged position in the analyses of firms' competencies or of organizational routines, and whatever the opinion one may have about the importance of codified knowledge, it is agreed that, beyond the tacit/codified opposition , (i) the different forms of knowledge are complementary, and knowledge creation and diffusion processes rests on combinations between tacit and codified knowledge, (ii) the sharing between codified and tacit knowledge is not given and only conditioned by the technologies in use, it is in constant evolution, alongside technological, organizational and institutional dynamics. More particularly, as noted by Winter [1987], the degree of codification of a firm's knowledge and competencies is partly controllable. It can be said that *codification systems are essential components of organizational and institutional patterns.* The question should then be posed of knowing what determines knowledge codification degree and patterns in different "spaces" (in the scientific community, as well as technological, managerial and the industrial ones…). Some will argue that codification will depend on reward and incentive systems, as well as on codification costs (David & Foray [1995]), but codification cannot really be reduced to a mere problem of economic calculation.

Starting from here, the reflexion can be pursued in several directions. First, around the analysis of codification as such, as a cluster of processes, social and economic forms ; then around codification motives, patterns and spaces (codification in a firm, a profession, the scientific world… ; the complex relations between codification and appropriation…). This field still largely remains to be explored (cf. Cowan & Foray [1998], Hatchuel & Weill [1992], Mangolte [1997]). Here are a few reflexions :

Codification has several key dimensions :

- It is first a means to store and memorize knowledge, independently from individuals. (Codification allows "this unique faculty of man's to be able to place his memory outside himself", Leroy-Gourhan [1965]). It ought to be noted here that codification is one condition for the constitution of a *firm*'s knowledge and competence base, to be later continued and developed independently from the moves of the individuals that constitute it. The constitution of common languages and codes is a key element in an organization's identity and permanence, which illustrates the fact that the characterization of organizational competencies cannot be exclusively reduced to or focused on the tacit dimension.

- It encourages the circulation and diffusion of knowledge, as well as its appropriation. Codification can thus encourage merchandisation, the reduction of information asymmetries, the externalization and increasing utilization of external knowledge by firms (Cowan & Foray [1998]). It should also be noted that codification is not only linked to the social diffusion of knowledge, but also occurs as a tool for the appropriation and diffusion of knowledge and competencies *inside the firm*, as it clearly appears in the previously mentioned analysis of Taylorism.

- It allows the coordination and integration of individual knowledge and competencies. The codification process participates in the transformation of individual into collective knowledge, "a set of high-order organizing principles acts as mechanism by which to codify technologies into a language accessible to a wider circle of individuals" (Kogut & Zender [1992]).

- It is a tool for the production and accumulation of knowledge. Codification is not a passive activity of description and transfer, it always implies an active, creative approach. Then it is a complex activity, implying *the construction of models* (Hatchuel & Weill [1992]), the elaboration of languages and the implementation of "codification technologies" (Cowan & Foray [1998]). Codification participates in the construction of representations that will strongly structure action and decision-making patterns, as well as performance assessment.

Codification can take place at several levels, involving more or less important groups of different agents, leading to more or less specific information. Thus, codification exist at a scientific level, providing knowledge and information systems likely to be used in various ways, within a wide institutional scope. At the other end of the spectrum, some other codifications, under the form of documents internal to the firm, can be extremely specific, regarding their usage and the agents they concern.

All this should lead us to question more thoroughly the role of codification in organizations and organizational learning. We shall limit ourselves here to only a few explanatory remarks.

(i) Two aspects of the role of codification in firms' knowledge creation processes can be identified :

- one focused on *the conditions of knowledge and competence transfer* (within a firm) and of *knowledge socialization* (cf. for instance Nonaka & Takeuchi's analysis). Codification is basically used to transfer, memorize and accumulate knowledge.

- the other one focused on *the coordination and integration of specialized individual knowledge and competencies* (cf. for instance Grant [1996]). The goal of codification is to produce common codes and languages, allowing the coordination and formation of collective capabilities, aiming at the integration of knowledge distributed among individuals, and not at its transfer, which ought to be minimized[20]. This strongly influences the nature and forms of the codification at work *in a firm* : it rather tends to save on its needs for information and knowledge sharing, and not to diffuse and socialize individual information and knowledge.

(ii) As with routines, it is necessary to consider two dimensions in codification : a cognitive one and a political one. The first one is usually taken into account and refers to codification in knowledge production, circulation, memorization and combination activities. From this point of view, codification appears as necessary to insure the coherence and continuity of actions within an organization, thus encouraging its competence learning and formation. Simultaneously, it limits its actors' autonomy and may hinder individual learning. Yet, codification also plays a key role in a firm's governance, as a tool for the appropriation of knowledge and the command of actions. This is particularly well illustrated by Taylorism, which is focused on a strict codification of productive practices aiming at transferring workers' knowledge towards the management, while transforming them into systems of "rules, laws and formulas", to take up Taylor's own words, as well as at boosting a specific pattern of productivity growth , and thus of organizational learning, based on the division of labor between conception and execution. Codification thus plays a major role in the determination of the locations where a firm's competencies, or at least some of them, are concentrated.

Organizations and firms may differ, as noted by Levitt & March [1996], "in the emphasis placed on formal routines". Those differences will depend on technological characteristics and production patterns (that give more or less importance to tacit, not easily codifiable knowledge), on environmental caracteristics, notably the role of uncertainty, and also on organizational choices, and notably on the degree of centralization.

[20] « the key to efficiency is to achieve effective integration while minimizing knowledge transfer », Grant [1996].

(iii) One of the main questions related to the economic changes of the end of this century concerns, beyond the thesis of the increasing role of knowledge, the transformations in the nature and patterns of the knowledge and competencies on which industrial growth is based. In such a perspective, some consider the development of knowledge codification, particularly scientific and technological knowledge, as one of the fundamental trends of our societies (for instance : Foray & Lundvall [1997], Cowan & Foray [1997]). This thesis is however hotly debated (Dosi [1996]). The growth of the "amount" of codified knowledge is certainly more and more important, simultaneously with the development of new body of knowledge in various scientific and engineering fields. Yet, it is also obvious that the development of codified knowledge implies new *tacit* knowledge and competencies, to be mastered, utilized and improved. If tacit knowledge remains fundamental (Senker [1995]), it is nevertheless indispensable to wonder about the various forms of tacitness. According to Winter [1987], one may deepen the analysis by considering to what degree codification can be achieved and the conditions for the transmission of tacit knowledge. From another viewpoint, it might be necessary to wonder whether the types of knowledge and competencies at play in different kinds of activities, i.e. riding a bicycle or solving a maths problem, are not fundamentally different in nature. This may particularly influence the comprehension of the evolution of knowledge and competencies in production, on account of technological changes. One may mention here one of the classical themes of the sociology of labour since the seventies : the development of automated, numerically controlled production means that workers' labour (in particular) is not so much focused on the handling of *objects* as of *signs.*

The interest of the discussion is to lead us to wonder what exactly codification is and what its modes and stakes are, so as to put to the fore the main trends in today's evolutions : the changes occurring in the conditions of elaboration of knowledge, in the "technology of technical change"[21] in relation with the development of theoretical formalizations, instrumentation and computerized calculation capabilities (Arora & Gambardella [1994])[22]. These trends have major consequences on the evolution of the division of labor and its forms of organization, notably in R&D, as well as on the determination of the nature of a firm's (or a nation's) strategic activities and competencies, and the ways to ensure a lasting competitive advantage. Some monographs also show that the new forms of organization are accompanied by the codification and standardization of the procedures that are resorted to (Coutrot, [1998]). It is particularly important to note that the search for flexibility tends to lead to *strongly formalized* organizations (Linhart 1993), which must be related to the necessity for a perfect coordination.

[21] But also in the "technology" of organization.

The increasing importance of articulated knowledge has another aspect : the development of the social division of labour, and more specifically of the cognitive division (Pavitt [1998]), which manifests itself through the multiplication of disciplines and specialised knowledge fields. This leads to the increasingly complex and systemic nature of productive knowledge. Innovation is increasingly based on a combination of multiple techniques and knowledge. Moreover, this knowledge is extremely varied as regards its characteristics : difficulty of acquisition, conditions of appropriation, rapidity of transformation…The ability to coordinate individuals and teams, to assimilate and integrate external knowledge then becomes essential. This also has major consequences on the nature of the key competencies a firm ought to hold and on its organizational choices.

Finally, the interrelations between tacit and articulated knowledge, as well as the forms and conditions of codification within organizations and at social level, appear essential for the understanding of organizational competencies. This aspect still requires further investigation.

2. From individual to organizational learning and capabilities

Speaking of a firm's capabilities, or of a "learning firm", is not obvious. At the start, there is a transposition, at a collective level, of categories built for the study of individual behaviors. If one categorically refuses to reduce the firm to an individual agent, it is then necessary to question the meaning – if there is one - of such expressions.

One may here identify two opposite positions. The first one consists in asserting there is no real meaning to speak of a firm's learning, that it is a mere (dubious) metaphor, and that, strictly speaking, *only individuals have the faculty to learn.* Indeed, according to Simon [1991], : "All learning takes place inside individual human heads ; an organization learns in only two ways : (a) by the learning of its members, or (b) by ingesting new members who have knowledge the organization didn't previously have", and "we must be careful about reifying the organization and talking about it as "knowing" something or "learning" something. It is usually important to specify *where* in the organization particular knowledge is stored, or *who* has learned it".

Considering such an approach, the analysis of a firm's competencies will more particularly be focused on such questions as : to what extent does an organization encourage (or not) individual learning ? ;

[22] Similarly, Pisano [1996], evokes the substitution of « learning before doing » for « learning by doing » in relation with the development of simulation technologies, which implies both the development of codification and the transfer of the learning place.

how do workers mobility and modes of labor management influence a firm's competencies ? ; where in the firm are different competencies localized, among which individuals or groups of individuals ? Additionally, let us mention that it is also possible, in such an approach, to speak of organizational learning, meaning the extent to which the fact of belonging to an organization conditions individual learning. This implies a clear vision of what an organization represents, and of the various categories of organizations[23].

This very individualistic approach perfectly coincides with Hayek's, stressing the fact that knowledge is *distributed* among a large number of individuals, and that the main economic problem is to ensure the *coordination* of individuals holding different and complementary specialized knowledge. This applies more particularly to the firm. The analysis of the determinants of a firm's performances should then deal with its members' competencies on the one hand, and on the coordination mechanisms it resorts to in order to integrate specialized knowledge on the other. It is for instance the conception of Grant [1996], who sees the firm as a "knowledge integrating institution", and insists on the fact that the major problem does not concern the *transfer* or diffusion of knowledge among individuals, or between individuals and the organization, but the *integration* of specialized knowledge within the organization. It should also be noted that one of the prerequisites for this integration is the existence of languages and common representations, that is to say of a *common knowledge*. Distributed knowledge and common knowledge are complementary.

The other approach, apparently contradictory, consists in asserting that there exists such a process as organizational learning. This corresponds to the evolutionary view, as seen before. Thus, for Marengo [1996], "organizational learning is a social phenomenon and cannot be reduced to the individual learning process of the members of the organization".

Organizational learning will be defined as the formation and improvement process of firms' capabilities. These capabilities cannot be reduced to the sum of an organization's individual capabilities. In such a perspective, organizational learning belongs to the whole organizational structure, it depends on the coordination patterns existing between an organization's members, and notably on the development of common codes (Marengo [1996]), on common rules and representations, as well as on "theories of action" that are specific to a firm (Argyris & Schön [1996]). A firm's knowledge is not only incorporated into its members, but also into various material artefacts, and mostly into a repertoire of rules and routines, practices and representations that structure individual behaviors and interindividual relations. One may then wonder whether both views are diametrically opposed, apart from the terminology in use, insofar as they lead to similar considerations : routines can on the one hand be considered as coordination and integration procedures

[23] Cf. on this point the very stimulating reflexions of Argyris and Schön [1996].

of individual knowledge, and on the other as integrating an organization's knowledge. In both cases, it is indispensable to consider individual competencies and learning, as well as coordination mechanisms, in order to capture the characteristics of a firm.

From our standpoint, it is relevant to talk of the learning and capabilities of a firm , insofar as it is really the firm that can achieve what an individual, or a group of individuals, cannot do. Let us just recall what Winter [1982] states : " it is firms, not the people that work for firms that know how to make gasoline, automobiles and computers". We just have to be clear about what we means by organizational learning, as well as about the complex relations between the learning of the organization and the learning of its members.

Saying that knowledge and learning belong to an organization (and not to its members) encompasses several ideas :

- *Knowledge is not embedded in individuals only.* The learning involved in an organization not only concerns individual capabilities, but also produces collective rules and routines, common representations and resources. To quote Argyris ands Schön [1996] : "In order to become organizational, the learning that results from organizational enquiry must become embedded in the images of organization held in its members' mind and/or in the epistemological artefacts (the map, memories, and programmes) embedded in the organizational environment." It is possible to speak of collective learning in so far as the outcome is created by the interactions between individuals, and cannot be attributed to anyone in particular. It should also be added that a firm's hierarchical structure and organizational patterns, can themselves result from the organization's learning process, as noted by Narduzzo, Rocco & Warglien [1999]. It is thus possible to consider two modes of emergence for a "collective intelligence" (Levinthal [1999]) : in the first one, an individual, or group of individuals, assigns the different stages of a production process to individuals, each one of them then developing his capabilities to carry out his task ; in the second one, a collective learning process develops individual competencies while giving birth to interaction patterns between individuals and contributing to their evolution.

- The role of the systemic dimension of organizational competencies. A firm's capacity is linked to the way it combines diverse individual and collective competencies. The interactions between individuals or teams is just as important, if not more, than individuals' own competencies. That is why, as seen before, several analyses have insisted on the role of integrative or architectural competencies.

- An organization frames and guides individual learning. Two aspects should here be taken into account, on the one hand the fact that organizational structures can more or less encourage individual learning, and on the other that they can also more or less encourage the process of socialization and the diffusion of individual competencies within the organization. “The organization supports creative individuals or provides contexts for them to create knowledge. Organization knowledge creation, therefore, should be understood as a process that “organizationally” amplifies the knowledge created by individuals and crystallizes it as a part of the knowledge network of the organization” (Nonaka & Takeuchi [1995]). Individual and collective knowledge becomes organizational insofar as it is diffused within the organization, socialized and collectivized (Midler [1994]), and if the organization can effectively incorporate it to its practices and summon it up to reach its own goals, which is not automatic. The analysis of the dynamics of knowledge creation within a firm proposed by Nonaka & Takeuchi [1995] aims at accounting for the conditions of articulation between individual and collective learning within an organization.

- Though rarely dealt with, a major aspect is that knowledge can, strictly speaking, belong to a firm. It is important to consider the means implemented by a firm *for its own appropriation of individual knowledge and competencies* This concerns the patterns of division of labor and types of organization, as shown by the history of Taylorism, and the appropriation by the legal system : intellectual property, labor legislation and corporate law.

It is obvious that even if we retain the concept according to which there definitely exists *organizational* competencies and knowledge, individual competencies and knowledge remain essential. Beyond the general traits that have just been mentioned, a lot still remains to be done in order to understand the interrelations between individual and collective levels. Organizational patterns can strongly differ from one another according to the way those relations are structured ; one might for instance read about the differences between “A” firms and “J” firms on this aspect. A few remarks should be made :

(i) The degree of autonomy of individual competencies and learning may vary according to the organizational context. Symmetrically, a firm’s competencies may depend on certain key individual capabilities. That's particularly the case in high-tech sectors. The key role of star scientists for the success of biotech firms is a good example (Zucker, Darby, and Brewer [1998] Darby, Qiao Liu, and Zucker [1999])

(ii) The relations between individual competencies (or learning) and a firm’s competencies are often questioned. Yet, other “ontological levels” ought to be considered. First, the different groups constituting the firm, where specific collective learning takes place. One of the major dimensions of a

firm's organization is the definition of those organizational units (workshops, research laboratories, functional departments, project teams…) and of the relation patterns between those groups. Learning, within those units, can be more or less autonomous or integrated to the rest of the organization (Argyris & Schön [1996]). The links between individual and organizational learning are thus always dependent on those intermediary levels playing a key role as locus of collective learning, which makes the comprehension of the conditions of organizational learning even more complex.

The social environment framing individuals and organizations should also be taken into account. An organization does not shut away its members, they are socially inserted, and belong to certain formal or informal groups constituting the society at large. Their competencies and learning, representations, "theories-in-use" (to use Argyris & Schön's terminology), partly take shape outside their firm and condition their action patterns within their firm, and then the relations between individual and organizational learning. An organization's structures, its abilities to assimilate individual competencies and develop its own ones are themselves conditioned by its relations with the outside world, with other firms and organizations, as well as by the institutional framework, which brings us back to the role played by organizations' institutional embeddedness.

(iii) The relations between individual and organizational competencies are closely linked to the locus of capabilities within the firm. An extreme holistic approach consists in considering that a firm's competencies are a characteristic of the organization's structure and routine system. It is then useless to wonder where competencies can be found inside the organization. Yet, in our opinion, even if admitted that organizational capabilities cannot be reduced to the sum of individual ones, it is necessary to wonder whether some internal, localized activities and capabilities do not play a key role in the firm's competitiveness, within a given technological and competitive environment. If we wish to go further on this point, it is indispensable to review the different types of capabilities, and to come back to the notion of core capability.

3. Types and locus of capabilities

To return to the initial question : how is it explained that some firms hold a sustainable competitive advantage ? The answer being because they possess some specific competencies and learning capacities, it is then necessary to question the exact nature of such competencies : how is it that, within a given context, some types of knowledge and capabilities give firms a sustainable advantage ? The answer to this question involves the identification of what is commonly refered to as "core

competence", and the factors that favor or hinder the evolution of a firm's competencies. Before returning to this point, we have to consider how to classify capabilities.

Types of capabilities

To define different types of capabilities we need some classification principles We will consider here three main lines of classification and next consider the links between the definition of different capabilities and the modes of division of labor.

(1) Dynamic capabilities

As seen before, the strategic management literature and the evolutionary theory have laid the emphasis on dynamic capabilities. It is worth returning to this aspect.

Following Simon [1965], one may consider that an individual's behavior lies in three kinds of "programs" (Mangolte [1997]) :

- "Execution programs" (human performance programs), corresponding to particular know-how, allowing the accomplishment of specific tasks.
- Less specific capabilities such as learning capabilities (learning programs), i.e. the capabilities to modify and adapt more specific programs.
- General capabilities, such as the "means-end" analysis, allowing to search for and solve problems.

At a firm's level, this leads us to distinguish (i) capabilities to carry out certain tasks or activities (technical capabilities in the strict meaning of the word, such as the capacity to produce certain types of goods with a given quality standard, but also managerial capabilities…to be studied later) ; (ii) the capacity to develop, through learning, and to transform these capabilities, so as to improve them and adapt them to environmental changes ; (iii) more general capacities to search for and solve new problems, to create novelty, *to change capabilities.*

The last two categories encompass what Teece, Pisano & Shuen [1997] call *dynamic capabilities* : "ability to achieve new forms of competitive advantage", "ability to integrate, build and reconfigure internal and external competencies to address rapidly changing environments". At a more fundamental level, dynamic capabilities can be seen as : "high-level procedures related to the search *for new problems and new problem-solving procedures*" (Dosi & Marengo [1994]). The distinction between *static routines* ("capacity to replicate certain previously performed tasks" and *dynamic routines*

(“directed at learning and at new product and process development”) belongs to the same idea (Dosi, Teece & Winter [1992]).

There may be a wide consensus to consider that *dynamic* capabilities are essential to ensure a firm’s (or a country’s) sustainable advantage, and that dynamic capabilities imply specific organizational patterns. Yet, the notion of dynamic capabilities may be ambiguous, and thus lead to some major questions. One may define several levels of dynamic capabilities, which, we believe, is the main aspect of things. Returning to the previously mentioned classification, one may thus roughly imagine two levels of dynamic capabilities :

(1) Capabilities that ensure sustained learning, allowing the improvement and renewal of a repertoire of specific capabilities and their adaptation to environmental changes. This type of capabilities may be embedded in specific organizational structures and action patterns, rules and routines, relatively stable technical and managerial systems, inside a technological or technico-organizational paradigm. One may thus try and identify the types of organization that encourage such dynamic capabilities, by developing individual and collective learning, as well as a firm’s capacity to innovate, whether it be generic patterns (the J firm), specific standards linked to sector-related régimes, or some firms’ own patterns. The existence of a stable “competence system” ought to be compatible with changes in organizational patterns and procedures. This entails consequences on the nature of the rules and routines in which capabilities are embedded : they cannot be rigid and purely automatic, univocally determining action modes. Moreover, the idea of a “competence system” implies the capacity to act along certain trajectories that tend to limit the scope of an organization’s practices (ways to do things that are considered feasible and legitimate), to limit its learning scope and patterns, and to restrict its possible evolution paths. Organizational learning is usually seen as being cumulative and path dependant. There is then a “quasi-irreversible commitment to certain domains of competence” (Teece, Pisano & Shuen [1997]).

(2) Dynamic capabilities may also be envisaged as the capacity for an organization to change in depth its organizational patterns and structures, to create new capabilities and routines and to change paradigm as well as system of competence. The underlying problem is then of a different nature than in the previous case, it is no longer linked to the question of knowing how an organization can learn and accumulate knowledge, but rather how it can “unlearn”, build a new knowledge base rather than exploit and develop its own, break off with its organizational rules and routines…The general and fundamental question is : how an organization (or an individual) can “change behaviors” (Argyris [1992]). This question can be posed either because of the internal inertia of behaviors, when core capabilities become “core rigidities” (cf. Leonard-Barton [1992], Leonard [1998]) ; or of environmental (notably technological) changes that question the effectiveness of a firm’s capabilities.

Fujimoto [1998] offers this distinction when he distinguishes, in the field of production and development capabilities, *static capabilities* that ensure a certain performance level, *improvement capabilities*, i.e. the capabilities to improve performances such as quality and productivity, and *evolutionary capabilities*, i.e. the capabilities to construct new competencies and new production and development systems[24].

One can think that these evolutionary capabilities are essential to determine firms' (and nations') sustainable competitiveness, and that the conditions for the formation and persistence of this type of capabilities are completely different from the previous ones[25]. The patterns in which such capabilities are embedded are undoubtedly very different in nature. One may notably think that the institutional environment will play a major role (the forms of competition, the characteristics of educational and research systems, labor markets' characteristics…). One may also suppose that inside the firm, this type of capability will be linked to organizational dimensions that are different from those at play in the previous case. The structures of governance and the system of power are particularly important at this level, insofar as conflicts are inevitable in processes that imply to challenge the position of different individuals and groups, and the compromises on which an organization is based. What has already been said should be recalled regarding the fundamental difficulties of double-loop learning and "the quasi-impossibility of a collective change that would simultaneously be deep, deliberate and endogenous" (Favereau [1988]). More fundamentally, it is questionable whether such a capacity to transform organizational capabilities and routines can be reduced to a collection of definite routines, rules and procedures and to well-defined organizational patterns : can "meta-routines" exist ? To put things differently: "There is no ready-made coordination for high-order collective learning" (ibid.).

(2) Technical and managerial capabilities

The co-evolution of technology and organization is one of the main dimensions of the transformation of firms and industrial structures, as shown in Chandler's works. The distinction between firms' technological and organizational capabilities and the way they combine is thus essential for the understanding of the determinants of competitiveness. The nature of these different capabilities should now be examined.

Technological capabilities may be defined as follows : "the ability to develop and design new products and processes, and to operate facilities effectively" (Dosi et al [1992]) : or else as : "the

[24] The organizational deuterolearning, as a category of double-loop learning, in Argyris & Schön, is of a similar nature.
[25] Cf. Fujimoto [1998] for some hypotheses on the conditions for the emergence of new capabilities.

resources needed to generate and manage technological change, including skills, knowledge and experience, and institutional structure and linkages" (Bell & Pavitt [1993]). Such capabilities can be considered at different levels (as seen later) : specific capabilities *in certain scientific and technological fields,* in the conception and production of *certain products,* more general capabilities in *certain functions* : i.e. production, R&D, engineering…

Managerial capabilities, can be seen as the ability to ensure efficient firm management, and to implement organizational innovations. This essentially includes a central aspect (cf. for instance Chandler [1992]) : *the capacity to coordinate and integrate* different activities and different skills, through certain organizational structures and internal policies, encouraging efficiency, i.e. what Carlsson & Eliason [1994] call "organizational capability".

Among these managerial capabilities, *competitive capabilities* ought to be given special importance. They mean the ability for a firm to adjust to and act on its environment, to opt for efficient actions in its relations with other agents. It notably includes the ability to be well positioned on different markets (products, capital, labor markets), the ability to become integrated into certain networks…("Essential too are those learned in the strategic activities of responding to moves by competitors, of carrying on the long, costly, and risky process of moving into new markets and adjusting to the constantly changing economic, social and political environment" Chandler [1992]). It also includes (cf. Dosi, Teece & Winter [1992]), *allocative capabilities* : deciding what to produce, at what price ; *transactional capabilities* : deciding to make or buy, to make by oneself or in partnership.

This organizational capabilities are specific insofar as organizational choices condition all the capabilities of a firm. Technical innovation capabilities somehow heavily depend on the organization's dimensions, as shown, for example, in the analyses on the organization of development. The same goes for competitive capabilities, even if one may often be tempted to link them to strictly individual capabilities. Technological and managerial capabilities are closely related, and the borderline between both is subtle. For example, the ability to develop new products or processes obviously has an organizational dimension, which has given birth to an abundant literature. Yet, the question of the relative importance of technological and managerial capabilities in a firm's success remains to be answered. It is particularly noticeable in the interrogations concerning the consequence of technological break-offs on firms' situation : can their inevitably ageing technological capabilities necessarily affect their competitiveness ? The answer may be negative if one supposes that managerial capabilities matter more and make the renewal of technological ones possible.

(3) Three levels of capabilities

It is easier to understand the way a firm's capabilities build up and develop if we consider the existence of a hierarchy of capabilities.

At a first level, we find *capabilities that are specific to certain fields of knowledge*. They notably include scientific and technological capabilities, but also managerial, legal or market-related capabilities. Some particular knowledge acquisition and learning patterns exist in those fields. Those capabilities can be localized within a firm and linked to relatively well-defined elements : essentially individuals and teams, data bases, expert systems. Such areas of capabilities have generally been defined in accordance with modes of division of labor, leading to the formation of discipline-related corpora ; they rely on a corpus of socially codified knowledge, henceforth on capabilities formation patterns that are partly external to the firm.

At a second level, one may consider *capabilities that are related to certain types of activities* of a firm, they are more general than the previous ones : i.e. capabilities to produce certain types of goods, to develop products or systems, market capabilities (on certain markets). These capabilities partly lie in the ability to coordinate individuals and teams, to combine different specialized capabilities : different technologies, different scientific and technological capabilities. They are more particularly incorporated to teams, organizational structures and routines, even in the firm's values and culture (for instance a strong engineering or financial culture…). Such capabilities can be defined according to the functional division of the firm's activities (R&D, engineering, production, marketing, financial capabilities…) ; one may also speak of "functional capabilities" (Quelin [1997]), or of product and market-related capabilities (Carlsson & Eliasson [1994]).

At a third level, we find more generic capabilities, i.e. *capabilities to control, combine, coordinate and integrate*, different skills and capabilities (specific technical capabilities, technical and market capabilities…), different activities (production, R&D, marketing). This type of capabilities appears crucial in various studies, notably Chandler's[26]. One can speak here of "combinative capabilities" (Kogut & Zender [1992]), "integration capability" (Iansiti & Clark [1994]), or "architectural competencies" : "the ability to *use* these component competencies – to integrate them effectively and to develop fresh component competencies as they are required" (Henderson & Cockburn [1994]). One may consider that dynamic capabilities, as devised by Teece et al. [1997], are essentially to be found at this level. They are more particularly found in managerial structures and practices (the "organizational architecture", Nelson [1991]), in essentially idiosyncrasic high-order routines and procedures, and in a firm's culture and dominant values. It should also be added that since those

[26] « learned routines are those involved in functional activities –those of production, distribution and marketing-obtaining supplies, improving existing products and processes, and developing new ones. Even more important are those routines acquired to coordinate these several functions », Chandler [1992].

capabilities mostly concern *coordination and control* activities (Pavitt [1998], it is particularly necessary to consider their double dimension : on the one hand the ability to combine different capabilities, and consequently to create common languages and procedures, and the ability to solve conflicts, to set up arbitrations and compromises, and to conceive and impose control and constraint systems.

As for technological capabilities, it is possible to identify two main types of "integrative competencies" (cf. Henderson & Cockburn [1994]) : the ability to have access to and assimilate knowledge that is external to a firm, as well as the ability to integrate knowledge within an organization, between disciplines, functions and professions. Similarly, Iansiti & Clark [1994], who insist on the importance for capabilities to be integrated, distinguish between "internal integration" ("the capacity for extensive coordination between different specialized subunits within an organization") and "external integration", which is itself subdivided into "customer integration" ("capacity to link information and knowledge about future customers" ») and "technology integration" ("capacity to link the evolving base of technical knowledge (both inside and outside the firm) to existing base of capability within organization").

As suggested here, one may think that these different types of capabilities are embedded in specific forms (characterized by the more or less important role of individual knowledge and skills, the importance of tangible - technological and managerial - structures, and by codes and routines specific to the firm…), in different locus and at different levels within the firm. We shall return to this point later. The hypothesis can be put forward that between the first and third levels, the importance of codified and generic knowledge decreases, whereas that of tacit capabilities, specific procedures and firm internal learning processes increases. It also ought to be noted that codification patterns change and tend to become increasingly specific to the firm (or to certain groups within the firm).

(4) Capabilities and division of labor

The formation of different types of capabilities results from the division of labor and specialization. The identification of different types of capabilities must therefore be linked to the modes of division of labor , within the firm and at society level. It is useful to start from a basic distinction (cf. Pavitt [1998]) between two fundamental modes of labor division: the cognitive one in the production of knowledge and that to be found within the firm.

The cognitive division of labor in the production of knowledge is expressed through the formation of specialized disciplines and knowledge bodies, partly codified in specific languages, as well as of organized professions and communities. This division is particularly visible in the way research and

education systems are structured, according to modalities determined mostly outside firms, at an *institutional* level. The evolution of this system shapes the evolution of capabilities, particularly of scientific and technological capabilities by creating new fields of knowledge,new types of capabilities, and new disciplines and professions. It also implies the increasingly " multi-technology" aspect of products. The firm's R&D and production activities imply the combination of an increasing amount of specialized knowledge and capabilities (Coombs & Metcalfe [1998]). We are henceforth led to make a clear distinction between *a firm's* specialized *technological* capabilities (that can for instance be identified through its workers' qualifications in different fields of activities, or by registered patents and publications), and its *product-related* capabilities (for instance its development capabilities) which largely depend on the ability to assimilate different types forms of knowledge and to combine different technologies[27]. It should also be added that this type of knowledge and capability systems evolution also concerns managerial knowledge.

The division of labor inside the firm's is based on this cognitive division but adding a *functional and hierarchical division*, which leads to the formation of *functional capabilities* : in production management, R&D, design and engineering, marketing, finance… Though such capabilities rely on specific technological and professional competencies, they have a strong organizational dimension : they imply the ability to coordinate and control , as well as to encourage collective learning processes. A firm's high-order capabilities essentially depend on its ability to coordinate these functional capabilities.

Nelson's distinction [1998] (quoted by Pavitt [1998]) between two types of firm knowledge can be added to the distinction already made between specific cognitive capabilities and functional ones. On the one hand, a "body of understanding" based on capabilities in specialized technical (or managerial) areas and reflected in the workers' qualifications, or else in registered patents. On the other hand, a "body of practice" which determines the ability to implement certain activities : design, development, production, sales… This second type of capabilities refers more systematically to *an organization*'s learning and experiments, as well as to the relations between its different components.

What are core capabilities ?

The knowledge and capabilities on which a firm's activities are based are of a very different nature. Henceforth, the main question is to identify and characterize, amongst them, those that are fundamental to a firm and which play a key role in the determination of its performances. To give an answer to that question, and to understand what the literature says on that point, it is necessary, in our opinion, to begin by a clarification. of the notion of core capability

[27] Cf. the analyses insisting on the difference between technological and product diversification.

Basic versus distinctive capabilities

When we try to determine what are the key capabilities a firm must hold in order to be competitive, we have first to make a clear distinction between two often confused questions. A first question is:

(1) *What are, in a given technological and competitive context, the capabilities necessary for a firm to remain competitive ?* These capabilities will generally be associated to certain forms of organization, to specific individual and collective types of capabilities, as well as to certain technico-organizational trajectories. They will notably include capabilities in production and development processes in certain sectors (the automobile industry for instance), in research processes in others (pharmaceuticals). Such capabilities *are not specific to a firm* but constitute the base for the general development of the whole sector. Their formation is part of a constitutive process of a certain dominant productive model (such as Fordism). This process raises two questions : on the one hand how to account for the factors of emergence of this model and the capabilities it integrates, these factors being largely found at the level of global industrial development and involving the whole social structure (the characteristics of national and sectoral systems of innovation and production) ; on the other hand how to explain that each firm can build up its own capabilities, that is to say how it can assimilate (and improve) a certain amount of technological and organizational innovations around which the productive model is shaped.

(2) The second question revolves around the problem of identifying the specific capabilities that can give a firm *a sustainable advantage on its competitors.* Strictly speaking, it is what one may call its "*core competence"* or "*distinctive capabilities"*.

As seen before, it is difficult to find a univocal definition of the notion of core competence. Yet, following Prahaled & Hamel [1990], they may be identified according to various criteria :

- "a core competence provides potential access to a wide variety of markets"
- "a core competence should make a significant contribution to the perceived customer benefits of the end product"
- "a core competence should be difficult for competitors to imitate. And it will be difficult if it is a complex harmonization of individual technologies and production skills"
- "core competencies are built through a process of continuous improvement and enhancement that may span a decade or longer" (op. cit.)

The difficulty of transferring and imitating them appears as the key aspect ; thus, for Teece, Pisano & Shuen [1997] : "competencies can provide competitive advantage and generate rents only if they are

based on a collection of routines, skills and complementary assets that are difficult to imitate". The difficulty of such a replication is naturally linked to the importance of the tacit dimension of routines and organizational procedures, but also to their specific dimension and to the systemic aspect of competencies : the firm's capacity is based on a coherent *system* of capabilities, linked to fundamental organizational and strategic options, to managerial patterns and (partly) specific material infrastructures.

The ambivalent nature of those core capabilities ought to be stressed : on the one hand as at the basis of the firm's competitiveness, they must be difficult to transfer and imitate, which will be attributed to the importance of tacit components ; on the other hand insofar as those capabilities are supposed to be an attribute of the firm, they imply internal transfer procedures, between individuals and groups, they must endure and develop independently from staff transfers, which means they cannot exist without knowledge diffusion and socialization procedures. This will always involve a certain degree of codification (Nonaka [1995]), which leads us to the dilemma pointed out by Kogut & Zander [1992] : the search for internal transfer cost cutting and better collective learning entails procedures of codification that are also likely to increase the possibilities for competitors to imitate. One partial solution to such a dilemma probably consists in the definition of specific codifications.

The theories that have so far been reviewed heavily stress this second aspect., whether it be the evolutionist works focusing on firms' differences, or the strategic management studies that are concerned with the factors of competitive advantage. Yet, it seems essential to us to consider the two aspects : the constitution and assimilation of what can be called *sector-related basic capabilities*, and the formation of *firm-related distinctive capabilities.* The conditions for the acquisition of both are in essence slightly different : the first depend on certain social codification patterns and, in a way, on the standardization of organizational procedures and patterns (TQM, project teams, just-in-time…). They imply, beyond the firm, social patterns for the formation and diffusion of organizational knowledge. The second are basically related to the firm's internal long-term learning processes as well as to the formation of specific capabilities and procedures. Both processes are, however, closely interrelated, insofar as the constitution of basic capabilities can never occur through a mere transfer of ready-to-be-used, standardized techniques and procedures but through an internal assimilation, adjustment and learning process.

The distinction between basic and distinctive capabilities confirms some aspects of Granstrand, Patel & Pavitt's (1997] and Patel & Pavitt's [1998] analyses of technological capabilities, and their distinction between "background competence" and "distinctive competence", as well as its corollary : "Distinctive Core Competencies are not Enough". A firm's competitive capabilities lie in a diversified collection of technological and managerial competencies. Henceforth, the priority being given to a

narrow corpus of core capabilities and the idea that a firm must focus on a limited number of activities (“back to basics”) ought to be seriously questioned (op.cit.).

The characterization of core capabilities

Apart from such general considerations as Prahalad & Hamel ‘s [1990], is it possible to expand further on core capabilities ? Some recurrent themes can be found in the existing literature :

- *Dynamic* capabilities matter most, above all high-order dynamic capabilities : i.e. the ability to learn and change capabilities.

- Many insist on the importance of “*combinative*” *or* “ *integrative*” *capabilities*, on the ability to coordinate (for instance Iansiti & Clark [1994], Eriksen & Mikkelsen [1996]). The central determinant of a firm’s competitiveness lies in its ability to combine different types of knowledge and capabilities, different skills andassets ; its ability to coordinate and integrate “the physical facilities in each of the many operating units –factories, offices, laboratories- and the skills of the employees” (Chandler [1990].

- Strictly speaking, managerial capabilities matter more than technological ones. Such is the outcome of various studies and of the emphasis laid on integrative capabilities. Therefore is the necessity to distinguish between basic capabilities and distinctive ones.

Two approaches can finally be found to identify core capabilities. The first one is concerned with the types of end products or technologies which ensure a firm its superiority. One may thus link a firm’s core capabilities to “core products” (Prahalad & Hamel [1990] : “the tangible link between identified core competencies and end products is what we call core products – the physical embodiments of one or more core competencies […] Core products are the components or subassemblies that actually contribute to the value of the end product”. The second stresses the role of cross capabilities, that are of a “coordinational ” nature, which corresponds to the Chandlerian approach, as seen before.

It thus appears that apart from very general definitions, few elements exist to clearly identify a firm’s core capabilities, in different contexts. Some will go as far as to say that giving a definition of core capabilities “is rather difficult, if not impossible, ex ante” (Prentice [1997]).

To go further, one would need a theoretical frame explaining the reasons why certain capabilities, or combinations of capability, may provide a firm with a competitive advantage, in a given technological, competitive and institutional environment. It would then be necessary to consider : (i) the specificities

of the firm's knowledge base and culture ; (ii) the specificities of technological trajectories, the sectoral structure and competitive environment ; (iii) but also the financial and institutional environment.

The locus of competencies and learning

The nature of key competencies depends on their location within an organization. Yet, this point has many facets. Firstly, can a firm's competencies be localized in a certain locus, or in certain specific activities, or do they belong to the whole organizational system ? The second position is the one which, to a certain extent, emerges from various studies on modes of organization, like Chandler's works, comparisons between « A » firms and « J » firms, or between adhocracies and bureaucracies. Yet, the differentiation of positions within the organization, and its hierarchical structure ought to be taken into consideration, and it is important not to overestimate the coherence and rigidity of organizational systems, and disregard the actors' (unequal) degree of autonomy and role within the organization, which implies that certain individuals or groups of individuals can play a specific role. Once this idea is admitted, one can either insist on the importance of certain functions and particular groups, or lay the emphasis on *individual* learning and competencies.

From a functional standpoint, one may put forward some conjectures on the locus where different types of competencies can be found within a firm's structure. Like Carlsson & Eliasson [1994], if one distinguishes three levels within an organization, one will find :

- Operating units, essentially concerned with the implementation of technical and functional capabilities, as previously defined.

- At the middle management level, the implementation of managerial capabilities; the capabilities to control, coordinate and integrate specific, technical and functional competencies : "These middle managers not only have to develop and apply functional-specific and product- specific managerial skills, but they also had to train and motivate lower-level managers and to coordinate, integrate and evaluate their work" (Chandler [1990]).

- At the top management level, one will find (i) capabilities to coordinate and control all of a firm's resources, to control and coordinate functions and divisions, to adjust and transform organizational structures : "changing technologies and markets constantly make both existing facilities and skills obsolete. One of the most crucial critical tasks of top management has always been to maintain these capabilities and to integrate these facilities and skills into a unified organization – so far the whole becomes more than the sum of its parts" (Chandler [1990]) ; and (ii) competitive capabilities. Carlsson

& Eliasson [1994] integrate a firm's "innovative capability" into this level. According to us, this can only be partly true since the innovation process implies, in different ways, a firm's whole organizational structure (as well as the institutional environment). Furthermore, one may consider that dynamic capabilities, and more specifically higt-level capabilities, are to be found at this level.

Some, like Chandler, heavily insist on the role of higher levels : "that middle management not only had to develop and apply functional-specific and product-specific managerial skills, but also had to train and motivate lower-level managers and to coordinate, integrate and evaluate their works". He insist even more on "the abilities of the senior executives who recruited and motivated the middle managers, defined and allocated their responsibilities, monitored and coordinated their activities, and who, in addition, planned and allocated the resources for the enterprise as as whole". Similarly, Nonaka & Takeuchi [1995], following Prahalad & Hamel [1990], insist on the role of top management.

Others, like Lazonick [1990, 1997], heavily stress the importance of "craft learning" and the integration of shop floor workers into the organizational learning process. This also leads him to insist on the importance of interfunctional integration and horizontal relationships as well as the fact that a firm's competitive capacity is based on a system of capabilities *to be found in different parts of the organization*. It may also lead to consider that core capabilities are in essence "collective and cross-functional […] Because a capability is "everywhere and nowhere", no single executive controls it entirely" (Stalk, Evans & Shulman [1992)).

The way a firm's capabilities are formed and localized is closely related to division of labor and organizational patterns, and their effects in the degree of autonomy of individuals and teams within the organization and the level in which decisions are taken, in different domains[28]. For example, the functional and multidivisional organization (the M form) tends to give preference to the formation of capabilities at *functional level* and *within professions* (cf. Midler [1996]), as well as at *business units level*, which may appear as an obstacle to innovation in today's technological and competitive dynamic conditions. Thus, the search for new organizational patterns that stress the role of inter-functional learning (see the various studies on new forms of organization for product development), or question the organizational structures that are based on the notion of strategic business units and that might not lead to the efficient exploitation of a firm's capabilities (Prahalad & Hamel [1990]).

The problem of the locus of competencies ought to be seen in relation with one's vision of organizational paradigms. The emphasis laid on the role of management, notably by Chandler, is understandable with regard to the nature of the observation : i.e. the constitution of the "Fordist" firm.

The analyses of Taylorism and its developments, notably by radicals and various studies on labor sociology, are useful for what they say on links between modes of division of labor and skills. Indeed, the Taylorist-Fordist- organization is based on (i) craft workers' knowledge and know-how expropriation, followed by a separation between conception and execution, as well as by a deskilling of workers' tasks[29], (ii) the implementation of a functional organization, where knowledge and capabilities are concentrated at the management level, which accounts for the tendency to focus on product design and management processes capabilities. The Taylorist organization tends to deny any form of learning at workshop level, the work organization being solely considered from a control standpoint. It is also possible to interpret those evolutions as the transition from a production essentially based on (workers' or professions') *individual skills* to a type of organization aiming at the constitution of a collective capability, controlled by the firm management. However, such an organization also gives birth to new professions and types of individual competencies, as shown by the analyses insisting on the polarization of skills: deskilling at one end of the line, "overskilling" at the other end (Freyssenet [1997]).

The limits of the Taylorist approach have been highlighted by several labor sociology analyses: whatever the workers' control system, task execution and production efficiency always partly rely on the workers' autonomous activities and competencies. Major changes in individual and collective learning processes mainly appear in post-Fordist models. It is not our purpose here to review all the aspects and problems relative to post-Fordism, but we believe it is possible to identify two main traits inherent in almost any interpretation that has been made : (i) the importance given to competencies and learning *at all firm levels*, going hand in hand with a greater labor autonomy ; (ii) the transformation of workers' control patterns, of the governance system, and the greater importance given to incentive rather than control procedures, as well as to motivations. We are thus led to observe the parallel transformation of political and cognitive organizational patterns. If we want to further pursue our analysis, we need to follow two directions :

(1) The first, and most explored one, deals with the advent of Toyotism and the characteristics of the Japanese organization. Two major aspects ought to be underlined : (i) the consideration of shop floor workers' learning, as mentioned before, and the importance given to the organization's influence on individual and collective learning within the organization itself and *at all its levels* ; (ii) the importance given, as regards learning processes, to interactions between agents and groups of agents, to horizontal relations and inter-functional linkages. One of the major characteristics of the Japanese industrial system is undoubtedly the fact that it directly implicates the workers' knowledge, encourages them to improve it, and involves them in product and process improvement procedures.

[28] See for instance Lazonick [1991].
[29] Cf. Coriat (19..) or Braverman (1976) for the most famous explanation of those theses.

(2) The second one concerns the specificities of science-based industries, and the reasons for the come-back of American firms' competitiveness. A few hypotheses will be introduced here. Four aspects ought to be taken into consideration. (i) The key role of highly skilled workers' competencies, hence the importance of their training conditions and of the modes of management of this workers. This testifies to the return to the acknowledgement of the importance of *individual* competencies. Whereas Toyotism gives preference to internal learning, we are led here to insist on the importance of *external training and learning*, as well as on the importance of workers' mobility for the development and the renewal of the firm's capabilities. (ii) The great importance of the capacity to integrate new technologies, given their increasing complexity and the wider dissemination of knowledge, which explains why some have insisted on the importance of combinative and integrative capabilities. (iii) The importance of the ability to have access to external knowledge and to assimilate it. (iv) The importance of the procedures aiming at knowledge appropriation, notably via the legal system, a key aspect for the *transformation of " real" competencies into financial performances.*

It is thus useful to go further in the analysis of the specific characteristics of the competence systems and learning patterns that tend to assert themselves today, and of their consequences on the strategic locus where competencies are accumulated.

4. The embeddedness of capabilities and learning processes : the « political » and institutional dimensions

We still have to examine two fundamental dimensions of the analysis of learning and organizational capabilities previously mentioned. For this purpose, it is useful to consider the problem of learning within the framework of an « ontological » triptych. Learning processes occur at three different levels :

i) At a first level, we find individuals that are socialized in an organized structure.

ii) At a second level, we find organizations, formed by groups of individuals, coordinated by specific rules and common aims. The identity and characteristics of such organizations are essential and cannot be exhausted by the representation of their internal cognitive system.

iii) At a third level, we find institutional systems, in which individuals and organizations are embedded.

The first level refers to the basics of individual behaviors' analysis which shall be left aside here, focusing attention rather on the other two, whose stakes seem decisive to us.

Organizations and firms. The cognitive and political dimensions

We have already insisted, in the analysis of routines, on the importance of taking into account the double cognitive and political dimension of organizations. To go further still, it is useful to start from an organization's fundamental attributes, that are of a triple nature :

(1) Organizations are organized collective entities constituted of conflicting interests, power and interpretation

The firm's analysis revolves around two main questions (cf. Coriat & Weinstein [1996]) :

- How to build up a collective ability to produce and innovate, and how the organization's accumulation of knowledge and capabilities is ensured. Most of the works that we have taken into account are focused on this theme.

- How to manage the conflicts of interests between individuals and groups that constitute a firm or an organization; conflicts which are more particularly visible when the surplus create by the organization has to be distributed among all the actors that contributed to it (cf. Azoulay [1994]). This question can find an answer with the definition of incentive and control procedures.

According to us, one of the major problems raised by most analyses on firms' capabilities is to forget this key aspect, by *implicitly supposing that the question of the formation of collective competencies and learning can be answered independently from conflict-solving patterns and incentive and control systems.* Yet, it is clear, as seen before, that both questions are closely related : the patterns of division of labor as well as the distribution of competencies within a firm are at the core of organizational learning processes and simultaneously define positions, « roles », as well as power and interest structures. The modes of workers' management play a key role in the mobilization of individual competencies as well as in organizational capabilities formation patterns, while keeping a fundamental position as a control and incentive system. *The consideration of such questions is particularly essential if we are to understand the conditions (and difficulties) of dynamic capabilities* and mostly of the ability to renew completely organizational capabilities and routines, which always implies the questioning of the positions and compromises on which a given regime of capabilities is based.

(2) Organizations are based on specific property relations

Their consideration allows us to indicate, on the one hand, the variety of goals that are pursued, and on the other hand the different kinds of motivations and incentives resulting from such relations (out of an ideal, obligation or interest). The property system determines the nature of the surplus created by an organization and the modes of distribution. It also largely determines performance assessment patterns, themselves being essential in individual and collective learning processes.

With this perspective in mind, the firm should be analyzed as *a particular organization* : (i) it is a *profit-oriented* organization, within which, at all levels, behaviors are conditioned by *monetary calculations*, (ii) it is an organization endowed with specific governance rules, linked to its property rights system, (iii) it is an organization submitted to *market constraints*. The exact definition of the property rights and constraints system applying to firms as a whole, as well as to different types of firms, has direct effects on the modes of learning and capabilities management[30]. One might think, for instance, that in today's globalization context, financial markets' constraints and their consequences on the forms of corporate governance play a key role and contribute to the orientation of knowledge accumulation processes as well as of the types of capabilities firms give their preferences to.

(3) These organizations are socialized through institutions

Those institutions set up the rules, constraints and representations organizations are submitted to, and according to which they elaborate their strategic goals (and so their internal rules and procedures, that is to say their routines). Such attributes constitute the methodological principles according to which social spaces, where individual and collective learning processes take place, appear more clearly.
To come back to the question of the relations existing between a firm's cognitive and political dimensions, two exploratory reflections shall be put forward.

(i) The first one is theoretical. The evolutionary approach, as well as the competence-based theories of the firm, lay the emphasis on organizations' cognitive dimension, whereas contractual theories, and more particularly agency and property rights theories, are essentially concerned with conflict-solving procedures. One might thus be tempted to consider them as complementary, and add incentive mechanisms to learning processes. Yet, such an approach seems hardly realistic. First, because there are not organizational routines to ensure cognitive coordination on the one hand, and contractual rules ensuring the compatibility of interests on the other. As seen before, the same rule and routine system ensure cognitive and disciplinary functions. Secondly, this is because organizational

[30] From this standpoint, it would be very useful, to study how behaviours and structures evolve within an organization, such as a football club, where commercial goals become prevailing, and which turns into a firm.

learning and contractual theories are based on radically different analyses of economic behaviors. The consideration of conflicts and authority relations coherent with learning theories implies the construction of another theorization of contractual relations. Indeed, learning processes also intervene in agents' strategic behaviors within the firm, in each one's representation of his own interest, of his degree of autonomy, in the implementation of cooperative or resistance behaviors, thusly in the constitution and evolution of partly tacit and partly formal compromises, on which the organization's functioning is based. In such a context, it is be noted that individual preferences cannot be considered as data : they are conditioned by the context in which they can be expressed and they change along with experience. This leads us to a major question, particularly from the standpoint of the relations between individual and firm competencies : to what extent, and under which conditions, individuals will agree to fully (or not) dedicate their competencies to an organization, to cooperate and participate in collective learning processes ? Such a question concerns the very heart of firm analysis, as well as the conditions of its efficiency. It still largely remains to be elucidated, if we admit that pure constraint, or the construction of perfect incentive contracts do not provide a credible answer[31].

(ii) From a factual standpoint, one should compare the historical transformations of organizational paradigms and the evolution of the relations between patterns of learning and control systems. At the risk of oversimplifying things, one may say that Fordism was based on a coherent system combining the centralization of capabilities at management level with a hierarchical structure focused on a strict control of shop-floor workers. Because of new constraints, post-Fordist evolutions have shown the necessity to mobilize competencies and learning processes at all firm levels, to foster the interactions and cooperations essential to the formation of collective learning and competencies, while ensuring that these competencies and learning sustainably remain *the firm's*. This has meant changes in power systems, aimed at combining the logic of control and discipline with that of incentive and motivation. The latter involves actions aimed at transforming the representations on which the organization and behaviors are based, as well as making them integrated by the different categories of workers. Indeed, the emergence of the theme of capabilities and of the "learning firm" in the management literature is the manifestation of its expression.

The role of institutions

Organizational approaches leave but little room for the institutional dimensions of the dynamics of knowledge : property rights and scientific systems, the structural traits of the labor force management, the modes of social division of labor in the production, the diffusion and the exploitation of knowledge… and their consequences on organizational dynamics and patterns (cf. Coriat & Weinstein

[31] Cf. Coutrot [1998] on this point.

[1999]). Yet, as seen before, institutional conditions play a role that can be essential in the determination of firms' core capabilities, and innovation patterns.

Thus, it would appear that – and here probably lies the interest of ecological approaches of organizations - the analysis of learning at an organizational level ought to be made in relation with his selection environment: similarly to an individual, *an organization is socialized* and sometimes organized within an ontologically superior structure (such is for instance the case of a public hospital whose functions and areas of specialization are determined under administrative supervision). Seen from that angle, the analysis of organizational learning must integrate the diversity of environments, of their respective constraints and representations, since strategies are elaborated, selection, codification and knowledge memorizing criteria are formed and performance assessment is carried out according to such parameters. This is, for example, analyzed in Salais & Storper's "worlds of production"» theory. Simon's analysis on innovation in organizational learning [1991] should also be considered, since he reviews the conditions in which an organization (like an individual) can *deviate* from its own world's existing representations.

The institutional framework appears multi-dimensional, since it integrates market structures, but also public and political ones as well as cultural aspects. The intertwining between organizations and institutions is very intricate[32], institutional variables will thus intervene in organizational structures via various ways. Two aspects of the problem will now be considered.

(1) As seen before, the assimilation of external knowledge and experience represents an essential way of learning for an organization, which gives much importance to the conditions that make the diffusion and selection of technological and organizational knowledge possible, and notably managerial and organizational models (such as the « M » form , Japanese labor organization methods, accounting systems, firms' governance principles). As already noted, the institutional context strongly conditions the modes of diffusion and "hybridization" of new organizational principles in different countries (Coriat & Dosi [1998]).

The literature on the sociology of institutionalization has dealt with the conditions of diffusion of organizational practices (Zonder [1987], see also Levitt & March [1996]). It notably insists on the importance of the legitimization motive in firms' adoption of organizational patterns and practices. Thus, "pressure on organizations to demonstrate that they are acting on collectively valued purposes in collectively valued ways leads them to copy ideas and practices from each other. The particular professions, policies, programs, laws, and public opinion that are created in the process of producing

[32] This poses basic questions as to the distinction between organization and institution and the way to conceive their relations, see Coriat & Weinstein [1999].

and marketing groups and services become powerful institutionalized myths that are adopted by organizations to legitimate themselves and ensure public support" (Levitt & March [1996]). Beyond the simple logic of mimetic behavior – copying what others do often appears to be less risky and open to criticism than other actions - the option for certain forms of organization may be the means, if not the necessary condition, to obtain public or private support. Hence the necessity to consider the whole selection environment conditioning organizational choices . This environment is often constituted by institutions in the classical meaning of the word - formal and informal "rules of the game" acting as a framework for the actors - but also of public and private agencies participating in the codification, social acknowledgement and diffusion of organizational standards. It would, for example, be worthwhile to study the conditions of diffusion of Toyotism or of new corporate governance principles.

(2) One aspect of the market environment which is directly linked to firms' capabilities needs mentioning : the existence of *markets for capabilities.*

The basic idea underlying firms' capabilities analyses is that a firm's competitiveness lies in the possession of specific capabilities (or other specific resources such as reputation) that cannot be acquired on a market, or more generally outside the firm. A contrario, this implies the necessity to analyze the nature of the knowledge and capabilities that a firm may have access to via its external relations, and particularly via the market.

It is thus essential, in order to understand the nature of a firm's specific capabilities, to take into consideration the existence of *markets for capabilities*, of markets where a firm can acquire capabilities, including tacit ones. These markets for capabilities are of different natures :

(i) The labor market, as a market for individual capabilities. The organization of labor markets is essentially characterized by the *standardization of capabilities*, linked to the social codification of knowledge. A firm's capabilities management patterns thus heavily rely on external capability formation processes and on the labor market organization. This aspect is important to understand the differences between capability management patterns, learning processes and the determination of core capabilities according to countries and sectors.

(ii) The markets for services can offer to firms various specialized *capabilities.* Such is the case for the services offered by consultant's firms. The nature of the capabilities that a firm may acquire in this way determines the specific capabilities it can focus on. Such services firms often participate in the codification and diffusion of organizational practices.

(iii) Lastly, firms or business units takeovers are a key means to acquire capabilities and capability systems. As noted by Coombs and Metcalfe [1998] : “an active market in corporate control is an extremely important complement to the process of capability formation”.

This aspect is all the more important as one may consider that the evolution towards a “knowledge-based economy” is marked by an increasing diversification and dissemination of knowledge and capabilities, accompanied by merchandization : the range of market-available knowledge and capabilities is wider and wider, which undoubtedly testifies to one of the major aspects of current historical transformations. This leads the fact that technological development tends to take place through the relations between firms, and between firms and other types of organizations. It is one of the major themes of the economics of technology and of the analyses of national innovation systems. This is in contradiction, to a certain extent, with Chandler’s approach focused on the role played by large, vertically integrated conglomerates. Without prejudice of further analyses, one may interpret those observations as the manifestation of a structural change in learning conditions, the transition from an internal knowledge-based regime to one based on collective, interorganizational learning.

The conditions for a firm to have access to external capabilities, and the nature of these capabilities are undeniably essential ; on the one hand for the determination of its overall capacities and the way it can organize its capabilities and learning, n the other hand for the determination of the nature of the capabilities that will grant it an advantage over other firms. Iansiti & Clark’s analysis [1994] of new organizational patterns in American high-tech firms is a good illustration of this point. More deeply, the way a firm organizes its learning and capabilities cannot be separated from the way the external capabilities the firm must acquire and assimilate are themselves structured.

Thus, the determination of firms’ core capabilities and knowledge creation patterns heavily depend on the various aspects of its institutional environment : the development and characteristics of markets, as just seen, but also non-market institutional traits, notably, but not only, in the field of education and research.

The variety of organizations among which learning takes place as well as that of the interactions between these organizations accounts for the diversity of environments. More generally speaking, the point we want to stress concerns the way organizations ought to be considered in order to grasp organizational learning : how to qualify those social spaces in their diversity ? Once asserted, the question is decisive regarding the dynamic interactions between a socialized organization and the collectively organized environment in which it acts and it learns. *In this perspective, the analysis of organizational learning is at the turning point between mechanisms and procedures that are both internal and external to the organization,* since it must learn from its environment in order to organize

and benefit from the internal knowledge it needs to exist. As noted by Coombs & Metcalfe [1998] : "it is necessary to see the formation and articulation of capabilities as dependent as much on external relations as they are on the internal working of firms".

CONCLUSION

Studies on firms' capabilities and organizational learning deal with aspects that are essential to the understanding of the structure and operation of firms as well as that of industrial dynamics. Through their diversity, they provide very valuable contributions, mainly as regards the collective cognitive mechanisms on which firms' capacities and performances rely. They make the comprehension of certain key elements in organizations' dynamism or rigidity possible as they allow us to further the reflection in one major field, given today's competitive environment : that of the conditions which enable (or not) a firm to evolve and adapt. As seen previously, these analyses pose various questions which, we believe, are largely the reflection of real problems, i.e. the expression of tensions that are inherent in the very nature of organizations :

- The first tension, which is a constituent element of organizational capabilities and learning, is to be found between individuals' and firms' capabilities. Indeed, the existing literature rightly insists on the necessity to consider the existence of firms' capabilities and learning, that are irreducible to sole individual capabilities and learning. The role of individual capabilities is, however, at the same time essential. Those conditions favorable to collective capabilities are not necessarily the same as those ensuring the coordination of learning and the transformation of individual capabilities into organizational ones.

- The second major tension is to be found between cognitive coordination problems on which most analyses focus and those linked to "political" coordination and conflict-solving procedures. The importance of this question has already been studied as regards the understanding of the routines and procedures on which organizations are based. One may therefore admit that the major problems posed by the profound transformations undergone by organizations' capabilities, and so the conditions for dynamic capabilities and high-order organizational learning, cannot be understood without taking into consideration the political dimension of organizations.

- The third tension is to be found between what might be called a vision of the organization as an autonomous agent and an enclosed, if not closed, system , and a vision of the organization as an open

and socialized structure. A firm, or any organization, is structured by its own rules, routines and representations. It is, indeed, as already said, the locus for learning processes and capabilities that are its own, and it has its own existence and interests. Yet, limiting one's reflection at this stage would leave aside the multiple ways organizations, and particularly firms, are conditioned by the institutional environments in which they operate. Institutional and social determinants pervade firms and closely condition their structure and capacity. This clearly appears in the complex articulations between internal and external learning that are pivotal for the definition and choice of firms' trajectories as well as for the determination of their abilities to evolve and change.

The way those tensions arise through organizational choices and according to institutional contexts, explains how an ultimate tension, to be found at the heart of organizational learning, between the continuity and path dependency of a capability regime and its necessary adjustments and transformations conditioning a firm's dynamic capabilities, is solved.

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