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**"THEORY OF THE FIRM IN AN EVOLUTIONARY  
PERSPECTIVE:  
A critical development"**

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**1. Introduction**

This paper is an attempt to develop the core elements of an integrated evolutionary theory of the firm. Our main purpose is to put forward some of our views about the subject, rather than making a comprehensive survey. It seems to us that the "so-called" evolutionary theory of the firm is rather sketchy and unsystematic. In fact, this theory does not really exist yet as a coherent set of propositions. But there are many promising (and some of them already quite fruitful) streams of research in need of some form of unifying principles. In addition, there are other approaches which might be complementary, such as the competence- and the resource-based approaches, or some aspects of modern organisation theory. In this paper we would like to highlight some of the main features of the emerging theory of the firm and to provide some hints on possible unifying principles which could link together these different pieces.

We first define the main elements (more precisely mechanisms) which represent the functions of an organisational structure such as firms and which should be explicitly included in an integrated theory of the firm. This exercise will allow us to map alternative theories and to stress the specificities of an evolutionary approach to the firm. In particular we have to consider that in an evolutionary approach the firm is conceived as a processor of knowledge instead of a pure processor of information as in

the traditional theoretical framework. We will also emphasize the features shared with the modern organisation theories.

Using the main elements of the functional representation of the firm, in the subsequent sections we develop some primary constructions of an evolutionary theory of the firm. We discuss the necessity of an internal coherence between the various mechanisms at work in the firm (sect. 4), as well as of an external relevance towards the selection mechanisms at work outside the firm (sect. 3). Our main argument will be that internal coherence is a necessary condition for the firm performance. However only the relevance of the organisational mechanisms to a specific competitive environment allow this performance to be achieved. Some emphasis will put on the coordination of learning processes and competencies (sect. 5) and on the role of routines and rules (sect. 6).

## **2. Main elements towards an evolutionary theory of the firm**

The evolutionary approach to the firm belongs to a family of approaches which consider the firm as "a processor of knowledge " (Fransman, 1994). On this point, the evolutionary approach differentiates itself from more traditional theories which see the firm as "an information processor". In this latter case, the behaviour of the firm can be understood as an optimal reaction to the environmental signals which are detected by the firm. In the former case, the firm is considered as the "locus" of setting up, of construction, of selection, of usage and development of knowledge. It is no more sensitive to the distribution of information than it is to the sharing and distribution of knowledge. "It is not so much the saturation of its abilities to deal with information which concerns the firm, as the risk of becoming too confined by inefficient routines" (Cohendet et alii, 1997). In fact, the evolutionary approach recognises the cognitive mechanisms as essential, and routines play a major role in avoiding the deliquescence of the organisation and its internal coherence. In other terms, the governance of the firm is not focused on the resolution of informational asymmetries but on the coordination and the development of new knowledge.

It appears that the main references of that literature focus on the internal cognitive mechanisms of the firm. Nevertheless, to be complete, a theory of the firm should incorporate an analysis of its organisational structure and its interactions with the environment. Therefore the evolutionary approach should tackle not only the definition of the frontiers of innovation possibilities, but also the analysis of the organisational structure of the firm. Our claim is that the evolutionary approach is potentially able to define the innovation frontiers and to bring an original vision of the

coordination between the three fundamental mechanisms necessary to define an organisational structure: the cognitive mechanism, the incentive mechanism and the coordination mechanism. Moreover, these mechanisms need to be coherent to ensure the capabilities and the potential performance of the firm.

## 2.1 The functions of the organisational structure

" *Organisations* is about the theory of formal organisations, systems of coordinated action among individuals and groups whose preferences, information, interests, or knowledge differ" (March, Simon, 1993). Indeed, the main function which is served by an organisation is to promote coordination among individual actions. The task can be achieved by means of a set of different instruments which we think could be usefully grouped into the following categories :

- Cognitive mechanisms, which promote the development of a collective knowledge basis which is an essential prerequisite for coordination to be possible (cf. Crémer, 1990 ; Kreps, 1992) ; we shall assume that the cognitive mechanism of the firm includes the informational mechanism, which allows the acquisition and exchange of information of the different parts of the organisation both among each other and with the external environment.
- Incentive mechanisms, which provide a "payoff structure" in order to guide actions in a certain direction. They include control/monitoring mechanisms, which instead exert a direct check on actions and their results.
- Co-ordination mechanisms, which allow the coherence of individual actions to meet a defined set of objectives, and of local and decentralized learning processes (Cohendet, Llerena 1991; Avadykian, Cohendet, Llerena, 1995)

These three mechanisms are not at all independent, and the efficiency of an organisation, its ability to "facilitate the joint survival of (itself) and its members" (March, Simon, 1993) even depends upon their coherence.

This means also that an "integrated theory of the firm" should be able to analyse in a coherent way the three types of mechanisms, as well as their relevance in terms of performance for the firm.

Two further remarks are needed to better understand the nature of the three types of mechanisms.

A first remark concerns the fact that coordination and division of labour are basically two sides of the same coin (Egidi, Marengo, 1994 and Egidi, Ricottilli, 1997) : the problem of coordination arises when labour has been divided. Now it is clear that all the previously mentioned mechanisms are normally studied as devices to achieve

coordination for a given division of labour, but they are also instruments to define the degrees and modes of division of labour. This is especially clear for the cognitive mechanisms, where obviously the division of knowledge they implement directly reflects on the division of labour, but this is generally also true of all the other mechanisms. Analyzing the feedbacks from the coordination mechanisms to the division of labour is an interesting line of inquiry which should be pursued.

Secondly it must be pointed out that in concrete cases most of the coordination mechanisms existing in real organisations cannot be ascribed to only one of the above categories (see for example Pavitt, 1997). For instance, incentive mechanisms have certainly consequences on the way knowledge is distributed and information is processed. This characteristic is particularly true for most of the routines (see sect. 3.).

## 2.2 Functions of organisational structure and theories of the firm

Recent developments of the neoclassical theory of the firm (especially those which could be grouped under the heading of principal-agent models) have basically reduced such a coordination principle to a bundle of bilateral contracts which are meant to achieve coordination by designing appropriate incentive schemes in order to direct self-interested individual action towards the common organisational goal. An important consequence of this approach is the absence in it of any serious treatment of the production process as a collective activity (cf. also Coase, 1988) : bilateral contractual agreements between the principal and each agent are so designed as to ensure that the latter applies the maximum possible effort, but how all the efforts are coordinated to produce the desired outcome is not at stake <sup>1</sup>.

But an alternative – or complementary – view, which is being developed by evolutionary theories, would rather stress the cognitive aspects of the organisational structure of the firm and its relation to the bounded rationality of the individuals who constitute the organisation. Members of an organisation are constantly engaged in repeated interactions among themselves. Each of these interactions involves idiosyncracies which are related to the preferences of the individuals involved and the knowledge they hold, the environmental conditions and the payoffs. Even if we assume away any incentive consideration and suppose that agents try in good faith to maximize an organisational objective function, the organisational payoff to the action of each individual will still depend on the actions of the others, therefore decisions must be

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<sup>1</sup> This view is probably epitomized by Alchian and Demsetz (1972), who do not see any relevant difference between the relation which occurs between employer and employee and the one between a grocer and his customers. This view clearly implies, in our opinion, a major neglect of the technological and organisational aspects of production.

coordinated. In a world where all the agents would share the same model of the world in which they operate, and where communication could take place and information could be collected without any limit and any cost, such coordination would not be problematic. In the absence of opportunistic behaviour, agents could exchange and/or directly acquire all the information necessary to coordinate their actions. On the other hand, in a world where agents differ in their perceptions of the environment, and where communication, acquisition of information and computation are limited and costly, coordination can only be achieved by means of the definition of a common set of rules, codes and languages which are well understood and shared by all the members of the organisation involved in a certain interaction. Routines, rules, standards ... become then central in the conceptual framework.

More generally, it is possible to represent the different approaches to the firm according to their relative emphasis on particular mechanisms at work in the organisational structure (table 1).

Table 1: Theory of the firm and mechanisms at work in the organisational structure

<b>FIRMS AS:</b>		<b>Cognitive Mechanisms</b>	<b>Incentive Mechanisms</b>	<b>Coordination Mechanisms</b>
<b>INFORMATION PROCESSOR</b>	Principal-Agent		X X X	
	Team theory		X	X X
	Transaction cost		X	X X
	Simon	X		X
<b>KNOWLEDGE PROCESSOR</b>	Competence-based theory	X		X X
	Modern Organisation theory	X X		X
	Evolutionary theory	X X	?	X

Let us consider some key examples:

- The principal-agent theory focuses on incentives schemes to cope with asymmetries of information. "... opportunism theories assume that individuals are self-seeking and often dishonest... In these models, incentives, monitoring and control procedures are seen as reducing the externality problems among individuals caused by cheating and shirking" (Postrel, Rumelt, 1992).
- It is the distribution of information which is at stake in the theory of teams (Alchian, Demsetz, 1972; Itoh 1987; Crémer 1993);
- Coase (1937) and its transaction costs interpretation <sup>2</sup> developed in particular by Williamson (1975, 1985, 1993) are concerned with the costs of access to information (on price for example) and not going very far beyond organisational or institutional solutions to opportunistic behaviours and informational problems. As Coriat and Weinstein (1995) point out, Williamson shares with the principal-agent theory the same basic assumption: the firm is conceived as a nexus of bilateral contracts. - Simon (1957) limits himself to questions related to the bounded capacity of agents to acquire, process and store informations.

All these theories of the firm and others such as the approach of Aoki (1986, 1988) consider the problem of treatment of informations (distribution, asymmetries, incompleteness...) as the focus point of the organisation. The existence and distribution of cognitive capacities is given and there is no process of learning which could modify them.

The seminal contributions from Penrose (1959) and Alchian (1951) but also in some sense of Knight and Coase<sup>3</sup> have allowed the development of approaches which consider the firm as a processor of knowledge (Fransman, 1994), a "repository of knowledge", where cognitive processes and coordination mechanisms play a dominant role. The evolutionary approach to the firm (Dosi, Teece, Winter, 1991; Teece 1988) as well as the modern theory of organisation have been strongly influenced by their contributions. Chandler (1992) for example acknowledges the importance of knowledge creation and management in the development of modern organisations (see also Nonaka, 1994; Nonaka, Takeuchi 1995).

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<sup>2</sup> See Foss (1996): "...it is doubtful whether modern work on economic organization, in its overriding concern with the efficient alignment of incentives, has really provided an adequate representation of Coase's ideas " (p.3)

<sup>3</sup> See again Foss (1996)

Our main purpose in this paper is to emphasise the specificities of the evolutionary approach and the need for further research in particular with regard to incentives schemes. The analysis of incentives is missing in this type of approach, as the analysis of coordination and cognitive mechanisms is missing in the principal-agent theory.

### **3. Diversity, selection and performance**

At this point, it becomes possible to define and assess the characteristics of an evolutionary theory of the firm.

Evolutionary theorizing in economics has been, since its beginning, mainly concerned with models of change and selection at the level of industries or national economic systems. It was then worth asking for a micro-analysis which specifically looked inside the firm. Some authors addressed issues of intra-firm organisation and the organisation of firms became an important element of the agenda of evolutionary economics.

The elements of an evolutionary theory of the firm which exist today are specific tools (generation of diversity and mechanisms of selection) and specific issues and questions that contribute to stimulating research on the analysis and dynamics of organisations. It appears that, to a large extent, the situation of the evolutionary theory of the firm could be seen as belonging to the *province* of modern organisational theory, and principally the organisational learning approach. A way to determine the potential development of the evolutionary theory of the firm is thus on the one hand to define, by analytical proximity, the main features shared with the theory of organisational learning, and on the other hand to clarify the specific issues and questions raised by the emerging theory of the evolutionary firm.

#### **3.1 Evolutionary approach of the firm and modern organisational theories: similarities and differences**

The two key concepts in modern organisational theory (cf. e.g. Cyert and March, 1963) and in the evolutionary economics paradigm (cf. Nelson and Winter, 1982) are those of routine and learning. These approaches dismiss the neoclassical vision of the firm as an optimising entity, whose behaviour can be reduced to a choice amongst a given and known set of production opportunities, and they claim instead that

the main concern of organisational studies should be the very process of generation of such opportunities.

Thus, at each moment in time, a firm can be characterised by a set of productive knowledge which has been developed so far and is implemented through the set of currently applied routines. Routines encompass the organisation's knowledge basis and they constitute the organisational memory. Routines are based on interpretations of the past more than on anticipations of the future.

Routines have a strong cohesive function : they largely survive the replacement of people that created them and keep the organisation together by conferring on it an individuality that is partly independent from the human factor. Routines thus allow the predictability of individual behaviour indispensable for collective action : routines guide behaviours. Routines are usually hard to change, and they are responsible for inflexibility and inertia in organisational behaviours. Recent attempts to accommodate organisational issues within the neoclassical theory of the firm have impressively broadened the scope of the latter and tackled fundamental questions which used to lie outside the concern of economic theory. But they have not been able to deal in a satisfactory way with the problem of learning because neoclassical theory in these most recent developments is concerned with information, whereas learning is about knowledge. In this perspective learning implies a modification of routines: routines change in response to experience through two main mechanisms. The first is trial and error experimentation. " The likelihood that a routine will be used is increased when it is associated with success in meeting a target, decreased when it is associated with failure " (Cyert and March, 1963). The second mechanism is precisely organisational search : " An organisation draws from a pool of alternative routines, adopting better ones when they are discovered. Since the rate of discovery is a function both of the pool and of the intensity and direction of search, it depends on the history of success and failure of the organisation (Radner, 1986).

Besides these common features shared with the organisational learning approach, the evolutionary approach of the firm presents the following specific characteristics :

- 1) Evolutionary models are based on the assumption of imperfect environmental matching. Once we depart from the neoclassical assumptions on rationality, the behaviours of firms (and for that matter, of all economic agents) cannot be deduced anymore from the environmental signals they observe. If agents are not endowed with a given optimal algorithm for all economic decision making, they cannot predict their behaviour by simply knowing the state of the environment and applying the same



algorithm or some reduced version of it. On the contrary, it becomes crucial to analyse the procedures (and how they are generated, stored and modified) which agents employ for decision making.

2) Evolutionary models stress the importance of heterogeneity among agents. Diversity is not only seen as a realistic assumption, but also as a major driving force for evolutionary dynamics. In evolutionary models of industrial dynamics there emerge a need for microfoundations which account for persistent heterogeneity across firms both in their characteristics (size, technology, behavioural traits) and in their performance (competitiveness, profitability, etc ...).

3) Evolutionary models suppose that collective adaptation and learning require diversity (mutation) but also mechanisms that guarantee the necessary global coherence: the selection mechanisms. Ultimately, each economic organisation can be considered as an evolutionary system which implements a particular balance between mechanisms of variation and mechanisms of selection on what constitutes the organisational learning basis.

In economic organisations, this trade-off between commonality and diversity of knowledge is also strictly connected to the trade-off between exploitation and exploration (cf. March, 1991): organisations always face the dilemma between concentrating their resources on the exploitation of the knowledge which is already available to them and the exploration of new possibilities. Both exploitation and exploration are necessary for the survival of an organisation. Without exploration of new possibilities, the organisation would find itself trapped into sub-optimal states and would eventually become ill-adapted to changing environmental conditions. But organisations which devote all their resources to the exploration of new possibilities will face too high a degree of risk, and even in the case of successful discoveries they will fail to exploit the knowledge they acquire and will systematically perform worse than followers and imitators.

4) Evolutionary models suppose that the learning process is driven by the search for better performance. This search is focused on some specific targets which require evaluation procedures. One must note a strong difference with the pure Darwinian hypothesis of mutation-selection. The firm has, in its logic of adaptation, the ability not only to learn and to transmit knowledge, but also to focus on specific targets, to expose the system to some specific mechanisms of selection and to orientate the mechanism of generation of diversity. In a way, the functioning of the selection mechanism in the evolutionary theory sets up a bridge with the neoclassical approach of rationality and change. “The traditional debate on the relationship between maximisation and selection involved radical positions. Milton Friedman used the natural selection

argument as an empirical proof of the decisions governed by maximisation behaviour. The opposed view, of Alchian and others, held the selection argument to present some natural adjustment capabilities of the economic system in the absence of conditions for conscious optimisation. Recent works go beyond the 'technological' discussion of whether survival is a proof of viability of behavioural rules by supporters of pure maximisation or of bounded rationality" (Zuscovitch, 1994).

The specific features of the evolutionary approach that have been recalled explain the adaptive behaviours of firms through the tension between mutations and various selection mechanisms. They highlight the contrast between efficiency and the innovative creativity of firms. "Creativity is intimately connected to uncertainty and the discovery process by which firms find and exploit their own choice sets, that is innovation possibility frontiers. Whether it is because of organisation, the individuals involved or historical happenstance, no two firms are expected to innovate in identical fashion and it is this emphasis on the decentralised emergence of technological diversity which is a defining characteristic of evolutionary approach" (Metcalf, 1993).

In any case however, the relevance of a given organisation structure, of a specific set of organisational mechanisms, in accordance with a particular environmental and institutional context will determine (or at least participate in) the performance of the firm. We can then say that the evolutionary approach has invested most efforts into the definition of the "external" relevance of organisations, and an understanding of their performances.

However we shall argue that the essence of evolutionary approach, when applied to the theory of the firm, should not be restricted to the definition of innovation possibilities frontiers and to the performance analysis, but should be directly exploited to understand and analyse the organisational structure of the firm, by providing answers that other approaches do not provide. We shall particularly focus on the hypothesis that evolutionary approach should bring an original vision of the coherence between the three fundamental sets of mechanisms in the firm : the cognitive mechanisms, the incentive and the coordination ones.

### 3.2 Towards a definition of the evolutionary theory of the firm

Let us suggest a somewhat utopian definition of such a theory : *an evolutionary theory of the firm is a theory which explains the structure and the behaviour of a firm as an emergent property of the dynamics of interactions of both its constituent parts among each other and of the firm itself with its environment.*

By structure of the firm we can refer to Herbert Simon's definition, whereby the structure of an organisation "designates for each person in the organisation what decisions that person makes, and the influences to which he is subject in making each of these decisions" (Simon, 1976, p.37). The organisational structure therefore defines who is responsible for what, who should send what kind of information to whom, who has the authority to do so, and so on and so forth. In other words the organisational structure defines the rules of the games that individuals within an organisation and parts (units, departments, services, and so on) of it repeatedly play.

What is crucial in this definition is that such rules of the games and routines should not be exogenously given but should emerge and evolve in the very process of interaction and that the behaviour of a firm depends on the structure, because of the decision-making process. In other words, besides the evolutionary processes (diversity creation and selection) going on in a specific environment for the firm as such, there are similar processes taking place inside the firm to create, select, transform rules, routines and more generally the different mechanisms defining the organisational coherence of the firm.

An open issue which deserves more attention is, so to say, which degree of emergence we are looking for, or, in other words, to what extent we require our models to be constructive. A strongly constructive approach would require complex organisations to emerge out of a completely unstructured set of individuals endowed only with a set of individual characteristics and basic interaction principles (such an approach is argued for, in biochemistry, by Fontana and Buss, 1994). A weakly constructive approach instead assumes already a much richer structure of interaction : the structure is exogenously given and serves as a basis for the development of new forms. The former approach has indeed a lot of appeal, but easily runs into the risk of too much abstraction of firms from the social and economic environment in which they are embedded.

#### **4. Coherence of organisational mechanisms: cognitive, incentive and coordination mechanisms**

An important aspect of the research agenda for the development of the evolutionary theory of the firm is to define a set of propositions which not only allow the analysis of external relevance of firms but also the degree of coherence of internal mechanisms such as the cognitive, the incentive and the coordination ones. We propose to use, as a first step, the tools of the evolutionary approach for examining the first-

order connections and feedbacks between pairs of the above mentioned organisational mechanisms .

#### 4.1. Incentive and cognitive mechanisms

An important question which remains open is the relationship between incentive and cognitive mechanisms in both directions. We can ask, on the one hand what are the incentive mechanisms which are more effective in promoting which kind of learning (it is quite plausible that effective incentives for learning do not necessarily coincide with effective incentives for resource allocation). It becomes then important to differentiate between types of routines and rules. It is in particular the task carried out by Favereau (1993, 1995) for the theory of salary. He distinguishes between two types of rules and routines: a first one corresponds to rules which are very precise, leaving no room for interpretation; on the contrary, the second one entails ambiguities ("interpretative ambiguity", Fransman, 1994) and allows for interpretation, in fact they allow the emerge of learning processes. On the other hand, it is clear that incentive schemes are themselves routines (or conventions) and are themselves subject to learning and adaptation. This "learning the incentives" line of enquiry has been already the object of some preliminary exploration in Coriat and Dosi (1995).

#### 4.2. Incentive and coordination mechanisms

If we adopt the point of view of organisational learning, the optimal incentive schemes proposed by the Principal-Agent theory are not completely satisfactory. According to this theory, the divergence of preferences and objectives between the principal agents implies inefficient solutions. Asymmetries of information and conflicts of interest lead mainly to strategic behaviour (hidden actions, hidden information, free riding, etc ...). However, if we suppose that agents have cognitive capabilities, the divergence of preferences can imply other effects than those generated by the strategic use of informational asymmetries. Cohen (1984) shows that diversity concerning preferences and objectives in a disturbed environment where learning and creation are the main factors of success, is conducive to higher performance. The collective advantage of this aspect of diversity is also pointed out by Schelling (1978) in the prisoner's dilemma with N players. But to exploit the potential sources of performance, specific coordination mechanisms have to appear. The cross-fertilization of local learning processes should find an appropriate coordination scheme.

The main point in the standard principal-agent theory is the optimal allocation of efforts among tasks. This theory is in general reluctant to allow for cooperation between agents, or even for some local or horizontal coordination mechanisms.

Futhermore, the objective is static efficiency. But when the interest lies on organisational learning, the main objective is dynamic flexibility. Incentive schemes should therefore allow the organisation to respond, continuously and in a satisfactory way, to disturbed environment. This necessity means an in-depth reconsideration of the setting up of incentive schemes: how to stimulate local learning and diversity while maintaining the coherence of the firm ? how to allow for trials and errors without diminishing the responsibilities for the final results ?

#### 4.3. Cognitive and coordination mechanisms

The evolutionary approach emphasises the tension between centralisation and decentralisation in the organisational learning process. Firms require both centralisation and decentralisation to operate successfully in a changing environment. Decentralisation in the acquisition of knowledge is a source of diversity, experimentation and ultimately of learning. But, eventually, knowledge has to be made available for exploitation by the entire organisation. When agents differ with regard to their representations of the environment and their cognitive capabilities, a body of common knowledge must exist, organisation-wide, which guarantees the coherence of the various learning processes. This is a prerequisite for an efficient management of the competencies. In order to cope with changing environments, the process of generation and modification of such a body of common knowledge, although fed by decentralised learning processes, has to undergo some forms of centralisation, even if it is basically maintained by decentralized learning processes (Cohendet, Llerena, 1991). Thus a tension inevitably arises between the forces which keep the coherence of the organisation, i.e. the common knowledge and the forces that promote decentralised learning. The balance will depend on the characteristics of the learning processes and those of the environment in which the firm operates. This cognitive perspective on the study of the firm has been taken by, among others, Cyert and March (1963) ; Cohen, March and Olsen (1972); Cohen (1991) ; Loasby (1976 and 1983) ; Eliasson (1990) ; Dosi and Marengo (1994) ; Marengo (1992 and 1994). By means of simulations exercises, Marengo (1994) has shown that, when flexibility and fine tuning to the environment are required, local learning processes can be effective provided higher hierarchical levels have the capability of pulling them together. Effective decentralisation seems therefore based on bottom-up knowledge and information flows more than on horizontal information flows, as it has been emphasised by Aoki (1988). Aoki's analysis tends to overestimate the importance of horizontal information flows: if learning is duly emphasized, the main issue of decentralization becomes the possibility that operational units can influence such a process, but this depends on the

organisational use of *ex post* information flows coming from such units, that is on vertical bottom-up information flows<sup>4</sup>.

In fact these information processing characteristics of the hierarchical and non-hierarchical modes of coordination have logical consequences for their efficiency in different environmental conditions; these results seem to provide support to the previously mentioned stylized facts about the Japanese economy. Aoki's (1986 and 1990a) and Itoh's (1987) main conclusions are that : “ When environments for planning (e.g. markets, engineering process, development opportunity) are stable, learning at the operational level may not add much information value to prior planning, and the sacrifice of economies of specialization in operational activities may not be worthwhile. Or the other hand, if environments are extremely volatile or uncertain, decentralized adaptation to environmental changes may yield highly unstable results. In both these two contrasting cases, the hierarchical mode may be superior in achieving the organisational goal. In the intermediate situation, however, where external environments are continually - but not too drastically - changing, the J-mode is superior. In this case, the information value created by learning and horizontal coordination at the operational level may more than compensate for the loss of efficiency due to the sacrifice of operational specialization ” (Aoki, 1990a, pp.8-9).

Thus, if the environment is stable, economies of specialization become essential and the hierarchical structure of coordination is likely to be the one which fosters the exploitation of such economies. If the environment is radically changing, the need for overall planning and broad resource reallocation might again require strict hierarchical coordination. On the other hand, if the environment is gradually changing and adjustment to varying consumer tastes becomes crucial, decentralized information processing might speed up the process of adaptation.

There are two divergent positions with respect to such hypotheses : at one extreme we can assume that agents' models of the world can differ, at the other extreme we can assume one model of the world is shared by all the members of the organisation. The “ loss of control ” literature takes the former position, but runs into the impossibility of accounting for communication within such a framework. If the models of the world differ, *ex post* information coming from subordinates would require a revision of the model maintained by the superordinate, but such a revision cannot be carried out within a Bayesian framework. This revision would imply a

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See Cohendet, Llerena, Marengo (1994) for a detailed discussion of this point.

modification of the superordinate's state of knowledge, that is a process of learning. For this reason, in this vein the models are limited to the consideration of *ex ante* information flows, represented by the top-down transmission of plans. Therefore diversity of representations of the world has only negative implications : it generates a chain of misinterpretation of the plans and loss of efficiency. The fact that diversity of representations could also have the positive effect of improving on the process of plan revision, by making use of the *ex post* information coming from subordinates, is not taken into consideration. The team theoretical tradition admits the use of *ex post* information, but it has to assume a unique representation of the environment, which is shared by the entire organisation.

On the one hand, the loss of control tradition ignores the problem of coordination, while on the other hand the team theoretical literature postulates coordination. In both cases it appears that, by essence, this literature considers the firm basically as an information processor. From this vision Aoki tried to move forward and examine the issue of coordination, by allowing horizontal information flows at the operational level, which can improve on the execution of plans. But learning, seen by Aoki as improvement of the state of knowledge, is still ruled out. The comparison between centralized and decentralized structures is based on information asymmetry, the implications for learning and adaptation are not examined.

Again, the question of interdependence of cognitive mechanisms (here decentralized learning processes) and coordination ones remains open in the case of firms considered as "knowledge processors". The contributions mentioned above suggest that each specific method of organizing a firm implies a specific set of routines and rules geared towards problem solving in a coordinated way. Here again, routines play a central role in the analytical framework (Cohen et alii, 1996).

## **5. Coordination of learning processes and the notion of competence**

In all the above developments, the concept of competence of the firm played implicitly a major role. This concept has recently been suggested as a leading explanatory variable for diversity and its persistence (Dosi and Marengo, 1994). The concept of competence, which relies on that of routines and rules, refers to a view of the firm as a social institution, the main characteristic of which is to " know (well) how to do " certain things. These competencies are compact sets of knowledge and capabilities to use them in an efficient way. Some of these competencies are strategic ("core competencies" according to Teece (1988)) and constitute the main sources of the

competitiveness of a firm. They are the results of a selection process both internal and external to the firm. The management, the construction and the combination of these competencies are critical to be able to understand the limits of the firm and the coordination as well as the incentive structure of the firm.

As it has been emphasized earlier, knowledge plays therefore a key role in the economics of the firm. This has some important consequences for our view of coordination :

- 1) Knowledge of complex production processes is necessarily distributed (cf. von Hayek, 1937) and cannot be fully grasped and controlled by a single individual. A primary role of an organisation becomes that of coordinating this dispersed knowledge;
- 2) Coordination in this case generally involves the creation of commonly shared bodies of knowledge : sets of facts, notions, “ models of the world ”, procedures which are – at least partly – known to all the members of the organisation involved in a given interaction. In a sense this kind of coordination is a pre-condition for the coordination of actions which is examined by the above mentioned studies and which implicitly assumes that all these mechanisms for the coordination of dispersed knowledge are already in place. It seems in any case most unlikely that mere incentive mechanisms could alone be sufficient to promote this kind of coordination.

But, and perhaps even more important, this focus on knowledge issues brings about also the issue of how such knowledge is generated, maintained, replicated, and modified (and possibly also lost), i.e. the issue of learning and its nature.

As repeatedly argued, (cf., for example, Nelson and Winter, 1982 ; Dosi and Egidi, 1991), innovative activities involve a kind of learning quite different from Bayesian probability updating and regression estimation: it requires agents to build new representations of the environment they operate in (and which remains largely unknown) and to develop new skills which enable them both to explore and to exploit this world of ever-expanding opportunities. Such representations are embedded in the routines.



## 6. Routines and rules<sup>5</sup> as cognitive, incentive and coordination mechanisms

Routines appear many times in the above discussion. And as a matter of fact, they constitute one of the main aspects of developments in the evolutionary theory.

As Nelson stresses (1994): "a firm can be understood in terms of hierarchy of practised organisational routines, which define lower order organisational skills and how these skills are co-ordinated and higher order decision procedures for choosing what is to be done at the lower level". Routines act as a coordination mechanism.

Routines encompass also the organisation's knowledge basis and they constitute the organisational memory : the organisation "remembers" a routine by applying it, in the same way as individuals "remember" their skills by exercising them. Routines represent a truce (cf. Nelson and Winter, 1982) in the conflict between the constituent parts of the organisation and, at the same time and through a similar process of achievement of a truce, they embed the shared collective knowledge of the organisation, they provide an at least partial codification of it, they allow it to be stored and replicated in a way which is at least partially independent from the people who actually generated it. Therefore routines have also the characteristic of a cognitive mechanism.

Finally, routines and rules contain another characteristic through the implementation of mechanisms of incentive and authority. "A crucial step when trying to bridge the evidence from cognitive psychology with organisational routines, involves an explicit account of the double nature of routines, both as problem-solving actions patterns and as mechanisms of governance and control" (Cohen et alii, 1996). Coriat and Dosi (1994) discuss this issues in the case of Taylorism and 'Ohnism': "The set of 'Japanese' production routines does not only embody different chanel of information processing but also distributes knowledge within the organisation in ways remarkably different from the Tayloristic/Chandlerian enterprise. And, at the same time, on the governance side, individuals' incentives to perform efficiently and learn are sustained (in the Japanese firm) by company-specific rank-hierarchies, delinked from functional assignments (Aoki, 1990)" (p. 22). In fact the mechanisms of

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<sup>5</sup> We use both terms 'routine' and 'rule' for two reasons: to stress that some mechanisms can be relatively more codified and to make an explicit reference to Favereau (1993, 1995) who uses the term "règle" in a similar way. It allows us also to refer to Reynaud B. (1996), who distinguishes between rules-to-be-interpreted and rules-to-be-executed. The latter ones are sources of learning and might be considered as cognitive mechanisms.

governance play in Coriat-Dosi's contribution the role of our coordination and cognitive mechanisms.

## **7. Conclusive remarks**

As Coriat and Weinstein (1995) pointed out, the evolutionary approach of the firm offers a unique advantage, compared to other competing theories, to provide explanation for three key issues of importance to understand the theoretical foundations of firms:

- It explains how one can define a firm: through the set of competences that the firm encompasses
- It explains why firms differ: because they rely on different routines and competences that are specific and that cannot be transferred (at low cost)
- It explains the dynamics of firms: through the combined mechanisms of searching and other evolutionary mechanisms as the possibility of transforming a set of secondary routines into a new core competence.

Another key feature of the evolutionary theory of the firm is that it proposes an in-depth reconsideration of the governance mechanisms. According to Williamson's conception, governance mechanisms are intrinsically linked to the approach based on transaction costs (which supposes that the firm is essentially a processor of information). What the evolutionary theory proposes is the setting up of governance mechanisms based on the distribution of knowledge. Mechanisms of governance relative to the distribution of knowledge come within a world of resource creation, where inadequate attitudes towards the creation or diffusion of knowledge (insufficient exploratory mechanisms for instance) is the main problem to overcome.

However, the evolutionary theory of the firm has still very little to say on resolution of conflicts within the firms and most of all on the potential conflicts that could emerge between shareholders and managers. It has also very little to say up to now on the role of the entrepreneur in an evolutionary context. These issues leave a number of areas of research open, but significant progress can be expected in the near future and we are confident that the evolutionary theory of the firm will constitute soon a coherent body of knowledge for the economic theory as a whole.

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