BRIDGING INDIVIDUAL AND ORGANIZATIONAL LEARNING THROUGH A SYSTEMIC APPROACH : TOWARD A DOUBLE HELIX KNOWLEDGE CREATION MODEL

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ABSTRACT

How should we understand knowledge creation in organizations? A wide body of empirical and theoretical research – labelled here as the spiralling perspective – assumes that knowledge creation is a fundamental element of organizational processes, and aims to identify different types of conversion processes framed by organizations. But what exactly is knowledge creation? The paper argues that this perspective suffers from insufficient debate on the definition of its research object regarding especially the tacit dimension.

One of the main limits of the spiralling perspective is its understanding of organizational conversion processes as series of separate conversion episodes. Stressing the discontinuity of knowledge (there is no continuum between tacit and explicit knowledge), an emerging "reproduction perspective" challenges this view. It argues that conversion processes face tacit traps that do not always allow externalisation.

The paper argues that, because of different types of tacit knowledge, related to the way organizations deals with ignorance (seen as central as *knowledge* management) and to the various nature of complexity emerging from the simple presence of humans inside organized systems, knowledge creation should not be understood as a single spiral conversion but rather as a double helix, referring to the biological DNA model. This double helix process allows the recombination of basic elements, such as knowledge, relation, emotion and object, having specific valences embodied in personal and contextual backgrounds. On the basis of these results, we discuss some implications for innovation and actionable knowledge creation.

(Knowledge Creation, Organizational Knowledge, Systemic Theory, Tacit Dimensions)

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INTRODUCTION

In the last thirty years, the profusion of research and the abundance of literature testify the renewal of interest for management sciences and resource-based view theory for the organizational learning. Source of competitive advantage, it takes on from now a strategic character (Wernerfelt 1984, Prahalad et Hamel 1900, Teece 1998). Thus “learning to learn” (Argyris et Schön 1978), becoming a learning organization (Senge 1990, Moilanen 1999, Heraty 2005) or improving organizational learning become major problematics of management sciences, for researcher as much as for practitioners**.**

Since March and Kogut and Zander’s seminal works (March 1991 ; Kogut and Zander 1992), the perspective on organizational knowledge creation has developed into a considerable amount of research that greatly improved our knowledge of organizational processes. Though the field of knowledge creation is far from being unified (Cook and Brown, 1999), a few basic ideas inspired most of the research (Kogut and Zander, 1992). First, researchers tried to explain the existence of the firm at a macro-level from a managerial point of view and not, as traditionally, because of economics concerns, focusing on the ability of knowledge creation as a competitive advantage.

Nonaka’s model of the spiral of knowledge creation (Nonaka 1994), which is today the dominant model of organizational knowledge creation, can be read as a more microscopic exploration of the problem raised by Kogut and Zander. By coming down to a lower analysis level, one are more directly interested in knowledge transfer and creation process. Nonaka proposed about this question a very stimulating lighting with his conversion matrix. According to him, knowledge creation arises from the constant dialogue between tacit and explicit knowledge. Tacit knowledge is deeply rooted in action, continuous, personally involving its holder in a specific context ; explicit knowledge is codified, discrete (in a mathematic sense) transferable, free from personal and contextual aspects. Knowledge

creation occurs if a constant cycle of conversion is working within an organization which then offers the required structure to the process.

We were personally involved in processes of “translating” “tacit knowledge” in “explicit knowledge” during various direct experiences in action research for different fields : ISO 9000 certification of a commercial network, a franchised book writing for a car new innovative distribution sign, the knowledge management design of a French competitive district and an another long-term investigation in a big national electric company. Based on these several experiences, we noticed that one face significant codification problems arising from what we proposed to call *tacit traps.*

We present a theoretical frame to understand this question. Then, building on this result and using the systemic theory as a guideline, we explore new ways to improve our understanding of the process of organizational learning and some potential managerial implications. The paper argues that, because of different types of tacit knowledge, related to the way organizations deals with ignorance (seen as central as *knowledge* management) and to the various nature of complexity emerging from the simple presence of humans inside organized systems, externalisation has a contingency factor conditioning its actionability.

First, we will present a literature review centred on the learning process. Second, we will focus on Nonaka’s model and the tacit traps challenging according to our datas the spiralling process. Then, we will explore how systemic theory or biological patterns can shed light on organizational knowledge creation and help bridging the individual and organizational knowledge.

I. KNOWLEDGE AND LEARNING : AN OUTLOOK

The individual learning has been studied at first by researchers in human behaviour. The behaviourists, precursors of individual learning theories, based their researches on the "stimulus-response" model. Then human behaviour depends on a mechanist and conditioned scheme (Pavlov's experience) and confers no specificity to individual. The cognitive scientists propose another conception of learning: it is a change in knowledge' level. In this way, individual interprets stimulus and takes an active part in the learning process. Piaget's researches (1959) are representative of this theory: to learn implies individual's mental models modifications. He explains two different process of learning: assimilation and accommodation. Assimilation characterizes the integration of information and the enrichment of mental models, without challenge its. To the opposite, accommodation is a development of intelligence which supposes change in mental models and in acquired knowledge in order to integrate the new data. For a large part, informations are assimilated, individuals add data in their memories; accommodation happens only when assimilation is no more possible. For Piaget, learning corresponds to the accommodation of mental representations and is a process, that is to say a whole of mechanisms which content must be precise.

The determination of learning content is nothing else formulating a response to the question: what we learn? The chain of transformation of data to competence presented by Mack (1995) is an element of response. Data are modified, by accumulation and juxtaposition, in information. This last is structured, organized and classified to become an explicit or tacit knowledge. Many authors distinguish tacit knowledge from explicit knowledge (Polanyi, Nonaka, Reix). The explicit knowledge is formalised and can be diffused by language or description, whereas tacit knowledge is not easily expressible. It includes cognitive elements, schemes, beliefs and mental models and defines individual's vision of world (Nonaka 1994). This knowledge is transferred by analogies, metaphors and practices.

According to Mack (1995), learning generates knowledge and competencies through a chain of transformation. This distinction of learning content reveals and explains the different levels of learning proposed by authors. The learning authors specified and organized into hierarchy different levels of learning. Kim (1993) develops a model based on the operational and the conceptual learning. The first one corresponds to the acquisition of know-how and implies action whereas the second necessitates comprehension and articulation of knowledge. Schein (1993) proposes another distinction, between three levels: *knowledge acquisition*, i.e. information integration in memories, *competencies and routines acquisition.* The author emphasized the link between the second level and behaviourism: a good behaviour is immediately recompensed whereas errors are not punished. This process is quite slow but generates new individuals habits and routines and ensured a lasting learning. At last, *emotional learning* is associated to Pavlov's experiences. Schein transposes the results to individual learning: the repressed actions beget a fear that blocks individual. Argyris and Schön (1974) propose the most complete theory, re-used by many authors. Indeed, single loop learning can be assimilated to learning adaptation (Senge 1990), to operational learning (Kim 1993) and to level 1 of Schein. Double loop learning is near conceptual learning (Kim) and "why" learning (Moingeon 1996).

Learning is a concept originally developed for the individual. We had to wait until Simon's work in the fifties to have it transposed to the organization, opening a way to a revival of researches (Koenig 1994). Numerous theories are proposed by authors, each one focusing on a precise element of the phenomenon (Leroy 1998): the learning object (information, knowledge, competencies), the learning subject (individual, organization), the learning trigger (error, innovation, environment change) or on the process itself (socialization, codification). The first part aims at synthesizing all these researches, focusing particularly on the organizational context dimensions, implicit in literature.

The concept of organizational learning has been studied in many areas (Easterby-Smith 1997): psychology, organizational development, management or sociology. Those different approaches ensure a larger understanding of the complex phenomenon that is learning: "*It contends that while various literatures are revealing in particular aspects of organizational learning, a more complete understanding of its complexity requires a multi-disciplinary approach"* (Dogdson 1993). The management sciences experience various researches**,** notably from Argyris and Schön (1978, 1993, 1994), Levitt and march (1988) and Nonaka et Takeuchi (1991, 1995).

Several definitions can be found in learning literature. For Argyris and Schön (1978), organizational learning is the cognitive process enabling the members of an organization to detect mistakes and to correct them by changing their action theory. Thus, an organization learns when it acquires information, no matter the way (knowledge, understandings, practices). Levitt and March (1988), in a behaviourist perspective**,** underline the notion of routine. The organizational learning is then considered as the process enabling organizations to codify past interference and to transform them into routines. To learn, an organization should integrate history consequences to its processes. Senge (1990), focusing on the learning subject, gives a more general definition "*in learning organizations, individuals improve at each moment their capacity to create the expected results, new ways of thinking*". Koenig (1994) formulates a definition commonly repeated**:** "collective phenomenon of acquisition and elaboration of competences, that, more or less deeply, change management situations and situations themselves".

Behaviourist and cognitive approaches of learning tend to be over passed to offer a common vision: "*learning can be understood as an organizational behaviour adjustment responding to environment change, as a transformation of the organizational knowledge corpus or as an interaction between individuals within the organization*" (Leroy 1998). If

some theoreticians try to show the convergence between approaches (Shrivastava, 1983, Huber, 1991, Edmondson et Moingeon, 1998), one difference remains**:** the learning subject.

The aim of such an interrogation is to understand what brings to learning its organizational nature. Two answers are possible: learning has an organizational character when the learning subject is the organization itself or when the individual learning deals with the organization and spreads through it. The first perspective infers a holist vision that totally dissociates individual learning from organizational learning, the last one being the result of an organization work, reified and existing by itself. Organization does not have its own brain but has information systems, cognitive systems and a memory (Hedberg 1981). Those researches widely use routine and organizational memory notions, which are not dismissed from the individualist approach. This second perspective puts the individual in the center of organizational learning: the organization exists through the individuals that compose it and doesn't have the ability to learn by itself. Organization members learn and this individual learning becomes organizational in two ways: socialization and routine diffusion. Argyris and Schön are precursors since 1978. Thus, they raise the organizational learning paradox: the organization is composed of individuals and individual learning is necessary to organizational learning; however the organization is able to learn independently of each individual but not of the whole. Therefore, even though the individual is the only one that can learns, he belongs to a learning system in which individual knowledge is exchanged and transformed. The individual as a source of organizational learning is henceforth established and accepted (Argyris and Schön 1978, Hedberg 1981, Shrivastava 1983, Cohen 1991, Simon 1991, Kim 1993, Nonaka 1994, Ingham 1995) and holds in this contribution.

II. TACIT TRAPS IN NONAKA'S SPIRAL OF KNOWLEDGE CREATION : INTRODUCING A CONTINGENCY FACTOR IN EXTERNALIZATION

As shown in the former part, the perspective on organizational knowledge creation has developed into a considerable amount of research that greatly improved our knowledge of organizational processes. Though the field of knowledge creation is nowadays far from being unified (Cook and Brown, 1999), we notice that a few basic ideas inspired most of the research since March and Kogut and Zander's seminal works (March 1991, Kogut and Zander 1992). Kogut and Zander tried to explain the existence of the firm at a macro-level from a managerial point of view and not, as traditionally, because of economics concerns, focusing on the ability of knowledge creation as a competitive advantage. Deepening this perspective at the mezzo-level of one firm, one of the basic assumption is that the organization afford a frame for a continual process of knowledge creation (the spiral) leading to the creation of organizational knowledge (Nonaka, 1994). Moving to the micro-level of knowledge creation processes, researchers identified a kind of residual factor, named *knowing*, that is hardly connected to the process of conversion (Cook and Brown 1999, Gherardi, 2001).

These ideas have noticeably deepened our understanding of organizations. Yet the very ideas that inspired the spiralling perspective seem to impose serious limitations to its explanatory power. The main limitation is that usually, researchers consider tacit as one homogenous category and as a consequence, a relevant unit of analysis.

We understand the tacit dimension of knowledge in a way referring to Polanyi (1967), something we know but we are unable to fully explain in order someone else could do the same with the same result. The term "tacit" is often misleading. Stenmark (2002) propose an interesting synthesis of the debates about tacit definition through the works of Nonaka, Tsoukas or Cook and Brown. Baumard (1996) gives a good explanation too of the various

forms of knowledge classically discussed: tacit/implicit/explicit. However it is not really easy to figure what kind of properties these forms of knowledge exactly have and it is even more difficult to determine where to place the twist between one of another.

We have, surprisingly, a very simplistic way of understanding and dealing with this "tacit dimension". So, our central concern will be on tacit dimension and the ability of replication. Is a unique category of tacit accurate enough? Can we consider tacit knowledge as one same kind of knowledge or is it possible to discriminate different types of tacit knowledge? If we accept different dimensions of tacit, how does it interfere with the replication question?

Our studies show that in some types of contexts tacit knowledge can be extracted and codified with a good capacity of rising efficiency in action but it is not always the case. This leads us to show the need of *breaking the tacit dimension* to better understand our capacity as researcher or manager to use it as a tool for action. We propose thus to define tacit dimensions through the way organizations manage their *ignorance* and involve a certain type of knowledge *regarding the nature of his complexity* (Barbier, 2004). Through a mapping using *organizational mandate* and a typology of *complexity forms*, we try to go beyond what we can call the *tacit wall*. So, according to us, the codability of every "type of tacit knowledge" can be explained by reference to the nature of the complexity at stake.

2.1 The Limits of the Spiralling Perspective

Founders intuitions about reproducibility

March (1991) had first explored the balance between exploration and exploitation. Starting then with an approach aiming to explain the existence of enterprise from a managerial justification point of view - instead of an economic reason - Kogut and Zander exposed two fundamental intuitions for which later developments on knowledge management are highly indebted to. First, they stated that it is not possible to codify all sorts of knowledge,

that is to say structure them in rules and relations, but the enterprise is generally “naturally inclined” to have its knowledge encoded in order to make it more easily spreadable. Second, they argued that the nature of knowledge generally changes if you try to codify it, and it is the degree of complexity that explains knowledge externalization costs.

Firms as frames for conversion processes

Nonaka’s model of the spiral of knowledge creation (Nonaka 1994) can be read as a more microscopic exploration of the problem raised by Kogut and Zander. By coming down to a lower analysis level, one are more directly interested in knowledge transfer and creation process. Nonaka proposed about this question a very stimulating lighting with his conversion matrix. According to him, knowledge creation arises from the constant dialogue between tacit and explicit knowledge. Tacit knowledge is deeply rooted in action, continuous, personally involving its holder in a specific context; explicit knowledge is codified, discrete (in a mathematic sense) transferable, free from personal and contextual aspects. Knowledge creation occurs if a constant cycle of conversion is working within an organization which then offers the required structure to the process.

Facing codification problems

We were personally involved in processes of “translating” “tacit knowledge” in “explicit knowledge” during various direct experiences in action research for different fields : ISO 9000 certification of a commercial network , a franchised book writing for a car new innovative distribution sign, the knowledge management design of a competitive district and an another long-term investigation in a big national electric company.

Quite everybody has heard about *ISO 9000 certification* or shopped in a *franchised network*. Indeed, quality certification and franchised systems represent a growing part of economical relationships patterns. But it is highly surprising that these successful

organizational tools are both built on what we could call *a voluntary blindness* regarding the matter of *tacit knowledge*.

In fact, *ISO 9000* main principle is : *"write what you do and do what you write"* (and try to improve gradually). In order to create a franchised network, you have to demonstrate that you own a *substantial, secret and transmittable know-how* and write it in a *franchised "book"*. This is simply impossible! However, it works. So, one has to cheat somewhere! We tried in particular, during a four years action research, to explore dynamic relations between tacit and explicit knowledge. In these projects, we focused on knowledge codification problems, especially in selling activities and on the design of activities with an important part of knowing in practice.

Organizational Knowing

Moving to another lower analysis level, one arrives to consider closely the externalization process itself. Cook and Brown (1999) stress that, more or less implicitly, knowledge is considered as only one sort, that's to say as if tacit and explicit knowledge were both variants from on sort of knowledge. According to them, this idea leads Nonaka to say: "realizing the practical benefits of tacit knowledge centers on its externalisation".

Cook and Brown, on the contrary, postulate first that each of the four sorts of knowledge (explicit/tacit, individual/ collective) has to be considered as distinct and without connection, because one sort of knowledge allows doing what others can't. These four sorts of knowledge are described as an epistemology of possession. They postulate secondly that this way of explaining knowledge is not able to account for all what is known. That's why they introduce another concept: knowing. Knowing is an ability closely dependent on practice, only usable when people are doing the action. Thereby, it is a kind of residual knowledge factor. We could talk about *interstitial knowledge* in opposition to brick built knowledge. The

knowing appears then as essential as the cement to hold knowledge bricks together, building the whole knowledge edifice.

2.2 From tacit dimension to tacit dimensions

Ignorance first, Knowledge later

With Girin (1995), we can underline the fact that the main problem of an organization may not be how to manage its knowledge, but how to organize its ignorance. It is indeed striking to see to what extend most members of an organization are totally unaware of what their colleagues do.

By mobilizing agency theory which studies the relationships between a principal and his agent, Girin shows how a member or a group in an organization will define mandates so as to be able to discharge on another person or entity the duty to accomplish for him what he has neither the time nor the capacity or taste to do himself.

Drawing the consequences of the results of the theory of distributed cognition, we can underline the fact that the agents, involved in this mandatory relation, are not individuals but complex entities made up of a combination of men, objects, physical spaces, machines, documents, etc.

Thus, Girin suggests calling *organizational agencement* a mix of human, material and symbolic resources endowed with the power to issue mandates. Then, the *organizational agencement* becomes the relevant unit to analyse the mutual prescription relationship between the members of an organization, the latter being summed up by the type of mandate in play.
Four typical situations can be identified in which the mandate given to the *organizational agencement* comes to management situations differentiated in terms of the way the activity is conducted, according to whether the result is clearly identified or not, and whether the activity to be done is more or less easy to describe.

		Mandate ***« saying »*** (description of principal expressed waitings)	
		Clear	***Confused***
Activity ***« doing »*** (description of the agent achievement)	***Simple***	**Need of cooperation** *Eg: organizing a dealer's supply*	**Ordinary vigilance** *Eg : selling point administration*
	Complex	**Need of expertise** *Eg : determination of a car former accidental status*	**Co-production** *Eg : sell or trade in a car*

Fig.1 – Mapping mandates in organizational agencement theory

Girin's complexity typology: how humans rise various forms of complexity in organizations

Noticing that the idea of complexity of a phenomenon often appears as the end of the thought process, Girin (2000) in contrast suggests it could be a starting point. Thus, it is possible to identify three different conceptions of complexity, referring to technical, metaphorical and human dimensions. In the technical sense, chaotic complexity means attitudes which are impossible to predict beyond a certain horizon (notably because of the sensitivity to initial conditions). The Np-complete problems are a good illustration of algorithmic complexity: the time required to calculate exceeds the predictive horizon. In the metaphoric sense, it is a non-linear property which is generally referred to and often improperly used.

But the complexity also appears because of the mere presence of man in organized systems. Girin identifies then four different types of complexity in systems involving human beings. The complexity of coordination is the result of either power conflicts, composition effects or phenomena linked to interactive rationality. Cartographic complexity is the result of

the limited cognitive capacity of individuals (the more detailed a map is, the more difficult it is to read). Contextual complexity shows the discrepancy between the prescripted task and the one which has indeed been done which is linked to background knowledge with multiple fittings. Framing complexity is the result of the necessity to interpret events by marshalling in real time the various resources of the *agencement*.

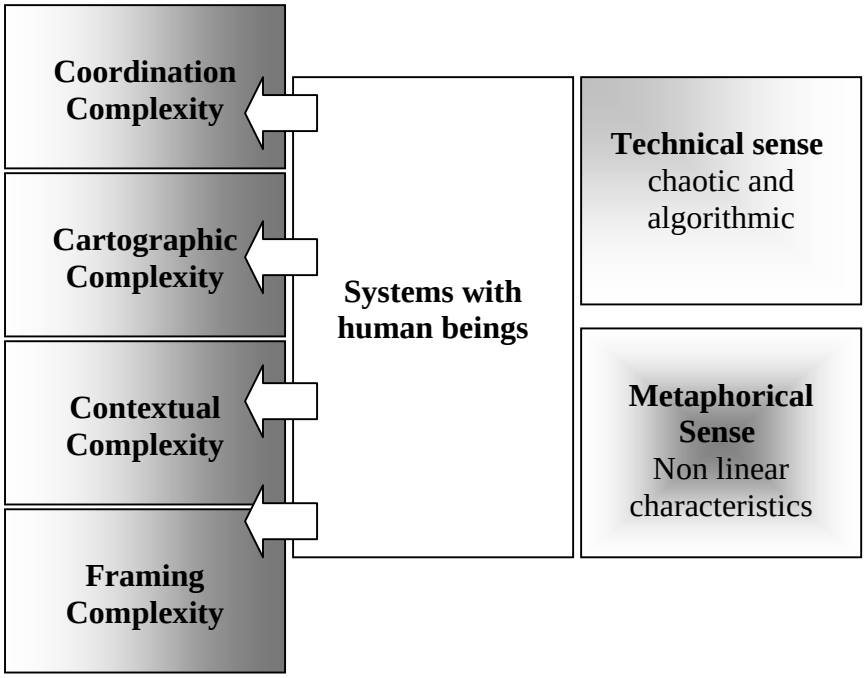

Fig.2 – Forms of complexity

Hatchuel's S-R inseparability theorem

According to Cook and Brown, immersion in an activity and dialogue with different sorts of knowledge (concepts, stories, abilities, genders) is the condition for a collective learning. Hatchuel proposes an axiomatical reformulation with his Knowledge and Relation inseparability theorem. Collective learning supposes a specific attention on mobilized knowledge, but also on the system of relations which allows the common building and validation of knowledge. According to Hatchuel, the knowledge produced by each of us

depends on how he is interacting with others, and organizational relations form the frames of learning interactions.

This position leads Hatchuel (2000) to propose a deconstruction of management sciences invariants (rationality, administration, contingency, performance), based on an metaphysic of action, that is to say, which calls out a principle or an aggregative subject hiding collective learning mechanisms. With the "operators" knowledge and relation" and the principle of inseparability S-R, Hatchuel creates a new axiomatic theory of collective action. The latter gives a conceptual and integrating framework to the dimensions of the dynamics of knowledge mentioned above: law of rationalities conversion within a rationalization process, collective learning mechanisms as a matrix of the company (seen as an artefact whose finality is entirely flexible), central role of action in reflexive learning processes.

2.3 Breaking the tacit dimension

Crossing theories toward four tacit dimensions

Building on what was said above and based on our own experiments; we are now formulating a theoretical proposition based on the research work of Girin. The process by which tacit knowledge can be "made" explicit (which we were faced with when writing the bible of franchising and doing ISO certification and which imply a formalization of know-how) stumbles upon an inadequately subtle categorization of tacit knowledge.

As a result, faced with the practical necessity to translate, at least partly, tacit knowledge to contribute to a theory of action, we suggest to refine the category of "tacit" in Nonaka's matrix, by crossing it with the two typologies proposed by Girin : a typology of mandates and a typology of forms of complexity, mobilizing human actors. Thus, we suggest highlighting the role played by the researcher or manager as a translator of tacit knowledge, relying on a categorization of tacit knowledge, which we distinguish in relation to the nature of complexity of the mandates and knowledge, which condition their implementation.

This deconstruction of the tacit dimension is very similar to the axiomatic proposed by Hatchuel if we defined the operator “knowledge”, according to the nature of its complexity and the operator “relation”, according to the way the mutual ignorance allowed by the mandate of the organizational structure is organized. Our interpretation aims at founding both the relation of prescription of the researcher in terms of collective learning and his capacity to identify the typical rational myths of management situation (quality insurance, rationalizing a service) through a reflexive process steeped in an awareness of tacit contingency.

Bridging research trajectories: a conceptual framework for understanding and leveraging the tacit dimension of knowledge

Therefore, there is no such thing as one single type of tacit knowledge but indeed several different types. As we see it, those types of tacit knowledge can be characterised to help managers through a translation process regarding the complexity and mandate at stake. This allows anticipating on the problems met when trying to reach explicit knowledge (different levels can be obtained) and guide the researcher’s leverage in terms of managerial contribution: management tools to frame action, formulating quasi-laws, helping find a situation pattern, implementing an improvisation capitalization system. The following matrix is a synthetic illustration of these ideas (see fig. 3).

The deconstruction of the tacit dimension can thus be seen as an illustration of the axiomatic proposed by Hatchuel. It hinges on the two knowledge and relation operators by typifying both (nature of complexity/ ignorance management) while respecting the principle of the impossibility to separate knowledge from relation, which can be seen in the scope of the explicitation that can be reached, according to a generic mandate type and a degree of knowledge complexity. Translating tacit knowledge thus seems possible for the two first categories involving a simple task with confused or clear mandate. Conversely, for a complex task, we are faced with what could be called “interstitial knowledge”, which cannot be

codified operational wise. Theses situations can be characterized by the existence of *tacit traps*.

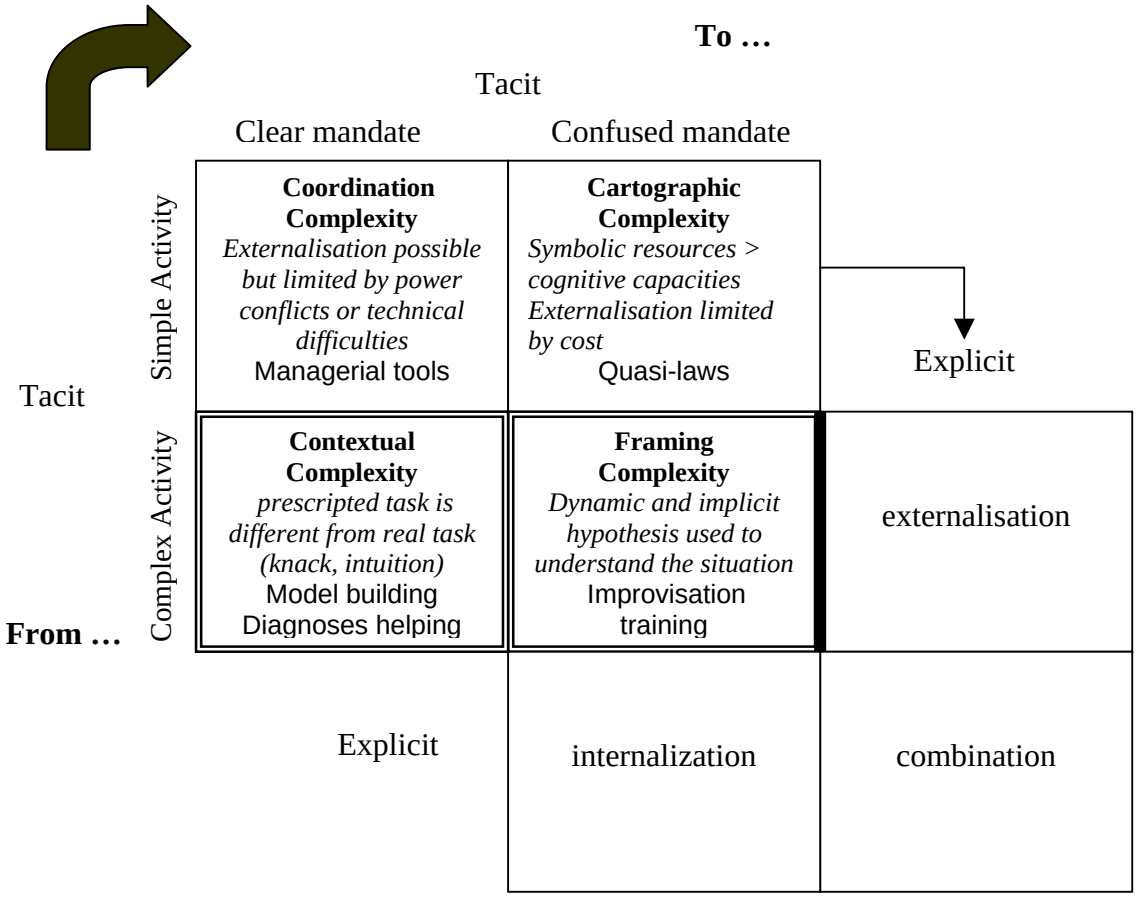

Fig.3 – Four tacit dimensions

III. THE SYSTEMIC APPROACH AS A TOOL TO MOVE TO AN INTEGRATED PERSPECTIVE OF LEARNING

The learning approach proposed in this article combines a perspective on learning that would be both complementary and integrated. The complementarily aspect is based on the link between individual learning and organisational learning, widely developed in many writings, whereas the integrated outlook considers the organization as a whole, puts the individual in context, sets the individual learning in the organization. In this way, we have to present the systemic approach. Its aims at being a general science whose underpinning would be valid for all disciplines. The approach of this article is to study the field of learning with a systemic approach and exemplifies itself the rationale of the theory.

System is a complex element which recovers different definitions. We can quote Leibniz (1666) : « System is a whole of parts » and most recently Von Bertalanffy (1968) : « System is a whole of units in mutual interactions" or Morin (1977) "System is an interrelation of units which constitute a whole entity". Premises of system theory are attributed to the Gestalt theory : this approach underlines notions of structure and interrelation and constitutes a first explanation of system. System theory is often perceived as the result of information's theory (Von Bertalanffy 1968), cybernetic (Lutasso 1977) and structuralism (Le Moigne 1990). With his work "General theory system", Von Bertalanffy (1968) is the precursor of system theory. He proposed an innovative model : the open system model, i.e. a system in permanent exchange with his environment. One of the principal concepts of system theory proposed by Von Bertalanffy and developed by Morin (1977) is the emergence. :"It is the attributes or properties of a system which present a new character compared to the properties of the parts". Since we consider no more the parts but the whole which its represents, the emergent properties exist. Those one imply that the whole cannot be reduced to its parts ; the whole is

more than the parts. Emergence is a property, a new quality acquired by the whole, indissociable from the parts of the system, which can be reduced to it.

The second concept underlined by systemic approach is the feedback which is defined as “homeostatic maintenance of balance in the living organism or goal’s research, based on circular causal chains and on mechanisms of differences between the state to maintain and the goal to reach” (Von Bertalanffy 1968). Complexity is one of the postulates of the system approach and confers to feedback different forms : recursiveness axiom (Le Moigne, 1990), auto-organization (Morin 1977) which reports the element to itself or recursive chains (Le Moigne et Morin, 1999). The recursiveness axiom explains the idea that the process and the result of the process cannot be dissociate : the result products itself.

Transposition of systemic approach to organization is not new : Parsons (1964) and Katz and Kahn (1966) researches testify it. They develop the idea that organization is a social system that presents all the characteristics of an open system. The organization is then an open social system : a whole of elements in interaction which constitute a whole of parts (individuals) in interaction with its environment. This idea has some implications for our analysis : we can apply open system’s characteristics to the firm, focusing on learning process. Rojot (2003) precises these characteristics : the information importation and exportation, the transformed, the recursiveness.

The first element, information importation, corresponds to an information entrance from the environment. This importation in the system translated into what systemic approach calls the transformed of social system : “Open systems turn information they import ; they do a work”. This transformed is an organization’s creation and is the process by which the system treats, transforms and integrates information from the environment : it is the organizational knowledge and routines. This notion of transformed underlines the evolutionary and dynamic of the system, the organizational learning constitutes an evolution

and change process of the firm. The transformed production needs the process of organizational learning and another element : the emergence. We have already said that systems have emergent properties and especially its ability to learn". The emergence comes from the system and is a catalyst of transformed : the ability to learn is prerequisite for organizational learning and organizational knowledge.

The second element is the recursiveness, which underlines the link between the process and its product. Regarding to this, we can emphasize the similarity between the recursiveness learning and the learning. On one hand, learning is in the same time a process (what is learning?) and a product (what we learn?). On the other hand, we recognize here Argyris and Schön research : individual is the source of organizational learning, this last feeds and modifies individuals' knowledge. Learning theory is a privileged field for the transposition of systemic approach, application that we can synthesize :

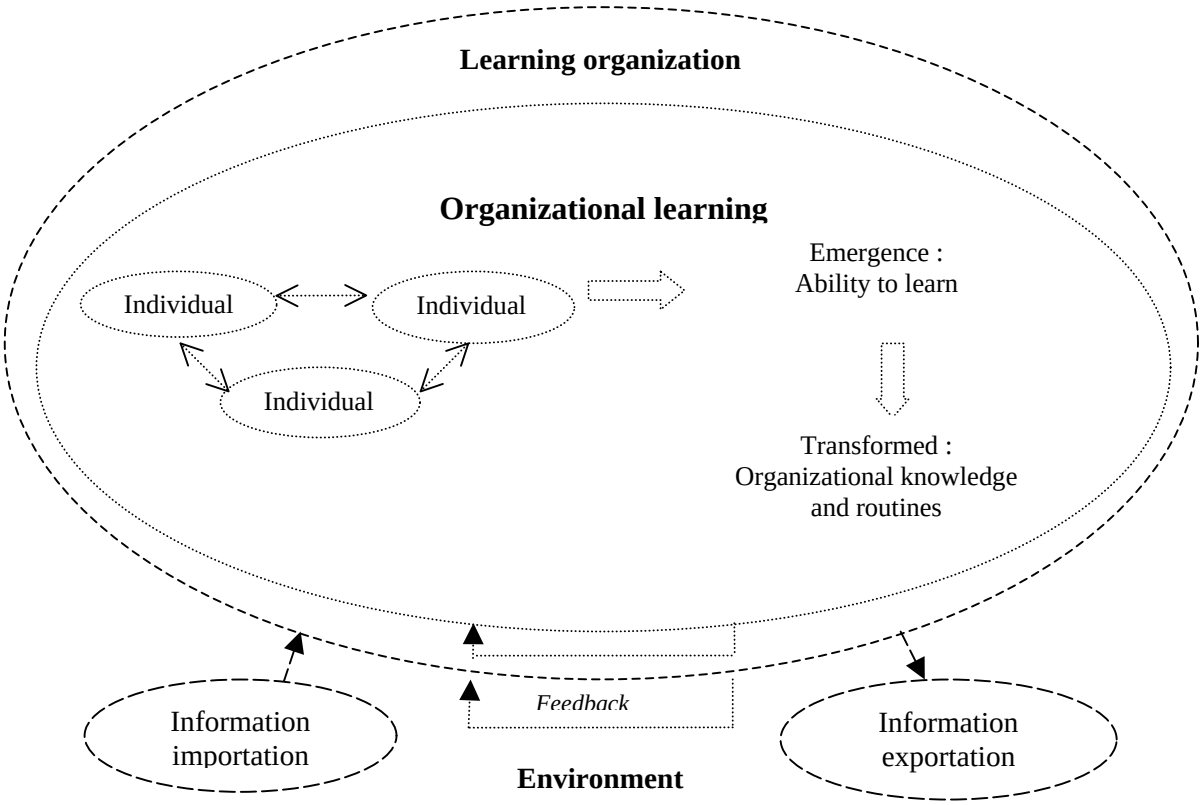

Fig.4 – Systemic view of individual and organizational learning

Our analysis contributes to a systemic approach of learning, that takes up the individual learning as source of organizational learning, but that integrates individuals in their context and considerates interactions between organization, individuals and environment. The outlook developed in this article considers the organization as a whole, puts the individual in context, sets the individual learning in the organization. This integrated approach emphasized on learning process and bridges the individual and organizational learning. In the following part, we will try to develop this idea more precisely regarding the micro-process of knowledge creation were we can found parallels for all the characteristics mentioned above.

IV . TOWARD A DOUBLE HELIX OF KNOWLEDGE CREATION MODEL

The next step in this paper is an attempt to build a new conceptual framework explaining the process of knowledge creation by including the consideration on multiple tacit dimensions in a systemic perspective. Indeed, the main model of knowledge creation is still Nonaka's spiral even if Cook and Brown demonstrated the need to articulate knowing to this scheme.

Our central idea is to reconsider Nonaka's conceptual framework from a geometrical point of view. According to us, it is not a spiral, it's an helix and this « geometrical » change has important consequences on how knowledge creation emerged. In fact, we sustained that Nonaka made the same mistake as in biology, the future Nobel prizes Francis Crick, James Watson and Maurice Wilkins in their first attempt to modelize the structure of DNA as pointed by Rosalind Franklin.

We introduce then some implications: questions about ignorance and improvisation may be as important as knowledge management; there is a capacity to *clone* knowledge under certain artificial conditions but it is a very specific case ; knowledge creation can be viewed as a process of replication with alteration, i.e. when you recombine same elements, you can introduce some small changes with far consequences as when you observe some change in DNA structure.

4.1 The discovery of DNA structure : not a spiral, a double helix ! [1]

To solve the structure of DNA four ideas had to come together. The first was that the phosphate backbone was on the outside, bases on the inside. The second that the molecule was a double helix. The third, that the strands were anti-parallel. And the last, that it had a specific base pairing.

The people responsible for the discovery of the double-helical structure of DNA were Francis Crick, Rosalind Franklin, Linus Pauling, James Watson and Maurice Wilkins. Franklin, trained as a chemist, was expert in deducing the structure of molecules by firing X-rays through them. Her images of DNA - disclosed without her knowledge - put Watson and Crick on the track towards the right structure… and the Nobel prize.

Franklin found out that by bundling super thin strands of DNA and zapping them with a super fine x-ray beam there were different forms of hydration. Her photographs showed a fuzzy cross which meant a helix. Since the water would be attracted to the phosphates in the backbone, and the DNA was easily hydrated and dehydrated, she guessed that the backbone was on the outside and the bases were on the inside. The first part of the problem was solved. In 1951, Franklin gave a seminar to bring the unit up to date on what she had achieved so far. In the audience was James Watson, a zoology graduate, who had become interested in molecular biology, with particular emphasis on DNA. After the seminar Watson, based on

[1] adapted from various historical sources about DNA and Rosalind Franklin.

what he had heard and seen, but only partly understood, built with Francis Crick their first model of DNA. When they invited Franklin and Wilkins to view the model, Franklin tore its construction to shreds.

In fact, we sustained that Nonaka made the same mistake as in biology, the future Nobel prizes Francis Crick, James Watson and Maurice Wilkins in their first attempt to modelize the structure of DNA as pointed by Rosalind Franklin. They initially build a spiral model but then realize their mistake, considering the spectrographic work of Franklin, and fixed their model as a double helix, pointing the specific properties of replication of this structure.

The DNA model as a pass way for a better understanding of knowledge replication

DNA is the common name for Deoxyribonucleic acid. It is made up of nucleic acids containing eoxyribose (sugar), consisting of complex molecules, present in the chromosomes of all plant and animal cells, and carrying in coded form instructions for passing on hereditary characteristics. The DNA molecule takes the shape of a double helix, a structure that is like twisted ladders. The rails of the ladder are made of pairs of nitrogen-containing nucleotides which are subdivisions of DNA.

Because each nucleotide within a rung of the DNA ladder is always paired with the same complimentary nucleotide, one half of the molecule can serve as a template for the construction of the other half. The four nucleotides in DNA contain the bases adenine (A), guanine (G), cytosine (C) and thymine (T). Chemical and X-ray data and model building exercises show that, in nature, base pairs form only between A and T and between G and C.

Heterocyclic amine base pairing is an application of the *hydrogen bonding principle*. In the structures for the complementary base pairs the thymine - adenine pair interacts through two hydrogen bonds represented as (T=A) and the cytosine-guanine pair interacts through

three hydrogen bonds represented as (C≡G). This complementary pairing explains how identical copies of parental DNA can be passed on to two daughter cells. When the DNA helix "unzips", two new molecules are formed from the half-ladder templates. The precise sequence of nucleotide rungs of the DNA ladder directs the manufacture of proteins and determines the identity of a living organism.

4.2 Basic bricks of knowledge creation

Elementary bricks of knowledge : the E-R-O-S model

According to Hatchuel's *inseparability theorem*, Knowledge (S) [2] is always connected with Relation (R). We can consider that we have here two elementary bricks and an idea to push forward. Indeed, what should the fundamental analysis unit of knowledge be ? Should we stop with *articulated rational information* or should the relations (with people and between blocks of knowledge) be included in the perimeter of thought, adding this way a kind of *relational knowledge* ?

Further, should the side of *emotional intelligence* be considered, as there are usually emotions associated with events or objects (at least with *souvenance-memory* if not with *habit-memory* as put by Bergson [3])? Following Latour (1994), we can ask what is the place of artifacts in our knowledge, should we not include objects as depository of knowledge and partly actors with their own "inscripted logic" ?

Our proposition is that knowledge is composed by those four elementary bricks and the relevant unit analysis should embrace this organizational *agencement* in Girin's way.

[2] We keep the original symbol « (S)avoir », in French.
[3] Bergson H. [1938], *La pensée et le mouvant*, Quadrige, Paris. Bergson underlines (p. 242) with William James that we have to accept integrally the experience : our feelings are part of it as well as our perceptions.

Knowledge elementary components	Tacit	Explicit
Tacit	**R** *(R)elation*	**O** *(O)bject*
Explicit	**E** *(E)motion*	**S** *(K)nowledge*

Fig.5 – The E-R-O-S model

We can notice that the e*ros model* meets in a certain extent Nonaka's approach in the way that you can consider each fundamental brick as central in Nonaka 's conversion matrix's relevant array : from tacit to tacit : building relation, socialization ; from tacit to explicit : you have to use objects in order to code and conserve the knowledge ; from explicit to explicit : you recombine bricks of knowledge ; from explicit to tacit : you associate emotion to knowledge through experience.

Types of valency between the four EROS bricks : a graphical outlook

We sustained that there is a kind of quantum of knowledge (referring to the triplet, that's to say each knowledge sequence is composed at least by three of these elements) and some valency relation between these quantum just as in biology.

According to us, we can drew a parallel between biology knowledge codification system and what happens in organizational knowledge creation or replication process. This process works with primary elements or fundamental bricks (like proteins in biology : A – T and G – C).

For knowledge, the first link is S(Knowledge) – R(elation), as asserted by Hatchuel (2000) with is "S-R" *inseparability theorem*. We propose a second linkage between O(bject) and E(motion).

And *knowing* appears then as a kind of matrix, the equivalent of the ribosomal structure needed to catalyse the whole process in biology reproduction, and providing a knowledge structure embedded in contextual collective knowledge and personal knowledge history.

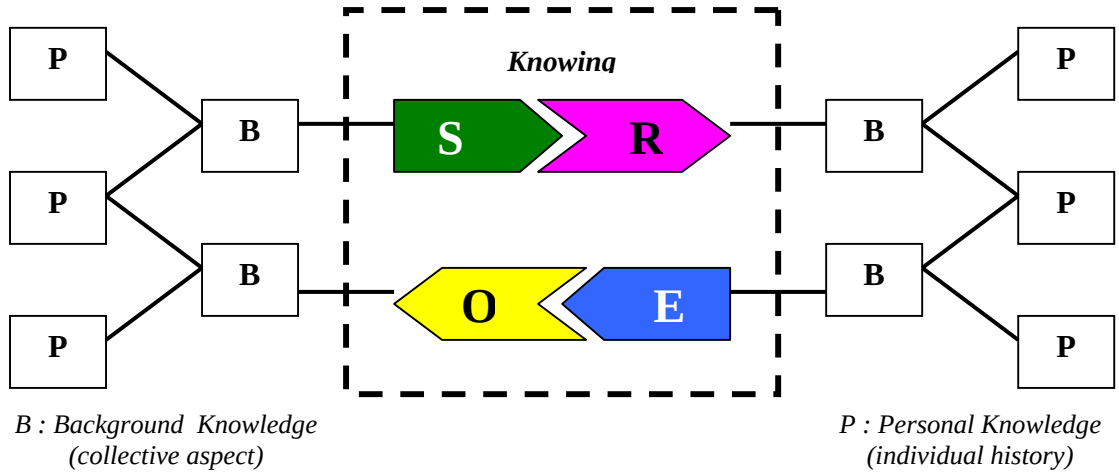

Fig.6 – Double helix of knowledge

The central process of mimesis and mutation

So, considering the properties of our model, it is likely to understand first the process of knowledge creation as a process of reproduction, based on a mimetic scheme with mutation instead of Nonaka's conversion mechanism.

As Cook and Brown put it, there is a part of knowledge which is only accessible precisely when you are doing the task or part of action. We consider that this could be true too for the process of knowledge creation understood as a mimesis phenomena at first, with a recombination and coupling process involving specific elementary knowledge bricks, that's to say associating a new relation with a brick of formal knowledge, or an emotion with an

object. The first elements are relatively static but they are dynamically related to form some new pairs, explaining differences by mutations in imitation or repetition patterns.

If we admit the former points, we can describe knowledge creation process in two steps : the double helix opens and then a complementarity process occurs.

Four types of learning experiences, accidental or intentional, connected to an underlying mimesis scheme organizing the process of knowledge replication can be drawn : learning by doing (inscription in habits, repetition), learning by failing (detecting an error), learning by professing (imitation of patterns), learning by experimenting (experimental sciences, statistical sciences : general or specific laws more or less connected with each other and with a representation of the world).

Then, different types of mutation can occur : genetic type (consist in the substitution or addition of an element in the DNA), genomic (involves the elimination of entire pieces of chromosomes) or chromosomic (an entire chromosomic configuration change, two genomes are merging in the same cell).

Drawing the equivalence for organizational knowledge, in reference to the cognitive paradigm and its scripts of action, this leads to understand different level of improvisation or innovation [4]. The first level is understood as an interpretation phenomena : the knowledge is reinterpreted by the learner with small personal changes. The second level refers to embellishment, you improve, from your point of view, the knowledge sequence. The third level is about variation : starting from the same point, you introduce new directions, new laws. And the forth level is about improvisation, mainly by merging two ideas.

[4] Weick K [1998], " Improvisation as a Mindset for Organizational Analysis", *Organization Science*, vol. 9, n°5, p 543-555.

CONCLUSION

Starting from action researches cases with concerns for knowledge codification, our work is deeply rooted in years of practice with reflective analysis. We tried to show the need of breaking the tacit dimension to help the researcher in managing the knowledge as a tool for action.

Thus, we analysed the difficulties during knowledge codification, experienced with ISO 9000 and franchising, in two different ways. One the one hand we focused on the researches initiated by Kogut and Zander (1992), pushed forward by Nonaka (1994) with organization as analysis unit, improved by Cook and Brown (1999) on the scale of activity and reshaped in terms of collective action by Hatchuel (2000). One the other hand we use the work of Girin (1995 and 2000), forging the *organizational agencement* concept and proposing a theory of complexity forms. Merging those approaches leads us to propose to break the tacit dimension of knowledge regarding the way organizations manage their ignorance and involve a certain type of knowledge regarding the nature of its complexity. The results shed light on what we could named *tacit traps,* in contradiction with the idea of a tacit-explicit continuum, and allow to propose a conceptual framework for the researcher when dealing with knowledge as a tool for action.

Pushing forward this analysis, we discussed the consequences of our four tacit dimensions on the knowledge creation process. We proposed to reconsider Nonaka's spiral model in a systemic perspective and in the same way that occurred initially in DNA discovery, thanks of Rosalind Franklin works. We sustained that the knowledge creation process is far more a replication process, allowed by the double helix of knowledge structure. We argued this helix is composed by four elementary bricks (E-R-O-S model), arranged in pairs, following Hatchuel's inseparability theorem and adding a valency relation between Emotion and Object

as the other part of the helix linkage. This approach shed light on the central *mimesis* process occurring with different types of mutations that can explain new knowledge creation with different level of innovation.

REFERENCES

ARGYRIS C. and SCHON D. [1978], *Organizational learning: A Theory of action perspective*, Reading, Mass : Addison Wesley.

BARBIER J.-Y. [2004], « Situations de gestion, formes de complexité et explicitabilité des connaissances tacites. Les dimensions de la connaissance tacite. », *Conference Research Methods Division Academy of Management (USA) – ISEOR (Lyon), « Crossing frontiers in quantitative and qualitative research methods », Université Jean Moulin Lyon 3, March, 18-20*.

BARBIER J.-Y. [2005], "Breaking the tacit dimension : the double helix of knowledge creation", 6th International Conference on Organizational Learning an Knowledge, University of Trento, Italy, 9-11 June.

BAUMARD P. [1996], *Organisations déconcertées. La gestion stratégique de la connaissance*, Masson, Paris, 259 pages. (Traduction : *Tacit Knowledge in Organizations*, Sage, London, UK, 1999).

BERGSON H. [1938], *La pensée et le mouvant*, Quadrige, Paris.
BERTALANFFY (von) L [1993]., *General system theory*, (first edition 1968), Dunod.
COHEN M.D. [1991], Individual learning and organizational routine: emerging connections, *Organization Science*, Vol 2, n°1, February.

COOK S. D. N. and BROWN J. S. [1999], « Bridging epistemologies: The Generative Dance Between Organizational Knowledge and Organizational Knowing », *Organization Science*, vol.10, n°4, July-August, 381:400.

DAVID A. [2000], « La recherche-intervention, cadre général pour la recherche en management ?" in David A., Hatchuel A. et Laufer R., *Les nouvelles fondations des sciences de gestion*, Vuibert, Paris.

GHERARDHI S., NICOLINI D., ODELLA F. [1998], "Toward a Social Understanding of How People Learn in Organizations", *Management Learning*, 29, 3, 273:297.

GHERARDI S. [2001], "From organizational learning to practice-base knowing", *Human Relations*, 54,1, p. 131:139.

GIRIN J. [1995], "Les agencements organisationnels", in Charue-Duboc F. (ed.), *Des savoirs en action*, L'harmattan, Paris.

GIRIN J. [2000], « Management et complexité : comment importer en gestion un concept polysémique ? », 125 :140 *in* David A., Hatchuel A. et Laufer R. (ed.), *Les nouvelles fondations des sciences de gestion*, Vuibert, Paris.

HATCHUEL A., Weil B. [1992], *L'expert et le système*, Economica, Paris.

HATCHUEL A. [1994], « Apprentissages collectifs et activités de conception », *Revue Française de Gestion*, juin-juillet-août.

HATCHUEL A., [1994b], « Modèles de service et activités industrielles : la place de la prescription », in De Bandt J., Gadrey J., *Relations de service et marché des services*, Editions du CNRS, Paris.

HATCHUEL A. [2000], « Quel horizon pour les sciences de gestion ? Vers une théorie de l'action collective » *in* David A., Hatchuel A. et Laufer R., *Les nouvelles fondations des sciences de gestion*, Vuibert, Paris.

KIM D.H. [1993], The link between individual learning and organizational learning, *Sloan Management review*, 38:49.

KOGUT B., ZANDER U. [1992], « Knowledge of the firm, combinative capabilities and the replication of technology », Organization Science, 3 (3), 383:397.

LE BAS C. [1993], La firme et la nature de l'apprentissage, *in Economies et Sociétés, Série dynamique technologique et organisation*, W, n°1, 5, 7 :24.
LATOUR B. [1994], "Une sociologie sans objet ? Remarques sur l'interobjectivité", *Sociologie du Travail*, 4, pp. 587-606.

LEMOIGNE J.L. [1999], *La modélisation des systèmes complexes*, Dunod.
LEROY F. [1998], « L'apprentissage organisationnel, une revue critique de la littérature », *Acte de la VIIème conférence internationale de l'AIMS.*
LEVITT B., MARCH J. [1988], "Organizational learning", *Annual Review of sociology*, n°14, 1988, p 319-340.
LUSSATO B.[1992], *Introduction critique aux théories d'organisation*, (first edition 1977), Dunod.
MACK M. [1995], « L'organisation apprenante comme système de transformation de la connaissance en valeur », *Revue Française de Gestion*, September-October, 43 :48.
MARCH J.G., OLSEN J.P. [1976], Organizational learning and the ambiguity of the past. *Ambiguity and Choice in Organizations*. Universitetsforlaget, Oslo, Norway.
MARCH J.G. [1991], "Exploration and Exploitation in Organizational Learning", Organization Science, vol. 2, n° 1, February.

MILES M. B. et HUBERMAN A. M. [2003], *Analyse des données qualitatives*, De Boeck, Paris.

MORIN E.[1977], *La méthode, tome 1 : La nature de la nature*, Editions du seuil.
NEVIS E.C. et alii [1995], "Understanding organisations as learning systems", S*loan Management Review, Winter*, 73:84.

NONAKA I., [1994], « A Dynamic Theory of Organizational Knowledge Creation », *Organization Science*, vol. 5, no. 1, février.

NONAKA I. et TAKEUCHI H. [1995], *The Knowledge-Creating Company. How Japanese Companies Create the Dynamics of Innovation*, Oxford University Press, New-York.

PAULRE B. [1993], « Apprentissage et systémique, l'analyse du changement technique : entre préformisme et constructivisme », *in Economies et Sociétés, Série dynamique technologique et organisation*, W, n°1, 5,25 :61.
PIAGET J.[1959], *La naissance de l'intelligence chez l'enfant*, Neuchâtel, Editions Delachaux et Niestlé.

POLANYI M. [1967], *The Tacit Dimension*, Routledge&Kegan Paul, Londres.

REIX R. [1995], « Savoir tacite et savoir formalisé dans l'entreprise », *Revue Française de Gestion*, September-October, 17 :28.
ROJOT J. [2003], *Théorie des organisations*, Editions ESKA.
ROSNAY (de) J.[1975], *Le macroscope*, Editions du Seuil.
SCHEIN E.H.[1993], "How can organizations learn faster ?The challenge of entering the green room", *Sloan Management review, Winter, 85:92.*
SENGE P. [1990], *La cinquième discipline*, First.
SHRIVASTAVA P.[1993], "A typology of organizational learning systems", *Journal of management studies*, 20, 1.

SONNTAG M. [1996], « Mécanismes cognitifs de coordination des activités et conception de la formation », *Revue internationale de systémique*, vol 10, n°1-2, pp 39-56.

STENMARK D. [2002], "Information vs. Knowledge: The Role of intranets in Knowledge Management", *Proceedings of the 35th Hawaii International Conference on System Sciences.*

TSOUKAS H. [1994], « Refining common sense: types of knowledge in management studies », *Journal of Management Studies*, vol. 31, n° 6.

WEICK K [1998], " Improvisation as a Mindset for Organizational Analysis", *Organization Science*, vol. 9, n°5, p 543-555.