THE EMERGENCE OF PROJECT TEAM ORGANIZATION: TOWARDS A REDEFINITION OF ORGANIZATIONAL KNOWLEDGE

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ABSTRACT

The emergence of project team organization, as a way of structuring companies invites a redefinition of organizational knowledge. Based on a synthesis of the existing definitions of organizational knowledge, this paper puts forward a typology of the various forms assumed by organizational knowledge, integrating a distinction between functional knowledge and project knowledge.

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In a functional or matrix structure, fields of business, functions, and their extensions when dealing with activity centers (for example workshops or services), are perceived as the origins of improvement in a company's performance. This partitioning clearly defines territories, and it is on the results of these territories that each manager, whatever his or her hierarchical level, is evaluated. Such a structure results in individual territorial defense behavior, defined by the thorough knowledge of a particular subject which acts as a source of power, either through retaining or altering information, or by poor cooperation.

Within the framework of a process-based organization (the project quite simply being just a temporary process) in which the will of the customer (either internal or external) is included, a customer who is not concerned to what degree people are involved, but rather by the overall resulting performance, it is largely the cooperation and the coherence of the actions between these territories which is the source of value. Such a structure naturally gives rise to concerns about collective learning and synergies, which question the normal power territories. The value obtained by the customer is no longer the sum of the successes in the areas of competence and power of the successive functional managers, but the result of the quality of integrations obtained between activities.

By its very nature, project team organization is oriented towards action. The whole project is geared towards the completion of the objective it has been given by utilizing dedicated resources. Furthermore, the project, which by definition is of voluntarily limited duration and cost, and which forms a restricted organizational space, would appear to the potential place for reduced-scale experiments in terms of time, space and cost. It thus embodies a learning tool which allows the company to test the validity of certain proposed hypotheses.

The emergence of project team structures and the resulting questioning of company structure based on centers of competence - functions or fields of business - necessitates a new portrayal of organizational know-how taking into account this new company structure, that is to say, horizontal and action oriented. In effect, the fact that structures are put in place which allow inter-project capitalization of experience gained during projects, makes the need to answer the following question all the more pressing, that is to say: "What are we learning?" (i.e. through the various projects).

So, when characterization of organizational knowledge is discussed by those authors interested in organizational learning, it is treated in a secondary manner, be it through the study of the object of organizational learning, or through the study of the contents of organizational memory. The definitions of organizational knowledge, resulting from these angles, are reviewed. After that, suggestions on the definitions of organizational knowledge are extracted from contributions made by authors who have defined organizational knowledge utilizing distinctions which take into account the different forms that this knowledge can take (Weber, 1913; Nass, 1994; Nonaka, 1994; Bohn, 1994). The areas of computer programming language and artificial intelligence (knowledge modelization) will also be explored with the aim of eliciting a definition of knowledge compatible with its

necessary organizational dimension. Finally, this summary will integrate the distinction operated by B. Kogut and U. Zander (1992) between functional and project knowledge, leading to a typology of the various forms of organizational knowledge, taking into account the aspects of a project as a organizational unit of reference in a horizontal organization.

1. INFORMATION, KNOWLEDGE AND KNOW-HOW: A FIRST DISTINCTION

M. Weber (1913) was the first of the organizational theorists to distinguish two types of knowledge gained from experience: on the one hand, knowledge relating to facts, available in the form of documents, and on the other hand, technical expertise which allows those with the experience to adopt new processing rules thereby by legitimizing and facilitating the development and usage of them.

The same applies to C. Nass (1994), learning through experience produces two types of knowledge, knowledge and know-how, or skill. Knowledge relates to facts, rules, laws and procedures which are relatively formal and established within in an organization. Thus, knowledge is based upon the possession of rapidly elaborated information. As to know-how, it is based upon the ability to treat information gathered through practical learning (Katz 1982), and the ability to generate new procedures and new conclusions. So, with practice, managers would be able to develop new techniques allowing them to gather, manipulate and interpret information. This know-how, in contrast with knowledge as defined by C. Nass (1994) is more tacit.

Moreover, if the terms "information" and "knowledge" often appear interchangeable in their use, there exists a clear distinction between information and knowledge (Nonaka, 1994). According to F. Machlup (1983), information is the flow of messages or meanings which may be added together, restructured and thereby change knowledge. Information is the bearer of new meanings (Bateson, 1975). Thus, information is a flow of messages whereas knowledge is created and organized by this flow of information, established in commitment and personal beliefs. This definition of knowledge puts the accent on an essential aspect of knowledge relating to human behavior.

As for R. E. Bohn (1994), he operates a clear distinction between data, information and knowledge. Data are made up of elements coming directly from captors, and are relative to the defined level of any variable. Information consists of data organized into a given structure which, placed in context, has meaning. Information describes the present and past state of a given part of the production system (company, sector). Knowledge goes further; it makes it possible for predictions to be made, for links in causality to be established or for decisions to be taken regarding "What should be done?".

This question reverts back to one of the axes in the development of computer programming languages, the interface between the individual and the computer. The analysis of the development of these languages results in the operation of a new distinction.

2. PROCEDURAL KNOWLEDGE AND DECLARATIVE KNOWLEDGE: A CLASSIC DISTINCTION IN THE COMPUTER INDUSTRY

In the computer industry, the distinction between procedural knowledge and declarative knowledge is classic. It reverts back, originally, to a choice in the "philosophy" which controlled the development of programming languages (Jorion, 1991). The birth of the latter, during the fifties, corresponds to an exact stage in the evolution of hardware.

Previous to data processing, and before the advent of a permanent software program in the internal memory of the machine, programming of successive instructions which the machine had to follow was done by hand, in machine language, that is to say, using the binary code. This programming using machine language was extremely heavy going and the appearance of a permanent software program led to it being abandoned in general practice. The permanent software program loaded into the machine translated the language of the user into the language of the machine; this left just the programming languages to be defined.

The first stage was that of "low level" programming languages which simply represented, in a shortened manner, the standard sequels of the binary code. The second stage consisted in refining the programming languages to a "high level" (FORTRAN, LISP, etc.), today they form enormous families linked by their genealogy. From then on, a choice existed for defining these "high level" languages; either one had to stay as close as possible to the computer's own logic, that is to say machine language, at the same time as taking into account the requirements of human ergonomics, or one approached the matter, as far as possible, in a natural language - natural for humans, that is - without however losing sight of the machine's logic. The first tendency was called "procedural", because it advocated that one should try to "stick" as far as possible to instructing the machine directly (algorithms), compilation and intervention were minimal; the second tendency was called "declarative" due to the programmer limiting himself to "declaring" what he intended the computer what to do, in this case the compiler or the interpreter did considerable translation work into machine language.

The choice, be it procedural or declarative, became progressively decisive, not only in the conception of programming languages, but also, one the language had been determined, in the style of programming adopted within the internal limits imposed (Jorion 1991). In practice, when programming is actually carried out, the distinction is often summed up by bits of relevant advice, more precisely, concerning style. So, knowledge can be declarative (relative to the nature of the undertaking), procedural (relative to the means given to complete the task in an efficient manner), or both at the same time.

The aim of artificial intelligence is to create knowledge. The analysis of expert systems leads to a typology integrating different forms of know-how.

3. THE BENEFITS OF ARTIFICIAL INTELLIGENCE: AN ENLARGED DEFINITION OF KNOW-HOW

In their work on the development of expert systems implicating the modelization of companies' knowledge concerned by these systems, A. Hatchuel and B. Weil (1992) identify three main types of knowledge. They are individually identifiable by having a specific way of organizing and using knowledge; know-how, know-understand, and know-how to combine. These three forms of knowledge are all "know-how" in the sense of "know-by what means", a translation of the English "know-how".

Know-how (in the restricted sense used by the authors) is a type of knowledge which, at no matter what angle it is considered, describes the way in which certain transformations are obtained through known actions. Starting from the original and desired state of an objective, such knowledge allows the intermediate stages to be determined, allowing the passage from one state to another. Knowledge is thus linked to an accumulation of procedures which are known and which can be memorized. The multiplication of experiences can be organized into rules for working and a variety of situations can be resolved using the memory of acquired solutions.

Know-understand or the repairer's knowledge is more complex, and cannot be defined in a linear manner, in each case action and investigation are mixed in a constantly new way. It is no longer a question of mobilising the sum of the procedures, but resolving a problem to which one knows there is a solution. Know-understand cannot be definitely absolutely, it supposes the practical and social aspects of repairing or decision making are assembled simultaneously. In effect, the repairer has as many types of knowledge as ways of presenting a function and defining its perturbations. According to A. Hatchuel and B. Weil (1992), archivable expertise exists which allows a diagnosis to be made of the causes of disfunctioning.

On the other hand, know-how to combine must find an individual response for each situation, without being sure that such a response exists. It oversees the individual arrangement of tactics, that of prioritizing and compromising; it is the "moving universe of strategist" (Hatchuel & Weil, 1992). Strategy builds a continually renewed history from variable elements available to it and tries to balance these as best it can with its own interests. Two types of knowledge are therefore necessary. The first is easy to define; it relates to objects which form the basis of the plan whilst it is being drawn up: tasks to be completed, resources to be mobilized, objectives to be obtained. The second type of knowledge does not easily fit into a readily recognizable form: it concerns "the art of

combining, putting together, coordinating", and the types of knowledge to which this art refers.

A. Hatchuel and B. Weil (1992) note that all activity is necessarily part know-how, part know-understand and part know-how to combine and that when an analysis is made of repetitive work stations, the most common error is not paying enough attention to the skills of know-understand and know-how to combine. In effect, most employees, for whose positions, it is imagined, only require know-how limited to the operations that need to be carried out, become "repair persons" as soon as the environmental work conditions linked to the positions no longer conform to the originally foreseen plan; this happens in order to reduce the effects of these disturbances. Furthermore, to varying degrees, they turn out to be "strategists" simply because of the complexity of the missions they have to accomplish and according to the role in diverse negotiations that these missions assume. The expertise of the different members in the company will thus oscillate between the different types of knowledge mentioned.

The analysis of organizational memory in terms of contents offers another perspective.

4. ORGANIZATIONAL MEMORY AND ORGANIZATIONAL KNOW-HOW : CHARACTERIZATION OF MEMORIZED INFORMATION.

By its very functioning, organization leans towards a system of processing information gathered from its surrounding. Organizational memory is a construction made up of a structured storage capacity as well as a process for memorization based on the existence of three stages:

- a phase during which knowledge is obtained, and in which the following play a key role: the arrival of new individuals into the company, personal and collective learning, and in a more general way, the attention which is paid to internal and external elements by the company;
- a "retaining" or "storage" phase which functions by means of retaining structures which are said to make up organizational memory (Weick, 1979) through which information can be filtered and encoded, and
- a restorative phase which involves the localization of knowledge in the company and which can be affected by an omission, be it involuntary or voluntary.

Organizational memory is made up principally of information concerning decisions made and problems resolved (Walsh & Ungson, 1991). Stored information relates to a stimulus or an event, originating from the surroundings, which require a response by the company, and also relates to the response itself. Information can be perceived globally and characterized through the questions "Who?", "What?", "When?", "Where?", "Why?" and "How?". According to J. Walsh and G. Ungson (1991), understanding of "Why?" requires

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environmental stimulus, organizational response and both properties of the two dimensions of knowledge, to be taken into account simultaneously.

Organizational knowledge may therefore be defined as information related to environmental stimuli and to the organizational responses which are consequently generated, according to the double sequence "What?"-"How?".

Furthermore, the debate on the definition of organizational learning as a process is not neutral regarding the definition of the object of this learning (i.e. organization knowledge).

5. COGNITIVE LEARNING AND BEHAVIORAL LEARNING : DIFFERENT OBJECTS

The cognitive and behavioral approaches towards organizational learning differ from one another in the link between organizational learning and the change in the organization itself (Leroy & Ramanantsoa, 1996). In effect, the cognitive approach of organizational learning dissociates the evolution of knowledge and the change in the organization, and forms a necessary but insufficient preliminary on organizational change (Duncan & Weiss, 1978; Huber, 1991). But these two approaches to organizational learning also differ regarding the object of learning (What is one learning?).

Thus, for the supporters of the first approach, organizational learning may be defined as the process by which the organization develops a certain knowledge relating to the links of causality between actions taken and results, and the effects of the environment on these relationships (Duncan & Weiss, 1978). So whilst individual learning entails almost permanent changes in the behavior of the individual, organizational learning brings about the development of a knowledge base which makes change possible (Shrivastava, 1983). This knowledge, which is a result of the process of learning, can be shared by the members of the organization, is generally agreed upon and is integrated into the procedures and structures of the organization. Here, knowledge is defined as the entirety of the relations of causality linking organizational actions and results, relations which convey the meaning of "Why?".

Cognitive learning may have as its object knowledge qualified by declaratives (Kogut & Zander, 1992), which would then correspond to what D. H. Kim (1993) calls conceptual learning. This knowledge may be explicit, or at least, in so far as it concerns representation, be made clear by externalisation (Nonaka, 1994), that is to say a codification which allows the crossing over from tacit to explicit. Cognitive learning can also have as its object the understanding of reasons or "know why" (*Learning Why*, Kim, 1993).

Believers in the behavioral approach to organizational learning, themselves define the organization as a body of standard procedures which guide its behavior (Cyert & March, 1963). For the evolutionists, routines result from a process of learning (Levitt & March,

1988, Nelson & Winter, 1982). These routines are the manifestation of tools integrated by the company, which allow it to respond to stimuli coming from the surroundings. They have been built up through learning realized during the history of the company and which allows appropriate responses to be made to new stimuli by employing an analogy of situations already encountered. Well entrenched in the organizational past, it appears difficult to make changes to routines, and so these changes are made by a process of adjusting procedures and management systems, either through the addition of new routines (Levitt & March, 1988), or by a crisis occurring which leads to their eradication (Hedberg, 1981).

Within the organization, behavioral learning involves routines, procedures, practices, know-how and know-how to be. So, the behavioral characteristic of learning is connected to the degree of tacitness contained in these elements (Winter, 1987; Cohen & Bacdayan, 1994). The modalities of learning - practice, repetition, imitation, socialization - are functions of the details of the learning.

So, on the one hand, behavioral learning may have as its object, knowledge qualified by procedures (Kogut & Zander, 1992), and on the other hand, it may be knowledge which is essentially tacit in nature (Ingham, 1994), hard to define or difficult to express, but nevertheless possible to teach (Winter, 1987) through practical participation by the employees involved in the learning process (Ingham, 1994).

The first type of knowledge refers to what D. H. Kim (1993) called operational learning and related to "How?". This knowledge, formalized and set out in user guides or procedural manuals, is thus of an explicit nature.

The second type of knowledge can be more individual: it is the knack acquired and integrated by an experienced person. In this case, learning is done through a process of internalisation (Nonaka, 1994), resulting in a process repeated and constantly corrected, transforming explicit knowledge into tacit knowledge. The tacit knowledge can also be collective and related back to "Know- how to behave" in the organization. Behavioral learning therefore happens through the employee taking part in a community of interactions and refers to what I. Nonaka (1994) calls socialization.

6. PROPOSAL FOR A CLASSIFICATION OF DIFFERENT TYPES OF KNOWLEDGE

The preceding developments lead to an analysis of organizational knowledge along two dimensions: a first dimension concerning the type of learning which generated the knowledge, a second dimension which would relate to the type of knowledge acquired.

The first dimension could thus contrast with cognitive learning (Duncan & Weiss, 1979; Fiol & Lyles, 1985; Huber, 1991) and behavioral learning (Cyert & March, 1963, Nelson &

Winter, 1982; Starbuck, 1983; Levitt & March, 1988). The second dimension could concern the distinction proposed by M. Polanyi (1966) between tacit knowledge and explicit knowledge, a distinction considered again by certain authors to characterize the various types of knowledge (Winter, 1987; Nass, 1994; Nonaka, 1994).

The intersection of these two dimensions leads to a characterization of the various types of knowledge according to their object "What?", "Why?" and "How?", represented in the following matrix.

Table 1
Classification of Organizational Knowledge

2nd dimension	1st dimension	
	Cognitive Learning	**Behavorial Learning**
Explicit Knowledge	Déclarative or Conceptual Knowledge *WHAT ?*	Procedural or Operational Knowledge *HOW ?*
Tacite Knowledge	Know-why *WHY ?*	Know-how & Know-how to behave *HOW ?*

7. INTRODUCTION OF THE PROJECT DIMENSION WHEN CLASSIFYING KNOWLEDGE

Taking up the distinction used in the field of artificial intelligence between declarative knowledge and procedural knowledge, B. Kogut & U. Zander (1992) propose a categorization of organizational knowledge taking into account a distinction between information and know-how. Thus defined, information encompasses a description of facts, axiomatic proposals and symbols.

Using the definition proposed by E. Von Hipel (1988), B. Kogut & U. Zander define know-how as "accumulated expertise or practical competence which allow an individual to do something easily and efficiently". This definition stresses the accumulative characteristic of know-how implying that it must be learnt and acquired.

Whilst knowledge, as information, contains the knowledge relative to knowing what something means, knowledge, as know-how, as the term itself suggests, consists of a description of how to do something.

Although this description appears as a fundamental element in the analysis of organizational knowledge, further to those of J. March and H. Simon (1958) and Cyert and J. March

(1963), many works have tried to expand the notion of routines in the context of organizational learning. However, B. Kogut and U. Zander (1992) affirm that routine is not an adequate unit of analysis. In effect, a routine is a rich but incomplete characterization of organizational knowledge. The widespread use of the term routine in literature (Nelson & Winter, 1982; Hannan & Freeman, 1987; March & Simon, 1958) has given rise to an analogy between routines and outlines. But this outline would seem to describe what B. Kogut & U. Zander (1992) call information rather than know-how as they have defined it. To use a metaphor, these authors liken knowledge to a recipe, which contains no substance except the capacity to produce the desired end product, and comparing information to a list of ingredients. This distinction between information and know-how can be likened to that used, in the field of computer processing language, between declared knowledge and procedural knowledge. Declared knowledge is made up of a descriptive summary of a given fact. Procedural knowledge, on the other hand, is made up of a descriptive summary of a practice or process.

Furthermore, B. Kogut & U. Zander (1992, p.398) operate a second distinction between the knowledge acquired by the project employees assigned to the project by different functional divisions in a company, and that knowledge gained by the project team as a whole. By superposing this second distinction on to the first, the knowledge acquired by the functional employees committed to the project can be divided into two categories. The first category of knowledge is information gathered during the project by the employees according to their individual specialties. The second category is knowledge of the types of know-how developed during the project by the employees which enable them to solve problems or accomplish the tasks set according to their specialization.

According to the same classification, the knowledge acquired by the project team, which will now be called project knowledge may be put into two categories. The first category of knowledge if the information acquired relating to the retaining and sharing of information by the employees or the knowledge of "who knows what". The second category regroups the various types of know-how relative to managing the project.

Table 2
Classification proposed by B. Kogut & U. Zander (1992)

	Functional Knowledge	**Project Knowledge**
Information	Functional Information	Who knows what
Know-How	Functional Know-how	Project Know-how

This classification is reviewed and refined using the characterization of the types of organizational knowledge previously described. Two distinctions are introduced, the first between declarative or conceptual knowledge, and more tacit knowledge, know-why representing the links of causality between actions and results; and the second between procedural knowledge or mainly explicit operational knowledge and essentially tacit

knowledge, the know-how here being understood in the larger sense of know "by what means" (Hatchuel & Weil, 1992).

Table 3
Proposal of classification of organizational knowledge

		Functional Knowledge	Project Knowledge
UNDERSTANDING	**Conceptual or Declarative Knowledge (Explicit)**	Functional Information (1)	« Who knows what » (3)
	Know-Why (Tacit)	Representations « function » of the links of causality actions-results (2)	Representation of the « correct » project (4)
ACTION	**Procedural or Operational Knowledge (Explicit)**	Functional Procedures (5)	Project Procedures (7)
	Know-How or Know-How to Do (Tacit)	Specialized Know-How (6)	Integration Know-How (8)

(1)   Information gathered, during the project, by the authors in their respective areas of specialization E.g.. Marketing executives will acquire information relative to the firm's market thanks to the marketing studies carried out for a project.

(2)   Elements of functional culture which contribute to the full understanding of the business, which guide the action and explain "What should be done".

(3)   Knowledge relative to the keeping or sharing of necessary information and know-how in order to complete the tasks required by the project or the knowledge of "Who knows what?". This type of knowledge is particularly pertinent when the project team is being formed or when, during a project, intervention is required by experts working outside the project or even those within the firm itself.

(4)   Elements of "project" culture which contribute to an understanding of the actual project tasks, and which direct the action and explain "What should be done?"

(5)   The particular procedures, methods and techniques specific to each function and

implementation required for performing associated tasks relevant to their specialty.

(6)   Knowledge which is transferable but undefinable the individual ability of experts to resolve problems and to accomplish tasks pertinent to their skills. Acceptance of know-how in the larger sense of know "by what means" which includes know-how, the knowledge of understanding and knowing how to integrate (Hatchuel & Weil, 1992).

(7)   Procedures, methods and techniques particular to the management of the project (cost, time and quality management tools).

(8)   The removal of boundaries between skills and functions, necessitated by operating transversally, calls for the development of types of knowledge which are not functional, but rather specific areas of knowledge regarding integration developed to manage the coordination of functions: the ability to form and operate the networks, develop the communication languages used between different specializations, ensure information circulates, develop a culture of cooperation, define methods for managing individual's careers which are compatible with the objective of integrating, identify coordination needs, put in place synchronization procedures, favor creativity by cross-fertilization, define respective roles and, if necessary, rearticulate, acquire and diffuse the types of know-how involved in inter-functional activity, investigation and diagnosis, problem structuralization, and the definition of arbitration procedures (Lorino, 1995). These areas of integrational knowledge are the various types of know-how connected with project management.

This classification of organizational know-how is the result of an initial synthesis of definitions of organizational know-how. It takes into account the emergence of a new dimension in company structure - the horizontal structure, the project - making a distinction between skill oriented and project oriented knowledge.

An empirical validation of this classification will be the object of further research. To this end, new product development projects will constitute a preferred study objective. In effect, on the one hand, these projects will concern and associate skills and functions within a company considered together, and on the other hand, they will form a privileged learning and experimentation platform (Carlsson & *al.*, 1976).

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