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The Dimensions of Knowledge Sharing

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Abstract –

Many authors have come to realize that knowledge management is the key to organizational performance and survival in continuously changing economic, technological, political, and social environment. Knowledge sharing is among the main activities of the knowledge management process. Indeed, due to the division of labor and accompanying fragmentation, specialization, and distribution of knowledge, organizations create permanent or temporary units – called organizational settings – in order to achieve collective goals such as products and services development and delivery. Organizational settings are composed of organizational actors with complementary knowledge, who need to share knowledge since they can't achieve a collective outcome individually. Therefore knowledge sharing is required either within or between organizational settings so that organizations remain productive and competitive and reach their objectives Nevertheless, as experienced by many organizations, knowledge sharing is difficult to take place in practice, whatever the strategy followed. We think that there is no silver bullet to solve the knowledge sharing problem within modern organizations. Knowledge sharing is a situated process whose improvement depends on the characteristics of organizations. In this paper, we propose a framework which identifies the main aspects of knowledge sharing – called knowledge sharing dimensions – on which it is possible to act in order to improve the knowledge sharing process.

Keywords: knowledge, knowledge management, knowledge sharing; knowledge sharing dimension

1 INTRODUCTION

As stressed by many academics and practitioners, knowledge is the source for competitive advantage in modern organizations. For instance, (Drucker, 2002) notes that "the next society will be the knowledge society. Knowledge will be its key resource, and knowledge workers will be the dominant group in its workforce". In line with the conclusions of (Drucker, 2002), (Grant, 1996) states that, "the firm is conceptualized as an institution for integrating knowledge". These authors have come to realize that knowledge management is the key to organizational performance and survival in continuously changing economic, technological, political, and social environment (Leonard & Swap, 2004) (Goh, 2002). Knowledge sharing is among the main activities of the knowledge management process. On the one hand, many academics and practitioners have demonstrated that knowledge sharing is positively related to reductions in production costs, faster completion of new product development projects, team performance, firm innovation capabilities, and competitive advantage (Wang & Noe, 2010) (Mesmer-Magnus et al., 2009) (Lin, 2007). The potential benefits of knowledge sharing have encouraged many organizations to invest heavily into knowledge management initiatives including the development of knowledge management systems which use state-of-the-art technology to facilitate the collection, storage, and distribution of knowledge. On the other hand, knowledge sharing is a necessity. Indeed, due to the division of labour and accompanying fragmentation, specialization, and distribution of knowledge, organizations create permanent or temporary units – called organizational settings – in order to achieve collective goals such as products and services development and delivery. Project teams are examples of organizational settings. Organizational settings are composed of organizational actors with complementary knowledge, who need to share knowledge since they can't achieve a collective outcome individually. Therefore knowledge sharing is required either within or between organizational settings so that organizations remain productive and competitive, and reach their objectives. Nevertheless, as experienced by many organizations, knowledge sharing is difficult to take place in practice, regardless whatever the strategy followed (Hansen, 2002). For example, despite the considerable investments in knowledge management, it has been estimated that at least $31.5 billion are lost per year by Fortune 500 companies as a result of failing to share knowledge (Babcock, 2004). We think that there is no silver bullet to solve the knowledge sharing problem within modern organizations. Knowledge sharing is a situated process whose improvement depends on the very characteristics of organizations. In this paper, we propose a framework which identifies the main organizations aspects – called knowledge sharing dimensions – on which it is possible to act in order to improve the knowledge sharing process. Our paper is organized as follows. Section 2 defines the ramifications of knowledge i.e. the concepts of data, knowledge. In section 3, we present the knowledge management process and identify its main characteristics. Section 4 is dedicated to the presentation of the main findings identified in the literature regarding knowledge sharing, and the causes of failure of implementing knowledge sharing strategies in modern organizations. Section 5 presents our theoretical framework. In this section, based on an analysis of the complexity of the knowledge sharing process, we deduce the knowledge sharing dimensions. In section 6, we conclude this paper and list the future research directions.

2 THE RAMIFICATIONS OF KNOWLEDGE

The ramifications of knowledge include three main concepts: data, information, knowledge. In this section, we define these three concepts and explain their relationships.

While many authors agree on definitions of the data and information concepts, the definition of the knowledge concept raises many discrepancies and debates between researchers. Indeed, according to most authors, data is a sequence of signs, numbers, and letters while information results from the application of an interpretation model to data. A single data may be associated with many types of information due to the application of many interpretation models to it. For example, "10121965" is data which may represent many facts, assertions or perceptions. Information is data with semantics i.e. data associated with an interpretation model which reflects the context of creation and use. Information involves manipulation of raw data. Often, information can be used to obtain a more meaningful indication of trends or patterns For example, if a "dd.mm.aaaa" French model of date is

used as a model of interpretation, 10121965 means December 10, 1965. In contrast, if an "mm.dd.aaaa" English model of date is used as a model of interpretation, 10121965 means October 12, 1965.

Many definitions of knowledge have been proposed in the literature. Instead of listing these definitions, we propose to summarize them using a classification based on four perspectives. The first perspective considers knowledge as an integral object self-sufficient and independent of human beings and organizational context. According to (Nonaka, 1994), this perspective refers to knowledge as a "justified true belief" that can be codified and separated from the minds of people. (Alavi & Leidner, 1998) note that knowledge described by this perspective may be considered as information. The second perspective defines assumes that knowledge is embedded in the minds of people who know and convert their knowing into action (Polanyir, 1967). This perspective stresses that information is converted into knowledge through people's acts of thinking (McDermott, 1999). A third perspective, which focuses on the social facet of knowledge is gaining popularity among academics and practitioners. Authors belonging to this school of thought define knowledge as "the social practice of knowing" i.e. knowledge is embedded in a community rather than just in one individual. According to this perspective, knowledge is highly context dependent (Blackler, 1995) (Wenger, 1998). The three perspectives of knowledge listed above are based on (Wasko & Faraj, 2005). Other authors have proposed similar classifications of knowledge. For example, For example, (Hedlund & Nonaka, 2005) note that knowledge has three facets: stock facet, flow facet, and interactions facet. The stock facet is associated with knowledge storage while the flow facet refers to knowledge transfer. Finally, the interactions facet focuses on knowledge transformation. From Alavi and Leidner's point of view, there are five perspectives on knowledge: knowledge as the state of knowing and understanding, knowledge as an object to be stored and manipulated, knowledge as a process of applying expertise, knowledge as a condition of access to information, and knowledge as the potential to influence action (Alavi & Leidner, 1998). Whatever the perspective taken into account, knowledge has many characteristics. It is an asset vs. a process, explicit vs. tacit, and individual vs. organizational. In particular, as emphasized by (Connell et al., 2003), explicit knowledge is "knowing about" while tacit knowledge, on the other hand, is "knowing how" and includes insights, intuition, and hunches – which are often built by experience and difficult to formalize and share. Sharing explicit knowledge within an organization is a relatively common occurrence which takes place through the exchange of written or oral documents. On the other hand, sharing tacit knowledge takes place at two levels: individual, and organizational. At the individual level, tacit knowledge needs to be externalized i.e. partially converted into explicit knowledge. At the organizational level, externalized tacit knowledge is socialized i.e. exchanged between many organizational actors. Whatever the type of knowledge, a common language is necessary in order for sharing it to take place.

3 THE KNOWLEDGE MANAGEMENT PROCESS

Knowledge management is difficult to define. Firstly, the word knowledge means different things to different people (Malhotra, 1998). Secondly, some researchers focus on the management of individual knowledge, while others are interested in knowledge management at the communities or corporate levels. For example, (Dennis & Vessey, 2005) use the agency and transaction cost economic theories to distinguish three knowledge management strategies: knowledge hierarchies, knowledge markets, and knowledge communities. Thirdly, the multiplicity of typologies of knowledge may be misleading. Lastly, the difficulty of defining knowledge management is partly due to the nature of knowledge which is both complex and intangible. For these reasons, many definitions of knowledge management, sometimes contradictory, have been proposed in recent decades. Despite their differences, these definitions have many similarities. On the one hand, the proposed definitions view knowledge management as the vehicle for organizational performance. On the other hand, they focus on knowledge and information which are often considered synonymous. Finally, many well-established definitions are not based on a multidisciplinary approach (McAdam & McCreedy, 1999).

Defined broadly, "Knowledge Management is the process through which organizations extract value from their intellectual assets". By adopting this belief of Knowledge Management, the following definition, proposed by (Stenmark, 2001) of Knowledge Management is suitable. According to this

author, knowledge management has two dimensions. One dimension consists in managing existing knowledge, which includes developing of knowledge repositories (memos, reports, presentations and articles), knowledge compilation, arrangement and categorization. The second dimension is to manage knowledge-specific activities, that is, knowledge acquisition, creation, distribution, communication, sharing and application. In other words, knowledge management consists of the administration of knowledge assets of an organization and the, sharing and enlargement of those assets. It often encompasses identifying and mapping intellectual assets within an organization, generating new knowledge for competitive advantage, and making vast amounts information accessible, considering and enabling all of the above. Knowledge management involves the panoply of procedures and techniques used to get the most from an organization's tacit and codified know-how (Teece, 2000). While defined in many different ways, knowledge management generally refers to how organizations create, retain, and share knowledge (Argote et al., 1999) (Huber, 1991). These authors note that the goal of knowledge management is to define how an organization adapts to changing conditions in order to survive, in the same way that animal and plant species change over time to adapt to changing conditions, unsuccessful firms die off or are swallowed up by more successful competitors. The next section is dedicated to the study of knowledge sharing which is among the most critical activities of the knowledge management process.

4 KNOWLEDGE SHARING IN ORGANIZATIONS: THE MAIN FINDINGS AND THE CAUSES OF FAILURE

In this section, we present the main findings regarding knowledge sharing and try to explain why the implementation of strategies for sharing knowledge in organizations has often failed.

3.1 The findings of the literature on knowledge sharing

The study of knowledge sharing has emerged as a key research area from a broad and deep field of study on technology transfer and innovation, and more recently from the field of strategic management. This activity aims at defining and providing the means by which an organization obtains access to its own and other organizations knowledge. In other words, knowledge sharing consists in communicating explicit or tacit knowledge to other individuals, and results in effective transfer and understanding of knowledge to recipients who are individuals or groups. According to (Cummings, 2004) and (Pulakos et al., 2003), knowledge sharing refers to the provision of task information and know-how to help others and to collaborate with others to solve problems, develop new ideas, or implement policies or procedures. These authors stress that knowledge sharing can occur via written correspondence or face-to-face communications through networking with other experts, or documenting, organizing and capturing knowledge for others. (Jackson et al., 2006) point out that knowledge sharing is the fundamental means through which employees can contribute to knowledge application, innovation, and ultimately the competitive advantage of the organization. (Cabrera & Cabrera, 2005), (Damodaran & Olphert, 2000), and (Davenport & Prusak, 2000) confirm these findings by emphasizing that knowledge sharing between organizational actors and within and across teams allows organizations to exploit and capitalize on knowledge-based resources. However, the need for sharing knowledge varies from one organization to another. Since communication is the fundamental activity through which social interaction is accomplished, many authors haves addressed the need for knowledge sharing as a need for communication. For example, the information processing theory developed by (Galbraith, 1973) interprets organizations as information processing networks. According to this author, the goal of organizations is the management of complexity resulting from the diversity of the input and the output, and the level of difficulty of an objective or performance. Moreover, the complexity inherent in organizations is often accompanied by uncertainty that must be reduced in two ways. The first way consists in reducing the need for information processing through the creation of slack resources and self-contained tasks. The second way recommends the organization's capacity of information processing through the investment in vertical information systems and the creation of lateral relations. Other authors consider that communication and

information processing are not well adapted to all needs of sharing knowledge. For example, (Carlile, 2002), (Carlile, 2004), and (Carlile & Rebentisch, 2003) introduced the concept of boundary objects to facilitate knowledge sharing in situations characterized by innovation, unstable relationships, and conflicting interests between organizational actors.

Knowledge sharing is based on two tasks: socialization and exchange. Knowledge exchange is similar to information exchange and consists in transferring or communicating explicit knowledge between individuals, groups, or organizations. Knowledge exchange is similar to the information exchange. For example, transferring a software design guide by a developer to another developer is an exchange task since knowledge contained in the software design guide is explicit. Increasingly, knowledge sharing focuses on issues other than communication between a supplier and a receiver of knowledge.

Drawing on a literature review, (Wang & Noe, 2010) have identified five primary contexts that can affect knowledge-sharing, including the relationships between the provider and the receiver of knowledge, the knowledge form and location, the knowledge receiver learning predisposition, the knowledge provider sharing capability, and the broader environment in which the sharing occurs. These authors suggest three types of knowledge sharing activities to be evaluated, which include:

- the analyzes of the knowledge form and location,
- the agreements, engagement rules, and managerial practices adopted by the organizational actors,
- and the specific knowledge-sharing activities used.

The framework proposed by (Wang & Noe, 2010) organizes knowledge sharing in six areas of emphasis which cover organizational context, interpersonal and team characteristics, cultural characteristics, individual characteristics, motivational factors, and organizational structure. Each area of emphasis consists of related topics. In particular, organizational context includes organizational culture and climate, management support, rewards and incentives. Interpersonal and team characteristics include team characteristics and processes, diversity, and social networks. Motivational factors refer to beliefs of knowledge ownership, perceived benefits and costs, interpersonal trust and justice, and individual attitudes.

We conclude this section by highlighting three facets of knowledge sharing. On the one hand, knowledge sharing may be analyzed as a social process through which organizational actors use diverse combinations of signs and artifacts to establish a shared understanding about reality in order to transform this understanding into collaborative actions which yield performance. On the other hand, knowledge sharing is believed to connect communication with learning, and may be considered as an area where communication overlaps with learning. Finally, knowledge sharing is a situated process for the followings reasons. First, knowledge is embedded in a social practice of knowing of a particular organizational setting. Second, knowledge sharing is a social process that takes place within relationships. Third, since organizations may be considered as distributed knowledge systems, the organizational setting where knowledge sharing takes place should be taken into account. Fourth, knowledge sharing is temporal i.e. while sharing knowledge, organizations must take into account what has been shared before, and what might be shared in future.

3.2 The failure causes of knowledge sharing strategies implementation

(Carter & Scarbrough, 2001) and (Voelpel et al., 2005) note that an important reason for the failure of knowledge management systems to facilitate knowledge sharing is the lack of consideration of how the organizational context, interpersonal relationships, and individual characteristics influence on knowledge sharing. In other words, the lack of knowledge sharing is due to non compliance with numerous conditions identified in the literature. These conditions are related to the characteristics of knowledge, knowledge provider, knowledge receiver, relationships between organizational actors, and organizational context. Explicitness and tacitness are among the main characteristics of knowledge which impact knowledge sharing (Boisot, 1998) (Szulanski, 1996). The characteristics of the knowledge provider include his workload and motivation (Huber, 1991) while the characteristics of knowledge receiver reflect notably his absorptive capacity (Cohen & Levinthali, 1990) (Lane & Lubatkin, 1998). Trust and shared language are among the most important characteristics of the relationships between knowledge provider and receiver (Andrews & Delahaye, 2000). Organizational

context characteristics include organizational culture, incentives, and information and communication technologies dedicated to knowledge sharing support. We think that, apart from the factors listed above, three additional factors are behind the failure of the implementation of knowledge sharing strategies in modern organizations. Firstly, as stressed above, the need for sharing knowledge varies from one organization to another. For example, if the relationships between organizational actors are stable, knowledge transfer based on information processing may be sufficient. However, this strategy of knowledge sharing is not appropriate if the relationships between organizational actors are unstable, or if these actors cooperate in a virtual organization. Therefore, not taking into account the variability of organizations needs for knowledge sharing is a cause of failure of knowledge sharing strategies. Secondly, if an organizational actor is not aware that his knowing can be of interest to other organizational actors, or if he is not aware of his lack of knowing, knowledge sharing cannot take place effectively. Finally, not understanding the motivation of organizational actors to share knowledge is another cause behind the failure of knowledge sharing strategies. Indeed, a uniform view of organizational actors' motivations to share knowledge doesn't help managers in determining effective actions to encourage knowledge sharing between these actors.

5 THE THEORETICAL FRAMEWORK

In this paper, we use the term dimension to refer to a crucial aspect of an artifact or a process. The identification of the dimensions of the knowledge sharing process aims at facilitating the determination of policy instruments to improve this process. However, the determination of the knowledge sharing is challenging due to the complexity inherent in this process. We think that the effective management of the knowledge sharing requires a preliminary analysis of this process. Thus, prior to the presentation of the knowledge sharing dimensions, we analyze its complexity.

5.1 The knowledge sharing complexity

The knowledge sharing process embeds two types of complexity: structural complexity, and systemic complexity. The structural complexity usually results either from the structure of organizations and organizational settings, or from the amount of explicit knowledge to be shared. Such a complexity is associated with the static facet of knowledge sharing and affects both the structure of the knowledge sharing process (number of tasks, implementation infrastructure, organizational actors involved,…) and the structure of the knowledge to be shared (types of knowledge, sources of knowledge, codification, storage, provision,…). The structural complexity inherent in knowledge may be illustrated by Figure 1 based on the Leavitt's model of organizations (Leavitt, 1963) (Stohr & Konsynski, 1992). Based on this diagram, we deduce that organizational knowledge resides either in the organization's components (strategy, culture, structure, people, tasks, production technology, information technology, or in the interactions between these components, or in goods and services it produces. Moreover, organizational knowledge is issued either from organization's components or from organization's external environment.

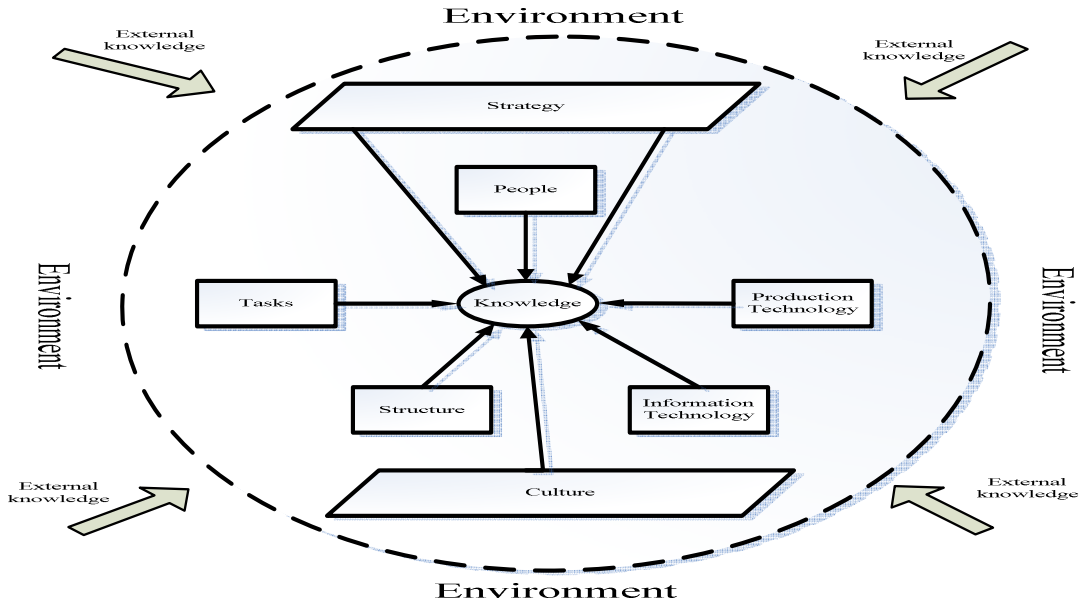

Figure 1. The structural complexity of organizational knowledge

The systemic complexity results from interactions between the parties involved in knowledge sharing. These include both the sources and the recipients of knowledge, and the media supporting knowledge sharing. The problems related to cultural differences, or lack of trust between organizational actors, are examples that illustrate the systemic complexity of knowledge sharing. The systemic complexity is associated with the dynamic facet of knowledge sharing. The two types of complexity are intertwined and influence each other. Therefore, to solve the different problems encountered while sharing knowledge in modern organizations, a systemic analysis, based on modeling the knowledge sharing process using levels of abstraction, should be done. We distinguish four abstraction levels which characterize the complexity of the knowledge sharing process. Each abstraction level is associated with a set of questions. First, the conceptual level of abstraction is about the knowledge to be shared and permits answering the "WHAT?". Second, the organizational level of abstraction concerns the organizational context in which knowledge sharing takes place, and the organizational actors involved in this process. This abstraction level is associated with the "WHO?", "WHERE?", and "WHEN?" questions. Third, the logical level of abstraction describes the solutions adopted to share knowledge, and permits answering the "WITH WHAT?" question. Boundary objects, and communities of practice are examples of such solutions. Finally, the physical level of abstraction concerns the tools used to share knowledge in an organization. Such tools include knowledge repositories, intranets, messaging software, Web 2.0 applications, and audio and video conference infrastructures. The physical level of abstraction is associated to the "HOW?" question. In this analysis, each level of abstraction is a model of the level of the level abstraction immediately below. The four abstraction levels of knowledge sharing are interdependent since apart from the conceptual level, each level of abstraction is a projection of the level of abstraction immediately above. The conceptual level of abstraction is a projection of the organization strategy, global characteristics, and external constraints. Figure 2 illustrates the four abstraction levels of knowledge sharing.

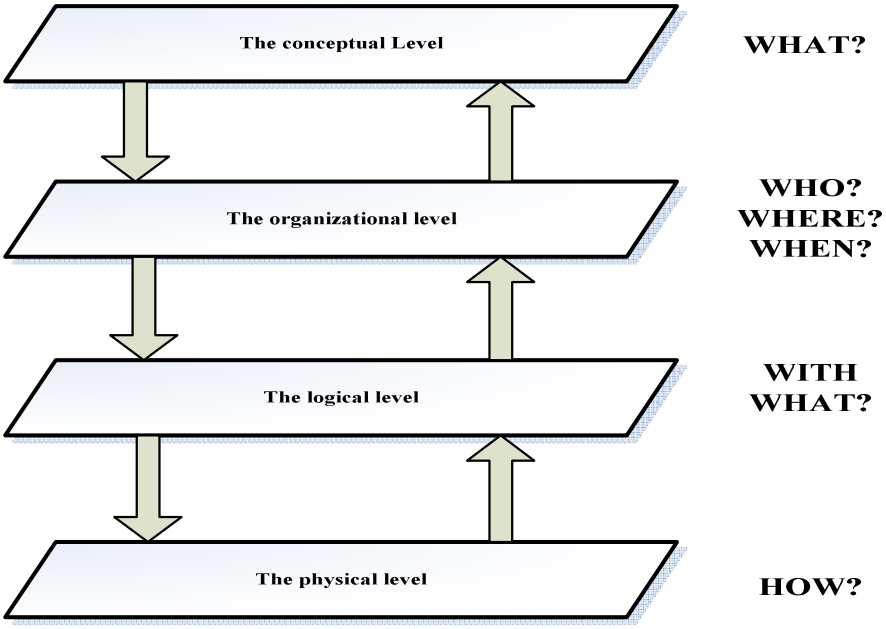

Figure 2. The systemic complexity of knowledge sharing

5.2 The knowledge sharing dimensions

We note that systemic view of the knowledge sharing activity in organizations reflects both the systemic complexity and the structural complexity of knowledge sharing. Indeed, each abstraction level is characterized by a set of concepts which constitutes resources to describe – at this level - either the knowledge sharing process or the knowledge to be shared. Therefore, each abstraction level helps understand and control both the structural and the systemic knowledge sharing complexities. This is why we use the four abstraction levels described above to identify the knowledge sharing dimensions. To do this, we associate to each knowledge sharing level of abstraction a set of dimensions which characterize it. The conceptual abstraction level focuses on the nature of the organizational knowledge. Sharing knowledge depends on its degree of articulation, its degree of specialization, and on the diversity of its sources. Therefore, the conceptual abstraction level of knowledge sharing is characterized by three knowledge sharing dimensions: the degree of knowledge articulation, the degree of knowledge specialization, and the diversity of knowledge sources. The organizational abstraction level takes into account the organizational actors involved in knowledge sharing, as well as the organizational context in which this activity takes place. In particular, sharing knowledge depends on organizational actors' characteristics, organizational context characteristics, and social climate characteristics. On the one hand, the organizational actors' characteristics include the characteristics of the knowledge provider (national culture, workload, awareness, motivation,…), and the characteristics of the knowledge receiver (national culture, absorptive capacity, awareness,…). On the other hand, the characteristics of the organizational context refer to the situated nature of the knowledge sharing process. They include the organizational culture, the professional culture, the management support and involvement, the management practices, the working language, and the geographical dispersion, etc. Finally, the characteristics of the social climate are about the relationships between organizational actors involved in the knowledge sharing process. These characteristics, which take into account the social nature of the knowledge sharing processes, include trust and shared language (Wenger, 1998). Consequently, the organizational abstraction level of knowledge sharing is associated with four knowledge sharing dimensions: the individual dimension, the social dimension, the managerial dimension, the cultural dimension, and the structural dimension. The logical abstraction level describes the solutions adopted by organizations in order to facilitate knowledge sharing. Such solutions are related either to teams organizing (creation of communities of practice and discussion forums, workshops,…), or to communication campaigns, or to the establishment of incentives and rewards systems. It follows that the logical abstraction level of knowledge sharing is associated with

three knowledge sharing dimensions: the work organizing dimension, the incentives and rewards dimension, and the communication dimension. The physical abstraction level describes how is implemented the knowledge sharing process within organizations. It refers to the logistic and technological resources mobilized to carry out this process. These resources belong to three categories: communication resources, physical resources, and monitoring resources. Communication resources refer to communication technologies tools like knowledge repositories, intranets, Web 2.0 applications, and audio and video conference infrastructures. Monitoring resources are composed of evaluation tools and resources managers. Physical resources include the infrastructure which supports the implementation and monitoring of the knowledge sharing process. Computers, networks infrastructure, and face-to-face meeting rooms are examples of such resources. Consequently, the physical abstraction level of knowledge sharing is associated by two knowledge sharing dimensions: the informational resources dimension, and the physical resources dimension. Table 1 synthesizes the knowledge sharing dimensions identified in this section.

Abstraction level	**Dimensions**
Conceptual level	Degree of articulation dimension Degree of specialization dimension Diversity of sources dimension
Organizational level	Individual dimension Social dimension Managerial dimension Cultural dimension Structural dimension
Logical level	Organizing dimension Incentives and rewards dimension Communication dimension
Physical level	Informational resources dimension Physical resources dimension

Table 1: The knowledge sharing dimensions

6 CONCLUSION AND FUTURE RESEARCH DIRECTIONS

The framework presented in this paper provides practitioners with instruments to help them define and implement effective knowledge sharing in compliance with organizations priorities and constraints. The thirteen dimensions identified above are not equally important for all organizations. Indeed, the objectives of organizations and the constraints they face, vary from an organization to another. Accordingly, the dimensions of knowledge sharing don't have the same weight regardless of the organization which implements a knowledge sharing process. For example, as pointed out by many authors, the social, cultural, structural, and informational resources dimensions are crucial in virtual and multi-national organizations. Similarly, in many organizations, monetary incentives and rewards are necessary to motivate organizational actors and encourage them to share their knowledge. However, it was demonstrated that such incentives may be ineffective in many organizations including virtual and multi-national organizations. Indeed, such incentives may create a competition context and generate discriminations which discourage organizational actors, and constitute a barrier to knowledge sharing. We note that individuals may share knowledge even if no economic incentives exist. For example, that individuals contribute to discussion groups on the internet or develop open source software cannot be explained solely from a rational economic perspective. Individuals may share knowledge even though they are not receiving any direct financial value in return. Thus, incentives and rewards other than solely monetary may either promote or inhibit the knowledge sharing process. As stressed by (Ciborra & Patriotta, 1996), there are situations where knowledge is not shared while it would be expected to take place according to an economic rationality. For example, for many organizations it seems very rational to develop knowledge repositories and to build intranets in order to share their best practices so that their employees do not have to reinvent the wheel over and over

again. These organizations implicitly assume that since their employees are paid by the organization, they are expected to contribute to these intranets and knowledge repositories. However, it has been experienced that in many cases intranets and knowledge repositories remain devoid of any content, since people do not contribute to it by sharing their knowledge. Therefore, the role of the incentives and rewards dimension in knowledge sharing varies between organizations.

We validate our framework in the case of a virtual organization composed of a French insurance company and an Indian offshore software development company. The goal of this virtual organization is to provide the insurance company with software systems needed to support its business processes. The collaboration between the two companies takes place through virtual project teams where the software designers belong to the insurance company and the software developers belong to the offshore company. Members of virtual teams exchange information by using both traditional ICT and Web 2.0 tools. Whatever the virtual project team, there is no face-to-face meeting between software designers and software developers due to the distance between the two headquarters. Our observations of work progress in this virtual organization permit us identifying that the main dimensions of knowledge sharing in this virtual organization include the social dimension, the individual dimension, the degree of specialization dimension, the structural dimension, and the cultural dimension. In particular, many barriers are related either to the lack of a common language or to the differences between national cultures. The lack of a common language results on the one hand, from the difference between the language spoken in the two companies involved in the virtual organization and on the other hand, from the differences between the jargon used by the designers and the developers of software systems. Therefore, communication between software designers and software developers was difficult and knowledge sharing in virtual project teams was limited to explicit written knowledge. Another barrier to knowledge sharing was the lack of trust between the two companies' employees. For instance, many software designers was reluctant to knowledge sharing with software developers because they fear losing power associated with the business knowledge they hold. Finally, we have noted that taking into account only the informational resources dimension may be risky. Indeed, as we observed in the experienced virtual organization, successful knowledge sharing in virtual organizations is not triggered only by adopting ICT tools. It depends mainly on virtual organizations maturity and their ability to adopt the appropriate principles and organizational values to overcome barriers related to their characteristics. In particular, for Web 2.0 tools to be effective supports to knowledge sharing, partners involved in virtual organizations must be mature enough for loosing control and moving to altruism without any organizational central guidance. Finally, we think that the lessons learned from our experience should be validated using more case studies. Another research direction consists in defining, for each dimension, a set of metrics to evaluate its weight in a particular organizational context.

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