Social, Managerial, and Organizational Dimensions of Enterprise Information Systems

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Chapter 14
Designing Open-Source OMIS Environment for Virtual Teams to Support Inter-Enterprise Collaboration

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ABSTRACT

Today companies large and small have taken to open source as a way to increase collaboration, reduce development costs, provide a friendly platform for their products and services. Underlying this movement is a set of concerns related to the initiative to allow knowledge workers across different enterprises to participate in joint project work, resulting in some inter-organizational processes of knowledge sharing, to be modeled and followed by other enterprises of interest. This formulation, in terms of discovering business mutual benefits, could be considered as the open source philosophy behind an enterprise's co-operation with other counterparts. In the specific context of establishing enterprise information systems (EIS) to enable organizations (especially small and medium enterprises) to integrate and coordinate their business processes, the stakes can be high in light of maintaining a company's competitive advantages. Whether open source will work at any company depends on both the capabilities of the company and the maturity of the open source processes and hence the software to support them. This article investigates the context of knowledge networks among virtual teams of professionals as the case-in-point discussion on a specific type of open source knowledge environment based on the Wiki technology, called organizational memory information system (OMIS) to support people working within and across organizational boundaries with technology. The issues of trust and shared understanding among organizations using the relevant OMIS environment is also deliberated in the discussion alongside the technology alignment and process adaptation for managing the OMIS-based collaboration among members of the knowledge networks.

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INTRODUCTION

Today, the scope of open source has grown beyond basic development tools (Fogel, 2006) to become a top-to-bottom infrastructure for computing of all stripes, including development environments, databases, operating systems, web servers, application servers, and utilities for all types of data center management. By open source (Woods & Guliani, 2005; Golden, 2005), we are referring to software that has source code available to its users. It can be downloaded at will and used or modified as desired, as long as its license requirements are observed. Typically, commercial software licenses reflect the rights of the creator to control how the software is distributed. They protect the intellectual property of the creator(s). Yet, open source licenses differ significantly from commercial software licenses. Commercial licenses restrict the use of the software as much as possible, to enhance the possibility of selling many licenses. In contrast, open source licenses are written with the aim of encouraging widespread use, with very few restrictions placed on the use of the software. Also, open source software is often distributed at no cost. This makes sense because it reflects the reality of source code availability. Thereby, a clear model of how open source for the enterprise (Woods & Guliani, 2005) comes to life is crucial to understand the life cycle of open source development for enterprise information systems (EIS) (Dunn, Cherrington, & Hollander, 2005) and its attendant processes, which have incrementally become essential in the process of organization development in the Internet age. Of critical concern here is the electronic medium (such as the Web) to support knowledge sharing (Vat, 2006) referring mainly to the activities that define expectations, enable empowerment, or verify performance of the people or units involved. In the specific context of competitive advantages, the transformative impact of an open source effort on the intellectual and social capital of an enterprise is not to be ignored (Stewart, 1997). Our discussion centers on conceiving specific EIS whose open source design relates to the practical rendering of IS (information systems) support for virtual teams within and across enterprises, for such purposeful organizational activities as collaborative project work and knowledge sharing for given areas of responsibilities (Vat, 2005, 2002). The framework of analysis employed should accommodate the configuration of an organization's value profile in cyberspace as exemplified in today's digital economy (Tapscott, 1997). This framework puts in perspective many an enterprise's efforts to nurture intra- and inter-organizational knowledge environments to support the value shop model of organizational memory (OM), mostly known as the OMIS, the organizational memory information system (Vat, 2008, 2001), in which value is created by configuring and applying specific knowledge to problems of interest to customers. The chapter concludes by elaborating on the issues behind open source for the enterprise OMIS, providing a sense-making perspective on the challenge to overcome barriers to knowledge sharing among virtual teams distributed throughout any network of business collaboration.

THE CONTEXT OF ENTERPRISE INFORMATION SYSTEMS

The idea of an enterprise information system (EIS) could be understood from the context of the two terms: enterprise and information system. The former could be defined as an organization (Hall, 2002) established to achieve a particular undertaking involving industrious, systematic activity. Today, whether the undertaking of an enterprise is profit driven or charity motivated, the enterprise needs an information system to support its activities. An information system (IS) is often defined as the network of all communication channels used within an organization (Dunn, Cherrington, & Hollander, 2004, pp. 1-2). This IS definition is quite consistent with the view (Checkland &

Holwell, 1998) that an organization is often seen at core as a social process, essentially a conversational process in which the world is interpreted by organizational members in a particular way which legitimates shared actions and establishes shared norms and standards. Indeed, organizations are also regarded as networks of conversation or communicative exchanges in which commitments are generated (Ciborra, 1987; Winograd & Flores, 1986). And IS support could be thought of as making such exchanges easier – the exchange support systems. Certainly computer technology is an important component of most modern IS; namely, any paths by which enterprise employees and business partners impart and receive information are included in the EIS. Typically, an EIS provides a technology platform that enables an organization to integrate and coordinate her business processes. It comprises different pieces integrated into a whole system that is central to the organization and ensures that information can be shared across all functional levels and management hierarchies. Put more simply, an EIS can be defined as a set of communication channels in a business organization, combined together in such a way as to form one network by which information is gathered and disseminated.

DEFINING EIS FOR LEARNING ORGANIZATION

In today's knowledge economy (OECD, 1996), many an organization is being compelled to question their entire existing operation and try to redesign it in a way that uses new technology to serve their organization better. Indeed, the excitement brought about by the Internet and the corresponding changes in organizational behavior, has prompted speculation about what the future generations of EIS support will look like for knowledge work, which is essentially subjective, eclectic, individual, context-specific and often one-off making it traditionally the most difficult to support with technology. Meanwhile, amidst the learning organization movement (Vat, 2003; Gregory, 2000; Jashapara, 1993; Garvin, 1993; Senge, 1990) towards empowering responsible organizations (and their human members) to create innovative IS support to meet the challenges of the knowledge-intensive organizations, there is a strong need to share knowledge in a way that makes it easier for individuals, teams, and enterprises to work together to effectively contribute to an organization's success. Therefore, enterprises are often confronted with the question of how to design EIS in support of the learning expected of today's organizations (King, 1996; Levine, 2001). Example support could include such features as structured and unstructured dialogue and negotiation among colleagues; creative synthesis of knowledge in integrating working and learning; documentation of data, information and knowledge as it builds up; and retrieval of recorded data, information and knowledge, as well as access to individuals with the necessary knowledge resources. To this end, the acronym "LOIS" (Learning Organization Information System) (Williamson & Lliopoulos, 2001) as applied to an organization is often used as a collective term representing the conglomeration of various information systems, each of which, being a functionally defined subsystem of the enterprise IS, is distinguished through the services it renders. An example to be discussed in this chapter is the organizational memory information system (OMIS) whose purpose is to facilitate organizational knowledge transfer within and without an enterprise. Collectively, a LOIS can be considered as a scheme to improve the organization's chances for success and survival by continuously adapting to both the internal and the external challenges. Consequently, we stand a better chance of increasing social participation and shared understanding within the enterprise, and thus foster better learning. Although we believe that this positioning of EIS represents a significant vision of a future generation of information systems, there are serious questions to be

addressed in connection with design approach used to characterize knowledge capture and sharing within the enterprise (Tabaka, 2006). All these have consequences for enterprise transformation (Rouse, 2006) in such areas as strategies, structures, processes, systems and people.

THE KNOWLEDGE POTENTIAL OF LOIS-BASED NETWORKS

In a world of growing competitive pressures and accelerated transformation of economies (Hamel & Prahalad, 1994), knowledge is increasingly recognized as an important source of value generation in modern organizations. In particular, the ability to create knowledge and move it from one part of the organization to another is the basis for competitive advantage (Inkpen, 1996; Jashapara, 1993). Modern information and communication technology (ICT) has played a central role in this by making it easier for small and medium-sized companies to form network links (Figallo & Rhine, 2002) and by facilitating the transformation of hierarchical organizations into ones based on networks of EIS (Malone & Laubacher, 1998). Yet, the central domain of an enterprise is often considered as the social network (Badaracco, 1991) that absorbs, creates, transforms, and communicates knowledge taking advantage of any LOIS blueprint of the organization. Indeed, this network concept has been approached in different ways (Nohria, 1992). While some approaches focus more on the structural aspect of networks, others tend to emphasize the processes of or relations within or between networks. One frequently quoted definition from Mitchell (1969, p.2) is this: a network is a specific set of linkages among a defined set of actors, with the additional property that the characteristics of these linkages as a whole may be used to interpret the social behavior of the actors involved. Consequently, the term knowledge network can be interpreted as a social relationship between actors. And actors in a social network of knowledge sharing can be persons, groups, collectives of organizations, communities or even societies. Today, hardly any industry remains unaffected by the evolution of network-like relationships within and between organizations (Fleish, 2000; Lodge & Walton, 1989). The term 'knowledge networking' is often used to describe the assembling of people, resources, relationships and communication technologies in order to accumulate, transfer and use knowledge for the purpose of creating value. Knowledge resources are continuously augmented by knowledge gained from learning situations, and therefore knowledge networks should be regarded as dynamic structures rather than static institutions. Thereby, in order to enhance the interaction of network members, it is necessary to examine their relationships, which are considered as the platforms for knowledge exchange, in which relationships can vary in duration and intensity, as well as in terms of frequency of interactions. But, they imply personal involvement, commitment, care and the optimum use of communication tools. Still, the flow of knowledge in the network is subject to such factors as the size and characteristics of the network, entry barriers, participation difficulties, as well as peculiar ownership issues.

POSITIONING TEAMWORK IN KNOWLEDGE NETWORKS

In the context of knowledge creation, whether the objective is to develop a new product or service or to design and implement a new organizational technology, such as a new ICT system, the key resource that is required is unquestionably knowledge such as that of the markets and customers, that of the available technologies, and that of materials. These different types of knowledge must be brought together so that new knowledge is created which leads to the development of the new product, service or organizational process. Typically, this diversity of knowledge will not be

possessed in a single individual, but rather will be dispersed both within the organization, say, across functional groups, and across organizations, say, with consultants or suppliers. Thus, knowledge creation, within the context of an organization or knowledge network, is typically the outcome of an interactive process that will involve a number of individuals who are brought together in a project team or some other collaborative arrangement. The successful completion of project tasks will often depend on selecting team members with appropriate knowledge, skills and expertise, so teams ideally will be chosen so that their members have a mix of knowledge and capabilities. We can refer to this as the intellectual capital of the team, or what Nahapiet and Ghoshal (1998, p. 245) call the "knowledge and knowing capability of a social collectivity." In fact, intellectual capital and its mix across the team, is important because in any group-based project work, team members are not likely to have all the relevant knowledge and expertise required, either to design the system, product or service per se or to ensure that it is accepted and implemented by all those for whom it is intended. Rather, team members will need to network with a range of other individuals in order to appropriate the necessary knowledge. In doing this, they will be drawing upon their collective social capital, defined by (Nahapiet & Ghoshal, 1998, p.243) as the "sum of actual and potential resources within, available through, and derived from the network of relationships possessed by an individual or social unit." Thereby, knowledge creation needs to be seen as an interactive teamwork process – one which involves a diverse range of actors with different backgrounds, cutting across organizational boundaries, and combining skills, artifacts, knowledge and experiences in appropriate ways. It is no doubt that teamwork should lead to more creative solutions than would arise if individuals (or individual organizations) worked alone or in sequence on a particular project. Still, effective teamwork must be cultivated, especially when the team members come from different backgrounds and have different disciplinary knowledge bases. The key is trust to be developed. This is seen to be perhaps the most critical issue for effective teamwork in knowledge sharing.

EMPOWERING KNOWLEDGE NETWORKING THROUGH VIRTUAL TEAMS

Knowledge is often considered as an objective commodity that is transferable independently of person and context. In light of this, many an organization has tried to solve problems and enhanced knowledge sharing by improving the information flow through the intensive use of modern technologies such as intranet-based yellow pages, knowledge maps and information warehouses. The potential of these technologies is undisputed. Nevertheless, what is also required is an integrated approach that includes both explicit and tacit knowledge where and how it is created and transferred. In practice, in order to make effective use of knowledge, networks must incorporate and make available the knowledge and experience of employees in their daily context of organizational working, learning, and innovating (Brown & Duguid, 1991). Working is traditionally seen as the production and delivery of products or services. Oftentimes, attention is focused on the efficiency with which this is achieved; so, working is frequently resistant to modification. Understandably, learning is explicitly regarded as the absorption of new knowledge, though the focus is typically on individual employees' acquisition of knowledge, rather than on encouraging them to learn how to learn, and how to interlink areas of knowledge. This tends to obstruct the conversion of new knowledge into working skills (Seufert & Seufert, 1999). Meanwhile, innovating is often associated with revolutionary proposals developed in a research and development context. Admittedly, this form of innovation is an important part of change in general, but it is just one end of a continuum of innovations that also take the form of improve-

ments in daily business, such as continuous process improvements. Consequently, taking too narrow a view of working, learning, and innovating can possibly lead to the strengthening of various barriers: functional and hierarchical barriers; barriers to customers, suppliers and cooperative partners; and mental barriers that impede the generation, transfer, and application of new knowledge. These could not only hinder the short-term flow of knowledge, but in the long term can also damage the organization's innovative and learning capabilities. Thereby, knowledge networking must render a conceptual framework to rethink the knowledge sharing model, with which knowledge barriers can be overcome by networking, and knowledge islands could be cross-linked to stimulate the evolution, dissemination and application of knowledge. In the peculiar context of inter-organizational collaboration, the openness and richness of OMIS to support virtual teams over knowledge networks are believed to offer fertile environment for the creation of new knowledge as well as the acceleration of innovation (Powell, Koput, et al., 1996). Importantly, to be considered virtual to some degree, a team must have some basic attributes (Gibson & Cohen, 2003): Firstly, it must be a functioning team – a collection of individuals who are interdependent in their tasks, share responsibility for outcomes, see themselves and are viewed by others as an intact social unit embedded in one or more social systems, and collectively manage their relationships across organizational boundaries (Hackman, 1987; Alderfer, 1977); Secondly, the members of the team are geographically dispersed; Thirdly, the team relies on technology-mediated communications rather than face-to-face interaction to accomplish their tasks. It is the degree of reliance on electronic communication that increases virtuality often thought of as a spectrum from slightly virtual to extremely virtual. In fact, where a team exists on this spectrum is a function of the amount of dependence on electronically mediated communication and the degree of geographical dispersion.

OMIS – AN ORGANIZATIONAL LEARNING AND KNOWLEDGE TRANSFER MECHANISM

The success of today's enterprises, measured in terms of their ability to learn and to apply lessons learned, is highly dependent on the inner workings and capabilities of their information technology (IT) function. This is largely due to the emergence of the digital economy (Ghosh, 2006; Turban, Leidner, McLean, & Wetherbe, 2005), characterized by a highly competitive and turbulent business environment, inextricably driven by the intra- and inter-organizational processes and the associated knowledge processing activities they support. One visible consequence is the increase in organizations' efforts to deliberately manage knowledge (Tapscott, 1997), especially the intellectual capital (Stewart, 1997; Menon, 1993) of their employees, which necessarily deals with the conceptualization, review, consolidation, and action phrases of creating, securing, combining, coordinating, and retrieving knowledge (De Hoog, et al, 1999). In a knowledge-creating company (Nonaka & Takeuchi, 1995), such efforts must be instrumental to enable the organization to launch and learn. Meanwhile, employees are expected to continually improvise, and invent new methods to deal with unexpected problems, and share these innovations with other employees through some effective communication channels or knowledge transfer mechanisms. The key is collaboration, implying that organizational knowledge is created only when individuals keep modifying their knowledge through interactions with other organizational members be it within or without the organization. The challenge that organizations now face is how to devise suitable information systems (IS) support to enable such collaboration, namely, to turn the scattered, diverse knowledge of their people into well-documented knowledge assets ready for reuse to benefit the whole organization or her affiliated knowledge network. This important context of employee-based collaboration through

the design of specific IS support constitutes the core of the organizational memory information system (OMIS) (Vat, 2008, 2005).

Defining Organizational Memory

By organizational memory (Walsh and Ungson 1991), we are referring to various structures within an organization that hold knowledge in one form or another, such as databases and other information stores, work processes, procedures, and product or service architecture. As a result, an organizational memory (OM) must be nurtured to assimilate new ideas and transform those ideas into action and knowledge, which could benefit the rest of the organization (Ulrich, Von Glinlow, & Jick 1993). Through understanding the important components of the OM (Vat, 2006, 2002, 2001), an organization can better appreciate how it is currently learning from its key experiences, to ensure that relevant knowledge becomes embedded within the future operations and practices of the organization. In practice, creating and using an OM is a cooperative activity, necessarily involving many members of the organization. If those individuals are not adequately motivated in contributing to the OM initiative, and the organizational culture does not support knowledge sharing (Orlinkowski, 1992), it is not likely to turn the scattered, diverse knowledge present in various forms, into well-structured knowledge assets ready for deposit and reuse in the OM.

Differentiating OM and OMIS

Operationally, it is important to distinguish between the organizational memory (OM encompassing people) and the OMIS that captures in a computational form only part of the knowledge of the organization. The OM captures the knowledge of the organization. The associated OMIS makes part of this knowledge available either by providing direct access to it (for example, codified knowledge assets such as experience reports), or indirectly by providing knowledge maps (for example, tacit knowledge assets such as personnel with specific expertise). Managing the OM deals first of all with the question of "Which knowledge should go into the OMIS?" Answering this question requires determining what knowledge is owned by the members of the organization, what knowledge is needed now, what is going to be needed in the future and for what purposes. This helps the organization to define not only a strategy for acquiring the needed knowledge, but also to establish validation criteria in relation to the defined goals. Besides, we also need to deal with "who needs the knowledge, when and why," as well as the policies for accessing and using the OMIS. This contextualization of the OMIS with respect to the organization's ability to learn is essential to implement the mechanisms of organizational knowledge transfer, examples of which are discussed in (Vat, 2006). In fact, in this modern age of information technology and swift change, learning has become an integral part of the work of an organization run along principles intended to encourage constant reshaping and change. An OMIS-based organization can be characterized as one, which continuously transform herself by developing the skills of all her people and by achieving what Chris Argyris has called double-loop learning (Argyris 1992), which helps transfer learning from individuals to a group, provide for organizational renewal, keep an open attitude to the outside world, and support a commitment to knowledge. One of the missions of the OMIS is to facilitate and bring about the fundamental shifts in thinking and interacting and the new capabilities needed in the organization.

Designing Services for OMIS

When designing an OMIS to nurture an organization's ability to learn (Vat, 2001; 2002), of particular interest are the following modes of learning behavior: 1) individual, 2) group, and 3) repository. Individual learning is characterized

by knowledge being developed, and possibly the result of combining an insight with know-how from other sources in the organization, but it is often not distributed and is not secured for reuse. Group learning is centered about the concept of communication in two possible modes: supply-driven, or demand-driven. The former is characterized by an individual who has found a way to improve the work process and communicates this to one's co-workers. The latter refers to a worker who has recognized a problem in the current process and asks fellow workers whether they have a solution for this problem. In each case, knowledge is developed, distributed, and possibly combined with knowledge from other parts of the organization, but it is seldom secured. In repository learning, the communication element is replaced by collection, storage and retrieval of knowledge items. Namely, it is typified by storing lessons learned in some information repository so that they can be retrieved and used when needed. Overall, in repository learning, knowledge is developed, secured, distributed, and is possibly the result of knowledge combination. It is convinced that the requirements of an OMIS design should be formulated in terms of some typical usage scenarios. Namely, an OMIS should facilitate individual workers to access the knowledge required by combination, to submit a lesson learned, and to decide which of the co-workers would be interested in a lesson learned. Also, there should be criteria to determine if something is a lesson learned, how it should be formulated and where it should be stored, and how to distribute some newly asserted knowledge piece to the workers in need. The perceived technical issues, nevertheless, could include the following: How are we to organize and index the OM to enhance its diffusion? How to retrieve relevant elements of the OM to answer a user request or proactively push relevant elements towards users? How to adapt the answer to users, in particular to their tasks, according to the knowledge contexts? These problems are largely related to the OM framework for knowledge distribution, whose goal is to improve organizational learning, with the aid of some innovative OMIS support the discussion of which, through the idea of service-orientation could be found in (Vat, 2008).

FUTURE TRENDS OF OPEN-SOURCE OMIS DEVELOPMENT

To collaborate is to work in a joint intellectual effort, to partition problem solving to produce a synergy such that the performance of the whole exceeds that of any individual contributor. The central issue in OMIS-based collaboration for inter-organizational knowledge networking is how individual learning is transferred to the organizational level and beyond. In this regard, the use of open source Wiki technology (http://www.wiki.org) as a collaborative tool within an organizational setting renders an excellent example. Yet, only with a clear understanding of the transfer process can we manage learning processes consistent with organizational goals, issues and values. If this transfer process were indeed actualized in the design and practice of the OMIS, we could well have a knowledge organization which has the capability of capturing learning in its different paths and incorporating that learning into the running of its daily operations.

The Design Aspects of Wiki Technology

Wiki is an open source technology. The software that operates any Wiki is called a Wiki engine (Kille, 2006). A variety of free Wiki engines (also known as Wiki clones) are available from the Web (http://www.wiki.org). There are also Wiki hosts offering Wiki service with a minimal fee, such as the Seedwiki (http://www.seedwiki.com), and JotSpot (http://www.jot.com). The first Wiki application invented by Ward Cunningham in 1995 was to publish information collabora-

tively on the Web (Leuf & Cunningham, 2001), and this first Wiki Web site (http://c2.com/cgi/wiki) is still actively maintained today. Leuf and Cunningham define a Wiki (Hawaiian word meaning quick) as a freely expandable collection of interlinked Web pages, a hypertext system for storing and modifying information (Leuf & Cunningham, 2001, p14). Cunningham's original vision was to create a Wiki as the simplest online database that could possibly work. Today, Wikis are interactive Web sites that can offer numerous benefits to users (Wagner, 2004), in the form of a simple editing and publishing interface that can be used and understood easily. Anyone can create a new Wiki page, add or edit content in an existing Wiki page, and delete content within a page, without any prior knowledge or skills in editing and publishing on the Web. In fact, the major distinguishing factor between Wikis and regular Web sites is the ability of Wiki users to easily edit all aspects of a Wiki Web site. Fuchs-Kittowsk and Kohler (2002) interpret a Wiki as an open author system for a conjoined construction and maintenance of Web sites (p.10). They suggest that Wiki technology can facilitate cooperative work and knowledge generation in such contexts as content management system, discussion board, and other innovative forms of groupware. Indeed, members of a Wiki community can build and develop meaningful topic associations by creating numerous links among Wiki pages. To make the Wiki technology useful for collaborative work in organizations, Wagner (2004) suggested eleven principles that govern the functional design of a Wiki application (p.270):

- **Open:** If a Wiki page is found to be incomplete or poorly organized, any reader can edit it as he/she sees fit.
- **Incremental:** Wiki pages can cite other pages, including pages that have not been written yet.
- **Organic:** The structure and text content of the site is open to editing and evolution.
- **Mundane:** A small number of (irregular) text conventions will provide access to the most useful but limited page markup.
- **Universal:** The mechanisms of editing and organizing are the same as those of writing, so that any writer is automatically an editor and organizer.
- **Overt:** The formatted (and printed) output will suggest the input required to reproduce it.
- **Unified:** Page names will be drawn from a flat space so that no additional context is required to interpret them.
- **Precise:** Pages will be titled with sufficient precision to avoid most name clashes, typically by forming noun phrases.
- **Tolerant:** Interpretable (even if undesirable) behavior is preferred to error message.
- **Observable:** Activity within the site can be watched and reviewed by any other visitor to the site. Wiki pages are developed based on trust.
- **Convergent:** Duplication can be discouraged or removed by finding and citing similar or related content.

The Knowledge Potential of Wiki as a Collaborative Tool

According to Wagner (2004) and Raman, Ryan and Olfman (2005), the use of Wiki technology can address some knowledge management goals for collaborative work and organizational learning. Here, a knowledge management system refers to any IT-based system that is developed to support and enhance the organizational processes of knowledge creation, storage, retrieval, transfer and application (Alavi & Leidner, 2001, p. 114). In particular, any Wiki clone can be designed to support such basic functions as searching and indexing capabilities for effective retrieval and storage of knowledge attributes. The most often cited benefits of using Wikis to support collab-

orative work thereby include the simplicity of learning and working with the technology, and the free download through the Wiki engines all the necessary knowledge items of interest throughout the organization. More importantly, Davenport and Prusak (1998) provide three essential reasons why organizations need such a technology to implement its knowledge management systems: 1) to enhance visibility of knowledge in organizations through the use of maps, hypertexts, yellow pages, and directories; 2) to build a knowledge culture, namely, to create avenues for employees to share knowledge; and 3) to develop a knowledge infrastructure, not confined solely to technology, but to create an environment that permits collaborative work. Promisingly, if designed and implemented effectively, Wiki technology can support a large portion of an organization's collaboration and knowledge management requirements – specifically, knowledge sharing, storing, and support for the communication process within organizations. A key advantage of using Wikis to support knowledge management initiatives is that the technology is free. Nonetheless, issues such as sufficient user training, the availability of resources and skills to support the technology, and effective customization of Wiki features must be considered before the value of using the technology to support collaborative work within and across any organization is to be realized.

REMARKS OF CONTINUING CHALLENGE FOR VIRTUAL TEAMS

Teams in general and virtual teams in particular, are complex social forms whose effectiveness is often the result of multiple practices (Gibson & Cohen, 2003; Lipnack & Stamps, 2000). To promote the working of virtual teams, it is important to create the conditions that support their effectiveness. This in turn requires to identify the many design and implementation factors, such as the organizational context (selection, training, and rewarding of team members), task characteristics, technology use, team member skill profiles, as well as work and team processes. Besides, the degree of virtuality amplifies the challenges that such teams face. As teams become more virtual, they confront greater uncertainty and complexity, increasing the difficulty of the information processing and sense-making tasks that they do. Meanwhile, since virtual teams are typically composed of members representing different disciplines, functions, professions, business units, organizations, countries, and cultures, the greater the number and depth of differences that need to be managed, the greater are the barriers to team effectiveness. Thereby, virtual teams must be designed, supported, and nurtured in a careful manner to be successful. Nonetheless, even though the working of virtual teams is yet to be readily smooth, the reality is that virtual teams have the potential to amplify the benefits of teamwork; namely, they could enable the best talent regardless of location to be applied to solve different business problems, create products, and deliver services. Cross-organizational teams can be set up to capitalize on each enterprise's unique competencies. When knowledge networks comprise virtual teams with people from different perspectives and knowledge bases (high degree of differences), innovation is more likely to occur (Pinchot, 1985), such that problems can be framed in ways that allow people to apply knowledge from one domain to another. Besides, relying on electronically mediated communication reduces the cost of coordination, and hence, the benefits of efficiency, as an important competitive advantage. Yet, what are the enabling conditions to harness the potential of virtual teams? According to Gibson and Cohen (2003, p. 8-10), there are three enabling conditions that need to be established: shared understanding, integration, and mutual trust.

- **Shared Understanding:** It is important for virtual team to develop shared understanding (or common perspective among

members of the team, concerning some specific object of interest, such as project goals or difficulties) about what they are trying to achieve (their goals), how they will achieve them (work and group processes), what they need to do (their tasks), and what each team member brings to the teamwork (member knowledge, skills, and abilities). When teams involve people from different disciplines, business units, organizations, and cultures, their members will have different ways of perceiving their tasks, key issues, and making sense of their situation. Dougherty (1992) used the term "thought worlds" to describe new product development team members because of such differences. By developing shared understandings, virtual teams learn how to bridge the chasm between thought worlds.

- **Integration:** It is important to establish ways in which different parts of an organization can work together to create value, develop products, or deliver services. This is the idea behind integration; however, the parts of the organization(s) represented by virtual team members are likely to be peculiarly differentiated in response to global competitive pressures and changing business environments. This differentiation across organizational units means that they are likely to have different policies, organizational structures, and systems of operation. Such differences can hinder effective collaboration in virtual teams both directly or indirectly. In a more subtle way, business unit policies, structures, and systems influence employee behaviors, providing incentives for some such as more company-wide collaboration and disincentives for others such as less cross-organizational conversations. The greater the degree of differentiation in an organization, the greater is the need for integration. The formation of virtual team is one mechanism to encourage integration. Other examples could include: access to communication channels, social coordination through agreed norms, providing individuals with particular role responsibilities for linking individuals together, assigning authority and control to particular individuals, careful selection of individuals to ensure an appropriate mix of skills and expertise, and utilizing incentive systems.

- **Mutual trust:** Trust is defined in different ways in the literature (Rousseau, Sitkin, Burt, & Camerer, 1998; Cummings & Bromiley, 1996), although two issues seem quite relevant: first, that trust is about dealing with risk and uncertainty; and second, that trust is about accepting vulnerability. Namely, to trust someone there must be a situation of uncertainty in which there is an element of perceived risk on the trustee's part: "the willingness of a party to be vulnerable to the actions of another party based on the expectation that the other will perform a particular action important to the trustor, irrespective of the ability to monitor or control that other party" (Mayer et al., 1995, p. 172). In the context of virtual team, mutual trust is a shared psychological state characterized by an acceptance of vulnerability based on expectations of intentions or behaviors of others within the team. Luhmann (1988) sees trust as an attitudinal mechanism that allows individuals to subjectively assess whether or not to expose themselves to situations where the possible damage may outweigh the advantage. Teams that have established mutual trust are safe environments for their members, who are thereby willing to take risks with one another and let their vulnerabilities show. There are, however, many sources of vulnerabilities that may be at risk in

collaborative situations, such as reputation and self-esteem, especially when members of virtual teams are geographically dispersed, and are of different backgrounds having diverse experiences and cultures. Typically, people tend to trust those whom they perceive as similar to themselves, but electronically mediated communication lacks the interpersonal cues essential for trust building. Likewise, it is often necessary to install special measures to establish trust in virtual teams, examples of which can be found in (Gibson & Manuel, 2003).

CONCLUSION

One of the most obvious characteristics of human beings is our readiness to attribute meaning to what we observe and experience in the world outside ourselves. If information is interpreted as what we get when human being attribute meaning to data in a particular context, then an enterprise information system (EIS), in the full sense, will be a meaning attribution system in which people select certain data out of the mass potentially available and get them processed to make them meaningful in a particular context in order to support those engaged in purposeful action (Checkland & Holwell 1995; Checkland & Haynes, 1994). Thus, if we wish to create an appropriate OMIS in the exact sense of the phrase, we must first understand how people in the specific situation conceptualize their world. We must find out the meanings they attribute to their perceptions of the world and hence understand which action in the world they regard as sensible purposeful action, and why. Having obtained that understanding we shall be in a position to build some of the purposeful models, and use them to stimulate debate aimed at defining some human activity systems (HAS) (Wilson, 2001) widely regarded by people within the situation as truly relevant to what they see as the required real-world action. Once an agreed truly relevant system has emerged, the use of HAS-based system development requires us to ask of each activity in the model the following questions: What information would have to be available to enable someone to do this activity? From what source would it be obtained, in what form, with what frequency? Besides, we need to be aware of what information would be generated by doing this activity? To whom should it go, in what form, with what frequency? In this way, an activity model may be converted into an information-flow model. Given the information-flow model, which is agreed to be a necessary feature of the situation studied (say, virtual teamwork), we may then ask: What data structures could embody the information categories that characterize such information flows? It is only then that we could start the design of a suitable information system, which should yield the information categories and information flows required by the structured set of activities regarded as truly relevant to the real-world action (say, inter-enterprise collaboration) that is itself relevant according to the meanings which people in the situation (virtual teams) attribute to their world as a result of their worldviews. Hence, those engaged in the tasks of building LOIS (or OMIS) support are involved in the delicate business of creating, within the organization, a conglomeration of different human activity systems (HAS) using the term from soft systems thinking (Checkland & Scholes, 1999). To create an entirely new organizational dynamics of OMIS to support virtual teamwork across any knowledge network, through the HAS's actually requires effort and commitment on the part of everyone involved, as well as a good imagination in the mind of the persons charged with directing its implementation.

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TERMS AND DEFINITIONS

Collaboration: To facilitate the process of shared creation involving two or more individuals interacting to create shared understanding where none had existed or could have existed on its own.

Double-Loop Learning: Together with single-loop learning, they describe the way in which organizations may learn to respond appropriately to change. Single-loop learning requires adjustments to procedures and operations within the framework of customary, accepted assumptions, but fails to recognize or deal effectively with problems that may challenge fundamental aspects of organizational culture, norms, or objectives. Double-loop learning questions those assumptions from the vantage point of higher order, shared views, in order to solve problems.

Knowledge Management: The broad process of locating, organizing, transferring, and using the information and expertise within the organi-

zation, typically by using advanced information technologies.

Learning Organization: An organization which focuses on developing and using its information and knowledge capabilities in order to create higher-value information and knowledge, to modify behaviors to reflect new knowledge and insights, and to improve bottom-line results.

OMIS: An information system supporting the development of organizational memory, whose design philosophy is often organization-specific. An example philosophy is to consider the OMIS as a meaning attribution system in which people select certain resource items out of the mass potentially available and get them processed to make them meaningful in a particular context in order to support their purposeful actions.

Organizational Learning: A process of leveraging the collective individual learning of an organization to produce a higher-level organization-wide intellectual asset. It is a continuous process of creating, acquiring, and transferring knowledge accompanied by a modification of behavior to: reflect new knowledge and insight, and produce a higher-level asset.

Organizational Memory: A learning history that tells an organization its own story, which should help generate reflective conversations among organizational members. Operationally, an organizational memory has come to be a close partner of knowledge management, denoting the actual content that a knowledge management system purports to manage.

Wiki Technology: This technology is based on open-source software in the form of a Wiki engine. The Hawaiian word "Wiki" means quick, with the connotation that this technology is easy to use once installed. Wikis run over the World Wide Web and can be supported by any browser. The technology is governed by an underlying hypertext transfer protocol (HTTP) that determines client and server communication. Wikis are able to respond to both requests for data (GET) and data submission (POST), in a given Web front, based on the HTTP concept.