Towards a Learning Organization Model for Knowledge Synthesis: An IS Perspective

Kam Hou VAT[†]
Faculty of Science & Technology
University of Macau, Macau

Abstract

This paper investigates the idea of knowledge synthesis appropriate to the context of a learning organization (LO) from an information system (IS) perspective. Specifically, we discuss the process for IS architectures and requirements analysis, applicable in the area of knowledge development and transfer within an organization. We conceive the core of a learning organization as composed of numerous information systems for different functionality, collectively known as the learning organization information system (LOIS). The particular LOIS subsystem supporting specific knowledge resources is constituted by organizational activities characterized through their respective knowledge work. To enable an organization to leverage on the intellectual assets behind those activities, we consider the idea of organizational memory as an important constituent of an organization's knowledge infrastructure. We then trace our conception of IS architectures according to the specific requirements from these learning activities. In particular, we will investigate the case of a university as a learning organization together with its various requirements for knowledge synthesis. The paper concludes by outlining our LOIS organizational components for investigation as an expression of our blueprints for knowledge solutions.

Keywords: Learning Organization Information System; Knowledge Management; Organizational Memory

1. INTRODUCTION

Currently, enterprises including educational institutes are challenged to do things faster, better and more cost-effectively in order to remain competitive in an increasingly global economy. Consequently, 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. The objective is to better coordinate their activities around a common purpose, and to provide individuals and teams with access to the information and knowledge they need when they need it, from wherever it exists, and in a form they can use. This idea of knowledge sharing and information exchange has been well discussed in the notion of a learning organization (LO) (Garvin 1993; King 1996; Levine 2001; Senge 1990; Williamson 2001). LO refers to 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. It represents the important concept of better knowledge for better behavior for better performance. Operationally, a learning organization should understand its environment and culture, including its current activities and work processes, to evaluate what is understood and to initiate improvements where necessary. Based on the above characterization, there are many information system (IS) instances that can be incorporated into a learning organization. When applied to a university setting, the guiding question to start our exploration of LO, and its subsequent LOIS (Learning Organization Information System), typically involves the identification of its strategic resources, and how they could serve as the foundation for knowledge synthesis (development and transfer). This paper attempts to expound from the perspective of IS architects, the models of representation required to support these knowledge activities initiating organizational transformation in the direction of a learning organization.

2. IRM AS FOUNDATION FOR KNOWLEDGE MANAGEMENT

To remain competitive, enterprises accrue numerous information resources to use in their problem solving, decision making and creative thinking for improving products, processes, and services. Nevertheless, these resources together with the people who use them must be managed in a coordinated manner to deliver value consistent with the enterprise's goals and objectives,

[†] fstkhv@umac.mo; Fax: (853) 837-954

which could include the following. 1) Promoting the importance of information resources and the need for business responsibility for managing those resources. 2) Encouraging the sharing of information resources by using common terminology, definitions, and identifiers across the enterprise. 3) Establishing an enterprise-wide information architecture, which shows the relationships between information held in various parts of the enterprise. 4) Ensuring information integrity through procedures to ensure accuracy and consistency. 5) Enforcing security through cost-effective controls to protect the information resources from accidental or deliberate modification, destruction, or unauthorized access. 6) Improving information accessibility and usability by putting it in useful formats to make it accessible in any way that makes business sense. In other words, an information resources management (IRM) (Van den Hoven 2001) function is needed to manage the enterprise's information resources as corporate assets in order to add value to their services and products, reduce costs, and meet customers' various needs. Meanwhile the view that knowledge is a valuable organizational resource has become widely recognized. Knowledge management (KM) (Dieng 2000; Spek and Spijkervet 1997) has emerged to help enterprises manage their resources in order to facilitate access and reuse of knowledge including their intellectual capital, which belong inherently to people and are the organizations' assets only through their application and reuse (Conklin 1996). KM attempts to address the issues of capitalizing on individual know-how in a collective knowledge so that others do not have to relearn "what the enterprise already knows" leading to the improvement of organizational work processes and productivity (O'Leary 1998). There are generally two types of organizational knowledge: formal and informal. Formal knowledge refers to the information from books, manuals, documents, and training courses. It is the primary product of knowledge work, captured easily by the organization. Informal knowledge is the knowledge created and used in the process of creating the formal results. It includes ideas, facts, assumptions, meanings, questions, decisions, guesses, stories, and points of view. It is an important ingredient in knowledge work as formal knowledge is, but is more ephemeral and transitory. Thus, it is hard to capture and to keep informal knowledge. The knowledge pool in an enterprise is stored in the form of both the formal and the informal knowledge whose interaction results in the continuous creation of organizational knowledge (Nonaka and Takeuchi 1995). Since the enterprise's formal knowledge could often be codified and recorded in a form that is easily accessible, oftentimes IRM is used to help enterprises better manage their formal knowledge as information resources. In practice, a KM system emerges when IRM is successfully coupled with other approaches for managing the informal knowledge in the enterprises. These other approaches could be incarnated as a three-tiered knowledge infrastructure (Vat 2000) composed of the front-end KM services supported by back-end organizational memory (Concklin 1996; Vat 2001) through a mid-layer KM architecture. More, different sets of KM services could be configured as different sub-systems of the LOIS, whose IS architectures could be derived according to their various requirements.

3. INFORMATION SYSTEMS FOR LEARNING ORGANIZATION

The acronym "LOIS" as applied to an organization is used here as a collective term representing the conglomeration of the various constituent information systems, each of which is a functionally defined subsystem of the enterprise LOIS, i.e., it is defined through the services it renders. On characterizing the requirements for the different LOIS services in support of our LO model for knowledge synthesis, we have the following suggestions (Williamson 2001). LOIS should support structured and unstructured dialogue and negotiation among organization's knowledge workers. They need to support reflection and creative synthesis of information and knowledge and thus integrate working and learning. They should also help document these resources as they build up (e.g. by electronic journals), and they have to make recorded information and knowledge retrievable, and individuals with information and knowledge accessible. Collectively, LOIS can be considered as a scheme to operate a form of organizational memory (OM), gathering and distributing data, information and knowledge across the organization. In the learning organization, the individual ISs are geared to improve the interactions between knowledge seekers and the various forms of information providers and knowledge creators (Kidd 1994). The main goal is to improve the organization's chances for success and survival by continuously adapting to the external environment. LOIS enables an organization to store and remember information and knowledge, helps learning and adaptation by making it easier to access and use such resources in other parts of the organization. Consequently, we stand a better chance of increasing social participation and shared understanding within the enterprise, and thus foster better learning. Nevertheless, there are serious questions to be addressed in connection with knowledge capture and transformation (from informal to formal), as well as knowledge asset management within the learning organization (Senge 1990).

4. ARCHITECTURES FOR LOIS

The field of information systems (King 1996, 1999) operates on the paradigm of identifying relevant data, acquiring it, and incorporating it into storage devices that are designed to make it readily available to users in the form of usable information resources. Importantly, each IS has its own architecture (Bernus and Schmidt 1998), denoting the integrated structural design of the system, its elements and their relationships depending on given system requirements. We might consider the architecture as an abstract plan including the corresponding design process of the system's structure appropriate to the goals of the system based on design principles and some methodological framework. Besides, the architecture has to represent all relevant aspects of a system, which are defined by models representing different system views. Such models are often derived from the goals the system

has to fulfil and the constraints defined by the system's environment. Our LOIS architecture has to guarantee that the mission of the enterprise is taken into account in the process of design, and that the system will support the enterprise in achieving its objectives. The IS models should provide sufficient evidence for the designer to believe that this will indeed be the case. From the models the system properties should be derivable and conversely, the models have to be designed so that the system requirements can be fulfilled.

5. KNOWLEDGE SYNTHESIS FOR LOIS

The philosophy underlying our LOIS design recognizes that our knowledge is the amassed thought and experience of innumerable minds and LOIS helps capture and reuse those experiences and insights in the enterprise. The notion that emerges resembles strongly the classical history paradigm of learning from past events, necessitating the collection of data and repeated re-interpretation of its meaning, significance and impact for next generations. That is also the idea of organizational learning (Kim 1995), supported by our organizational memory. Organizational memory is considered as the means by which knowledge from the past is brought to bear on present activities, possibly resulting in higher or lower levels of organizational effectiveness (Stein 1992) in terms of the decision-making, organizing, leading, designing, controlling, communicating, planning, and motivating functions of the management process. The cultivation of organizational memory is fundamental to enterprises that intend to establish, grow and nurture a learning organization (Hackbarth and Grover 1999), where individuals grow intellectually and expand their knowledge by unlearning inaccurate information and relearning new information. Oftentimes, there is the essential difference between doing it the way we always did it (single-loop learning) and arriving at an innovative solution that establishes new patterns and relationships (double-loop learning) (Argyris 1992; Kim 1995).

5.1 Knowledge Life Cycle

It is understood that organizational knowledge is often categorized into different knowledge areas depending on their strategic importance to the organization (contribution) and their specific stage of development (growth potential). Typically, there are four knowledge classes (Spek and Spijkervet 1997): promising, key, basic and outdated. The 'promising' knowledge areas are characterized by the pattern of low contribution but high growth, meaning that these areas are still in their infancy but have the potential to radically change the organization's knowledge household. The 'key' knowledge areas have the pattern of high contribution and high growth. They represent the core competencies of the organization, having the greatest influence on the unique position of the organization. The 'basic' knowledge areas have the pattern of high contribution but low growth. They are the essential areas for carrying out the activities of an organization, but such areas are widely available in all similar organizations. The last category is the 'outdated' knowledge areas characterized by low contribution and low growth, representing knowledge, which are hardly applied any more in the organization.

5.2 Knowledge Management

Knowledge management (KM) provides the instruments to employees of organizations, who are confronted with the need to optimize the control and management of their knowledge resources. The idea is to prevent bottlenecks caused by an inadequate knowledge household. It aims at improving the performance of organizational processes, and systems in general from the perspective that knowledge is the crucial production factor. To accomplish this mission, KM entails the following. 1) Formulating a strategic policy for the development and application of knowledge. 2) Executing this knowledge policy with the support of all parties within the organization. And 3) improving the organization where knowledge is not optimally used or is not adapted to changing circumstances. Subsequently, we have a number of objectives set in terms of the following KM processes. First, we have to ensure an effective and efficient development of new knowledge and improvement of existing knowledge with a view to the strategy of the organization and individual objectives of the employees. Second, we need to ensure a specific distribution of new knowledge to other departments and to new employees through knowledge transfer or relocation of knowledge bearers. Third, we must ensure an effective securing of knowledge, which is also easily accessible to the whole organization. More, we must ensure the effective and efficient combination of the best knowledge available within an organization or network of organizations. Overall, we need a process model for implementing knowledge management. And this model is often referred to as the KM cycle (Spek and De Hoog 1995; Spek and Spijkervet 1997)], in which KM is perceived as a cyclic process composed of four iterative activities: review, conceptualize, reflect, and act. 'Review' means checking what has been achieved in the past, and what the current state of affairs is. 'Conceptualize' is trying to get a view on the state of the knowledge in the organization, and analyzing the strong and weak points of the knowledge household. 'Reflect' is directed toward improvements: selecting the optimal plans for correcting bottlenecks and analyzing them for risks that accompany their implementation. 'Act' is the actual effectuation of the plans chosen. Obviously, the analysis, plans and actions are usually formulated in terms of the four 'KM processes' which aim at an integration of strategy formation and executive tasks where learning about the application and development of knowledge assumes a central role within the organization.

5.3 Organizational Memory

The term organizational memory (OM) has come to be a close partner of KM, denoting the actual content that a KM system purports to manage. Ideally, an OM should provide the knowledge required for the task at hand (or a pointer to that knowledge) without too much of an overhead when using or keeping the memory. Actually, creating and using an OM is a cooperative activity

necessarily involving many members of an organization. Principally, it is useful to view OM dealing with three distinct tenets of 'Acquire, Organize, and Distribute' operations, referred to as the AOD framework (Schwartz et al 2000). Briefly, acquisition relates to how we collect knowledge from members of the organization or other resources, and store them in an organizational memory. Organization refers to structuring, indexing and formatting the acquired knowledge so we can find it when we look for it. Distribution is the ability to get the relevant knowledge to the person who needs it at the right time. More often than not, each of these three tenets can be found at the center of different research efforts. Our intention here is to provide an integrative framework in which these efforts can be examined.

5.3.1 Acquire: Gather, Inquire, Validate/Verify, Encode. Acquiring knowledge begins with a process of gathering and inquiry. This is interleaved with validation of the collected knowledge. Validation is important as knowledge is moved from the realm of the individual to the organizational memory where others will access it. The acquisition phase ends with the encoding of the gathered knowledge. In fact, the success of an OM deeply relies on its ability to gather existing knowledge to satisfy the present and future needs of an organization. Knowledge can be present in the mind of people or externalized in the form of documents. In the first case, knowledge can be captured through the use of different communication tools for connecting people such as bulletin board, and electronic shared workspaces. In the second case, an OM needs to be equipped with tools for registering those documents in a shared memory. Besides, knowledge acquisition could also be done through inquiring various sources possibly external to the organization, to fulfill a precise demand. An inquiry can be user-driven or automatically preset. In the user-driven case, the request of a user that cannot be fulfilled can activate the search for the missing knowledge, where the users can be supported by the OM to keep in touch with the right knowledge source, say, by providing a map of expertise distribution among the organization. In the automatic case, the OM can inquire periodically for new knowledge, say, by sending a request to a specific bulletin board based on some given keywords. Thus, gathering and inquiry are complementary processes. Validation and verification are concerned with the quality issues of the knowledge sources. One approach to verification is storing knowledge of the providers with the knowledge itself, so that on one hand people can evaluate the source, and on the other hand, people are more motivated to provide high quality material. An example is to facilitate a process of cooperative construction of the OM. Once information has been gathered and evaluated, it must be encoded in a form that allows it to be manipulated and reused in relation to the varying needs of the members of an organization. The challenge is to codify knowledge and still leave its distinctive attributes intact, putting in place codification structures that can change as rapidly and flexibly as the knowledge itself (Davenport and Prusak 1998).

5.3.2 Organize: Profile, Associate, Rank, Classify. Once knowledge has been acquired, we begin the non-trivial task of organizing it for future use. An OM should generally be placed in between the workspaces of its users and the long-term information sources of the organization. As such, it serves two roles: acting as an active memory to support ongoing activities and as a persistent memory capturing, and structuring relevant knowledge for later use. The persistent memory part depends on the use of meta-data for the classification and description of information for later retrieval and use. Overall, the active part of the memory is maintained, stored and described according to the current interpretation and use of the knowledge. Often, profiling is needed to restore the context of knowledge usage in the form of some user-organization-project information. Associating is also involved to identify the relation of the knowledge to other relevant knowledge and to a given user. Classifying is the need to group different kinds of knowledge together to form a coherent or relevant package. Ranking is also important since there will always be multiple hits on any knowledge retrieval request and they must be ranked intelligently so that the user is presented with the best match. In short, some level of human expertise will be required, such as a librarian who can track subtleties of meaning and help with the indexing and structuring of the OM. For example, meta-data descriptions of documents may, depending on the situations, be divided into two categories: contextual and semantic descriptive meta-data. The former strives to capture the context of a memory document, such as its creator, title, location, modification date and history. The latter captures the intellectual content or meaning of an information object. Examples are selected keywords from controlled vocabularies or ontologies, written abstracts/comments and text-indexes. In cooperative settings, we might also involve some free-text descriptions, annotations or collected communication or discussion about the object. Simply put, content should be organized according to some consistent policy that ensures persistence of the OM over time.

5.3.3 Distribute: Awareness, Identification, and Delivery. Within the context of knowledge distribution, three elements concerning awareness, identification and delivery of knowledge often occur. First, there is the awareness on the part of the user that certain useful knowledge may exist somewhere in the organization. Then there is the identification of that relevant knowledge. Third, there is delivery of the knowledge to the point of action where it can be applied to the issue at hand. Awareness is often considered as more a function of management than it is of technology. Identification is a function of how successful the 'organize' stage is, combined with the appropriateness of the user interface provided. Knowledge identification most often requires a deliberate act on the part of the user, though this is increasingly becoming a collaborative act between user and system. Today collaboration often requires that we move towards systems that have internal representations of the users alongside the knowledge in order to enable a truly efficient identification. Delivery is a system-

dependent function. The interesting issue is that while much effort has been devoted to efficient acquisition and organization of knowledge, precious little has been done to understand how this knowledge can be seamlessly integrated into the behavioral patterns of users in everyday work situations. The current practice of knowledge delivery to the necessary points of action in an organization include multiple methods such as push, pull, email, and instant messaging, mostly through some Internet-based software systems.

6. THE OM SCENARIO FOR KM SUPPORT IN A UNIVERSITY-BASED LOIS

We envision that an OM's major function is to enhance the university's competitiveness by improving the way it manages its knowledge. It is the core of a learning organization, supporting sharing and reuse of individual and organizational knowledge and lessons learned. From an IS perspective, the OM is supported by a specific information system, called OMIS, which is a subsystem of the university's LOIS environment, and is considered as an iterative means to realize the KM services offered incrementally according to the ongoing functional requirements of the university. Technically, the OMIS could be implemented as a 'Web Information System' (WIS), representing IS efforts geared towards exploiting the benefits of the Web platform. The OMIS is the system knowledge workers use to perform KM processes. The underlying WIS(s) (Dunn and Varano 1999) may comprise numerous Intranet-based and Extranet-based distributed applications which are usually tightly integrated with the back-end OM in the form of, say, distributed databases or knowledge servers. We also imagine the OMIS is supported by intelligent KM services actively providing any user working on a knowledge-intensive task with the information required for fulfilling the task. Such information is largely based on the organization's formal knowledge, captured through explication of informal knowledge within the organization. It is mainly the 'what, how, why, when and who' of the knowledge resources. It is believed that individual knowledge workers (administrative, academic, support staff and students) construct and re-construct organizational knowledge through sharing with their colleagues the following. What information is needed; why it is needed; where it could be found; how it could be processed to achieve a specific result; and when which information is needed. Of particular interest are human knowledge sources whose knowledge must be made explicit so that others can access through the OM. In practice, there are different stakeholders involved in the LO model for knowledge synthesis. Knowledge providers represent the specialists or experts in whom the knowledge of a certain area resides. Knowledge users are the people who need to use that knowledge to carry out their work successfully. And knowledge decision-makers are the managers who have the position to make decisions that affect the work of either the knowledge providers or the knowledge users. Under the OM context (Dieng 2000), we also might have knowledge engineers, who acquire and model knowledge; knowledge watchers who gather, filter, analyze, and distribute knowledge elements from the external world; and a team of validating experts, who validate the knowledge elements before their insertion in the 'OM'. There are also OM-developers, who concretely build, organize, annotate, maintain and evolve the system. Overall, our idea of an OM is not centered on a passive information system, but an intelligent assistant to the user, who can freely access and reuse memory elements (Abecker et al 1998).

6.1 The Knowledge Scenario

One of the university's learning experiences we advocate is to enable knowledge development and transfer among teachers and students in an interactive and collaborative atmosphere. Students actively participate in generating, accessing, and organizing the required information. They construct knowledge by formulating their ideas into words and then develop these ideas as they react to other students' or teachers' responses to their formulations. Knowledge construction can then be considered as the process of progressive problem solving, which encourages students to be innovative, create intellectual property, and develop and acquire expertise. To achieve these knowledge tasks, our academic staffs need considerable skill and knowledge to deal with the acquisition, creation, packaging, and application of emergent knowledge. We expect an OMIS could facilitate these knowledge tasks through knowledge sharing across academic domains. It is about leveraging the expertise of people and making the most effective use of the intellectual capital of an organization. Understandably, it is important to have good coordination, evaluation and evolution of all these knowledge activities.

6.2 The Knowledge Solution

The transformation to a LO-based university as in the case of our LOIS, requires an objective methodology. This methodology must be instrumental to creating a productive and efficient LO model for knowledge synthesis, which preferably enables us to follow an iterative development sequence. This means being able to plan and prepare for a launch based on a new business model of education within a manageable cycle time. In particular, this model should enable our LO to launch and learn, and incorporate those lessons and launch again. Actually, this vision can be accomplished only if we have an agile operation based on a reusable business and technology infrastructure, and supported by a repository of reusable business and technology assets. This is the foundation from which we could start conceiving our OMIS. First, we need to define an electronic vision for our LO, to bring all of its real-world and virtual-world strengths together in a re-configurable constellation. Second is to define the LO's business architecture, encompassing its associated business models, processes, and applications which will let us move from vision to reality. Third, we have to entail a corresponding technology architecture that allows an iterative implementation of the business architecture. Fourth is to create a reusable infrastructure of both business models and technology applications based on the blueprints of the

business and technology architectures. This infrastructure should allow us to recycle every piece of learning, time after time, and in as little time as possible. In other words, realizing the LOIS of our university is not simply a technology issue to be managed by an IT/IS department. Instead, the LO transformation itself involves business process engineering and re-engineering, and it is a core strategic issue, requiring meticulous planning before construction. It is about molding selected aspects of the running university into whatever the reengineered vision of the educational process and the market (global and local) demand that they be. Indeed, it is about setting long-term goals to refocus the business of education.

6.3 The Knowledge Infrastructure

The knowledge infrastructure supporting our LO, comprises a three-tiered configuration, including the front-end KM services (KMS), the middle-layer KM architecture (KMA), and the back-end organizational memory (OM) (Vat 2000, 2001). Typically, various KM services, incrementally prototyped for the LO, could be made available to its users in the form of different Web information systems (WISs), each being interpreted as the iterative means to realize the specific KM processes of the organization. And, the specific KM services constituting the OMIS are made possible through repackaging its intranet-based or extranet-based services into a suitable WIS. It is believed that a well-devised OMIS with user-friendly KMSs enhances the probability of seamless, flexible knowledge acquisition, sharing, and integration among knowledge workers throughout the organization. The challenge we face is how to design KMSs to turn the scattered, diverse knowledge of our knowledge workers into well-structured knowledge assets ready for deposit and reuse in the OM (De Hoog, et al 1994, 1996).

6.3.1 The Design of KM Services (KMS). The design of KM services is an attempt to recognize the human assets within the minds of individuals and leverage them as organizational assets that can be accessed and used by a broader set of individuals on whose decisions the organization depends. According to (Nonaka and Takeuchi 1995), organizational knowledge can be created through interactions between tacit knowledge (informal knowledge) and explicit knowledge (formal knowledge). Four distinct interaction modes have been identified: from tacit to tacit (socialization); from explicit to explicit (combination); from tacit to explicit (externalization); and from explicit to tacit (internalization). Consequently, our KM services are devised based on these four modes of interactions. The 'Knowledge Socialization' process usually occurs in the form of informal communication when someone raises a question for discussion or an issue to be responded. It should receive direct ICT (information and communications technology) support that makes users communicate without imposing any particular structure on their interaction. The suitable KMSs could include discussion forum, or some brainstorming applications. The 'Knowledge Internalization' process occurs when we are actively searching for methods or lessons learned to solve problems at hand. We do knowledge interpretation from other colleagues' previous work, and we internalize knowledge by doing, and also by observing what other people have done in a similar context and by example. The suitable ICT elements should focus on recording explicit knowledge, making it available to potential users and enabling them to re-experience what other have done in similar situations. The corresponding KMSs could include lessons-learned databases, and process history tracking applications. The 'Knowledge Externalization' process, aimed to structuring knowledge and making it available to other users, involves concept mapping, tacit knowledge categorization and representation. The suitable ICT elements could include semantic networks and knowledge ontologies. The KMSs should focus on creating an OM to support knowledge preservation and creation. The 'Knowledge Combination' process involves various knowledge sharing and decision coordination. The ICT elements should focus on combining pre-existing explicit knowledge to produce new insights. The KMSs could appear in the form of document management system, group support system, and the workflow system.

6.3.2 The Design of KM Architecture (KMA). The KMA acts as the middle layer in support of the front-end KMSs through the back-end OM. Its logical requirements are to satisfy the KM concerns to create, retain, share, and leverage knowledge from the personal level to the team level, the organizational level, and even the inter-organizational level. Its development is conceived from two architectural perspectives: the business architecture, and the technology architecture. The former involves the development of management solutions that are related to modeling the business functionality of the organization; namely, business strategies, processes and structures that enhance and facilitate organization-wide knowledge leveraging. The latter involves the development of ICT components within an intranet-based knowledge medium to translate the organization's business vision into effective electronic applications that support the intra- and inter-organizational KM processes.

- *The KMA's Business Architecture.* This business architecture is designed to comprise a number of distinct KM-related components: e-Business models, e-Process models, and e-Application models, where 'e' denotes electronic. The e-Business model is aimed to provide a high-level perspective of the business initiative. The e-Process model is aimed to describe the internal and external processes representing the organization's daily behavior. The e-Application model is aimed to represent the electronic applications to be developed to streamline business processes from the end-user perspective. An example might be to support such aspects of a learning organization as knowledge diagnosis, and knowledge transformation. Knowledge diagnosis helps determine the most critical areas of knowledge capture and creation within the organization. Knowledge transformation involves such issues as the mapping of knowledge to empower personnel to quickly and accurately locate sources of knowledge applicable to specific business problems; and creation of reward systems that facilitate

openness, improvisation, integrity, creativity, team-spirit, trust and ability to change.

- *The KMA's Technology Architecture.* This technology architecture is composed of distinct stages of development such as e-Application rules, e-Application data, and e-Application distribution, where 'e' denotes electronic. The e-Application rules are the technical mechanisms, which enforce business rules that are peculiar to every business process to govern its operations. Typical components of e-Application rules include business objects and application frameworks to implement the business requirements. The e-Application data comprises items of resources (data, information, knowledge) stored and manipulated by the electronic applications (KM services). The heart of the e-Application distribution is a distributed architecture, which allows application resources to be located on individual application servers. These servers are typically connected by a network infrastructure, which provides a backbone of communication among the multiple distributed platforms of the organization, and which communicates using standard such as CORBA.

6.3.3 The Design of Organizational Memory (OM). The LO's KM processes require iterations of references and modification of the components developed in the business and the technology architectures of the KMA. This requirement implies the importance of a reusable asset repository for storing various business-specific and technology-related components in the form of tacit and explicit knowledge items. Our OM is designed to fulfill this specific requirement. Particularly, the OM could be configured differently for various purposes. For example, it could be structured into the business repository and the technology repository. Typically the business repository stores knowledge items which we can use to standardize definitions of business and process models. And we can archive existing process components, including entities such as degree programs, course structures, and professor profiles. These archived entities can then be recalled later by coworkers in other departments to be reused or modified for new process models. Similarly, the technology repository stores technology resources such as 'business objects', pre-built and purchased components, developer documentation, and numerous other technology standards.

7. REMARKS FOR CONTINUING CHALLENGES

On conceiving the conceptual framework to accommodate our exploration of LOIS, we have considered a number of organizational components that can be developed and implemented in the pursuit of a learning organization model for knowledge synthesis. In this paper we have specifically considered the KM-related component, which focuses on the acquisition, explication, and communication of mission-specific expertise that is largely tacit in nature to organizational participants in a manner that is focused, relevant and timely (Grant 1996; King 1999). The conceptual basis is that tacit knowledge can, in part, be made explicit and leveraged through the operation of KM-related processes, and systems developed for knowledge sharing. There are also other components such as the intellectual property management (IPM), individual learning (IL), and organizational learning (OL).

- *IPM-related Component.* This component deals with the activities that are involved in leveraging existing codified knowledge assets in the form of patents, brands, copyrights, research reports and other explicit intellectual property of the organization, to create additional value (Wiig 1997). The conceptual basis is that such codified knowledge may be thought of as a capital asset to maximize return from intellectual property. Also, the IPM-driven LO may devise a financial incentive that allows individuals and groups to be rewarded for the creation and leveraging of such property.
- *IL-related Component.* This component focuses on the training and education of individuals in order to enhance the value of the organization's human capital. The conceptual basis is that an effective IL-driven LO is betting on its people's enhanced individual learning that will translate into improved organizational behaviors and performance.
- *OL-related Component.* This component focuses on pursuing the creation of social capital in the organization (Probst and Buchel 1997). The conceptual basis is that social capital, in the form of organizational competencies, can be developed, refined, and enhanced to enable the organization to adapt to changing circumstances and demands. The OL-driven LO must facilitate group learning and group capacities for dealing with change so as to enhance the organization's ability to respond to change.

It is found that each of the above components represents a viable way of modeling different aspects of knowledge synthesis in a learning organization. In practice, we need some combination of the enumerated organizational components (plus others to be innovated) to evolve our LO model. This often implies some time-phased planning in which individual LO-components are implemented and allowed to mature before new and quite different components are introduced into the mix. Trying to capture this complexity into the design of our LOIS environment, is more an ongoing iterative process than a one-time 'waterfall' activity. As expected, our refinement process starts with the IS-component to provide a foundation for each of the other components. Once the IS infrastructure has been developed, the environment can more effectively implement other components such as the IPM-component. The logic of making this the second element of the overall plan lies in its potential to produce financial incentive that can be used as a basis for the motivation of individuals when the other components are implemented. The third is preferably the IL-component because it focuses on human capital, creating a strong people-based foundation for the more sophisticated OL-component, which focuses on the creation of social capital. The KM-component is a natural evolutionary step in the pursuit of the goal of a LO because KM activities such as communities of practice, expert networks, and electronic workspaces naturally evolve from the social context of organizational learning coupled with the technical capabilities provided by the IS.

8. REFERENCES

Abecker, A., Bernardi, A., Hinkelmann, K., et al., "Toward a Technology for Organizational Memories," IEEE Intelligent Systems, Vol. 13, No. 3, May/June 1998, pp. 40-48.

Argyris, C. On Organizational Learning. Blackwell, 1992.

Bernus, P., and G. Schmidt, "Architectures of Information Systems," In P. Bernus, K. Mertins, G. Schmidt (Eds.) Handbook on Architectures of Information Systems, Springer-Verlag, 1998.

Conklin, E.J., "Designing Organizational Memory: Preserving Intellectual Assets in a Knowledge Economy," white paper, Group Decision Support Systems, Washington, D.C., 1996; http://www.gdss.com/DOM.htm.

Davenport, T.H. and L. Prusak Working Knowledge: How Organizations Manage What They Know. Boston, Massachusetts: Harvard Business School Press, 1998.

De Hoog, R., et al., "Organization Model: Model Definition Document," Technical Report. Univ. Amsterdam and Cap Programmator. Deliverable DM6.2c of ESPRIT Project P5248 (KADS-II), 1994.

De Hoog, R., et al., "The CommonKADS Organization Model: Content, Usage, and Computer Support," Expert Systems with Applications, Vol. 11, No. 1, July 1996, pp. 247-260.

Dieng, R., "Knowledge Management and the Internet," IEEE Intelligent Systems, Vol. 15, No. 3, May/June 2000, pp. 14-17.

Dunn, J.R., and M.W. Varano, "Leveraging Web-Based Information Systems," Information Systems Management, Fall 1999, Vol. 16, No. 4, pp. 60-69.

Garvin, D.A., "Building a Learning Organization," Harvard Business Review, 71 (4), 1993, pp. 78-91.

Grant, R.M., "Toward a Knowledge-Based Theory of the Firm," Strategic Management Journal, 17 (Winter Special Issue), 1996, pp. 109-122.

Hackbarth, G, and V. Grover, "The Knowledge Repository: Organization Memory Information Systems," Information Systems Management, Vol. 16, No. 3, Summer 1999, pp. 21-30.

Kidd, A, "The Marks are on the Knowledge Worker," in Proceedings of the CHI'94 Conference on Human Factors in Computing systems, pp.186-191. ACM, New York.

Kim, Daniel H. Managerial Practice Fields: Infrastructure of a Learning Organization. Productivity Press, 1995.

King, W.R., "Integrating Knowledge Management into IS Strategy," Information Systems Management, 16 (4), Fall 1999, pp. 70-72.

King, W.R., "IS and the Learning Organization," Information Systems Management, 13 (3), Fall 1996, pp. 78-80.

Levine, L., "Integrating Knowledge and Processes in a Learning Organization," Information Systems Management, Winter 2001, pp. 21-32.

Nonaka, I., and H. Takeuchi, 1995, The Knowledge Creating Company: How Japanese Companies Create the Dynamics of Innovation, Oxford University Press.

O'Leary, D.E., "Enterprise Knowledge Management," IEEE Computer, Vol. 31, No. 3, Mar. 1998, pp. 54-61.

Probst, G. and B. Buchel, Organizational Learning: The Competitive Advantage of the Future, Prentice-Hall (Europe), Herdsfordshire, UK, 1997.

Schwartz, David G., Divitini, M., and Brasethvik T., "On Knowledge Management in the Internet Age," In D.G. Schwartz, M. Divitini, and T. Brasethvik (Eds.). Internte-Based Organizational Memory and Knowledge Management, Idea Group Publishing, 2000, pp. 1-23.

Senge, P. The Fifth Discipline: The Art and Practice of the Learning Organization. Currency Doubleday, London, U.K. 1990.

Spek R., van der, and R. De Hoog, "A Framework for a Knowledge Management Methodology," In: Wiig, K.M. (ed.), Knowledge Management Methods: Practical Approaches to Managing Knowledge. Arlington, TX, USA: Schema Press, 1995, pp. 379-393.

Spek, R. van der, and A. Spijkervet, "Knowledge Management: Dealing Intelligently with Knowledge," In: J. Liebowitz and L.C. Wilcox (eds.), Knowledge Management and Its Integrative Elements. Roca Raton New York, USA: CRC Press, 1997, pp.31-59.

Stein, Eric W., "A Method to identify Candidates for Knowledge Acquisition," Journal of Information Systems, Vol. 9, No. 2, 1992, pp. 161-178.

Van den Hoven, J., "Information Resource Management: Foundation for Knowledge Management," Information Systems Management, 18(2), Spring 2001, pp. 80-83.

Vat, K.H., "Designing Knowledge Infrastructure for Virtual Enterprises in Organizational Learning," in Proceedings of the Tenth Annual Business Information Technology Conference (BIT2000), Nov. 1-2, 2000, Manchester, england, (CD-ROM Paper No. 45).

Vat, K.H., "Designing Organizational Memory for Knowledge Management Support in Collaborative Learning," in Proceedings of the 2001 Information Resources Management Association International Conference (IRMA2001), May 20-23, 2001, Toronto, Ontario, Canada, pp. 634-638.

Wiig, Karl, M., "Integrating Intellectual Capital and Knowledge Management," Long Range Planning, 30 (3), June 1997, pp. 399-405.

Williamson, A., and C. Lliopoulos, "The Learning Organization Information System (LOIS): Looking for the Next Generation," Information Systems Journal, Vol. 11, No. 1, Jan. 2001, pp. 23-41.