An IS-Based Architectural Modeling for Learning Organization: A Conceptual Walkthrough

Kam Hou VAT
Faculty of Science & Technology
University of Macau, Macau
fstkhv@umac.mo

ABSTRACT

This paper investigates the design of an architectural model suitable for the development of a learning organization including its various information system support, collectively known as LOIS – the learning organization information system. This LOIS model is derived from a series of organization modeling activities capitalizing on various architectural initiatives to support different learning processes continually evolving over selected knowledge domains. To realize the LOIS services in an organization, whose activities are increasingly being virtualized over the Internet, we introduce our architectural components to model the organizational concerns for the respective organization imperatives. The paper emphasizes the importance of developing LOIS services not from the limitations of current technologies, but from the reality of organizational goals. Thereby, we present our innovative modeling constructs to incorporate organizational concerns in steering the information technology efforts to realize our LOIS initiatives.

INTRODUCTION

In the emerging knowledge economy (OECD 1996), as the possibilities of the information revolution challenge traditional business logic, companies are experimenting with a wide array of strategic alternatives and organizational forms. For example, learning organizations (Garvin 1993; Kim 1995; Levine 2001; Senge 1990) aim to continuously transform themselves by developing the skills of all their people and by achieving what Chris Argyris has called double-loop learning (Argyris 1990). These are mechanisms which 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 (Dodgson 1993; Kim 1995; Dieng 2000). Consequently, many organizations are being compelled to question their entire existing operation and try to redesign it in a way that uses new technology to serve their business better. The primary purpose of architectural modeling is to propose a suitable organizational architecture, and thereby make organizational design disciplined from an engineering viewpoint. The central idea is to reduce the risks of failure involved with performing organizational transformation, especially, the electronic transformation (e-Transformation) demanded by the Internet era, to extend an existing bricks-and-mortar enterprise to its clicks-and-mortar counterpart. Our discussion brings forth some suitable organizational models based on new architectural elements such as molecules, patterns and lattices, in the course of modeling the organizational imperatives. The different organization models should be presented in an engaging language so that the stakeholders involved can understand them, not just the transformation team. On the other hand, according to (Jacobson et al. 1994), today's organizational e-Transformation should better have a systemic re-engineering process in place. Such a process preferably includes a description that is adaptable to the transformation project in terms of the specific activity and deliverables involved. The deliverables, in the form of various organization models, should focus on the organization's architecture and dynamics. The activity should emphasize the development of an information system (IS) truly integral to the transformed organization. Importantly, we should have a tight seamless relation between the process to develop a specific organization model and the process to develop the supporting IS. Establishing this relation enables business people to communicate with IS people and IS people with end-users. Our idea of the learning organization information system (LOIS) (Williamson and Lliopoulos 2001) represents the conglomeration of different IS efforts, respectively dedicated to achieve some peculiar services of a learning organization.

ORGANIZATION MODELING FOR E-TRANSFORMATION

The electronic transformation (e-Transformation) from a bricks-and-mortar organization to its clicks-and-mortar counterpart, as required in the Internet environment today (Buffam 2000; Hoque 2000), requires an objective modeling methodology. This methodology must be instrumental to creating a productive and efficient organization model, which enables us to follow an iterative development sequence. This means being able to plan and prepare for a launch based on a new business idea within a reasonable cycle time. In particular, this model should enable our

organization to launch and learn, and then incorporate those lessons and launch again. Actually, this can be accomplished only if we have an agile operation based on a pragmatic philosophy as follows: First, we need to define an electronic vision to bring all of an organization's real-world and virtual-world strengths together in a re-configurable constellation. Second is to define the organization's business architecture, encompassing possibly its associated business artifacts (structures, processes, and expected 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 repository to keep track of the emerging business and technology artifacts, which should allow us to recycle every piece of learning, time after time, and in as little time as possible. Meanwhile, we accept the proposition of John Kay (Kay 1995) that the real world of business is too complex to be fully modeled. Our organization modeling approach should serve as an organizing framework by which concepts and goals may be formulated, extended, and synthesized. First, we must recognize that organizations are products of their social and historical growth. We thus need to identify the context that defines and constrains what is, and what is not, possible to design in an organization. Second, our modeling approach should structure its assumptions around such axes as organizational, business and information system concerns. Such axles motivate the necessary constructs with which an organization must deal to form its baseline. Third, our organization modeling could be made more flexible by introducing some innovative constructs through which each domain of the organization may be analyzed and operationalized. Fourth, we need to involve the concept of alignment among domains of the organization, which thereby introduce the notion of organizational patterns as composites of aligned domains, thus developing another expression of the organization architecture.

MODELING THE CONTEXT FOR LEARNING ORGANIZATION

The context of a learning organization is developed through a combination of choice and environmental influences. In particular, it requires choice associated with the constructs chosen by management to represent the organization, choice with respect to the organizational domains which management is interested in proactively designing, choice of alignment among such domains, and choice of possible implementation. Throughout the organization modeling process, which includes establishing an organizational philosophy, identifying domains in need of design, specifying an organization's invariant (rules) at all levels of abstraction, it is likened to the act of composing a symphony or painting a picture. The artist starts with an image – the final rendering is visualized even if not fully formed. As the artist fills in the image, the composition begins to take form. The artist shapes according to the image; yet, the form molds the image. Planned or emergent, the molded image is a product of visualization, which also applies to organization modeling. It is the process that interweaves strategic intent, architecture, and change into molding the organization image. In creating the organization model, the great challenge is to shape the organization so that all of its pieces (organization domains) work together in consonance. These pieces are said to be in alignment when their respective behaviors correspond with one another.

Conceiving Organization Molecules

In any organization, domains exist and are instantiated. The specification of a domain is often done through an information-modeling construct. In our discussion, we call this construct a *molecule*, a term borrowed from elementary chemistry, to represent the crystalline formations of generic modeling ideas as they pertain to an organization. Thereby, organizational molecules can be introduced for organizational domains, which are managed collections of organizational constructs that have unique properties as a collection, enabling analysis and design of organizational tasks such as business process redesign. Each molecule could also be considered as the schema we choose to frame organizational design decisions – the whole and each of the parts. Indeed, the process of building a molecule for a given domain involves taking the knowledge areas from the specific domain and connecting them together in a particular manner. This unique way of combining knowledge areas creates a composite specification of behavior in the form of the dynamic aspect of the underlying organization model.

Discovering Organization Patterns

Every organization exhibits certain recurring behaviors in the form of some emergent characteristics. We use the term *organization patterns* to connote the underlying predictable behaviors, representing the level of fit within and among organizational domains. Patterns help us organize and integrate knowledge at the organizational level. The challenge of organizational design is that while the emergent characteristics themselves are recognizable, the same cannot be said of their underlying patterns. Discovering and capturing patterns is an exercise in understanding organizational architecture. Based on our discussion in organization molecule, we may consider an organization pattern as the representation of a domain, which in turn, could be described using an organization molecule – a

collection of organizational constructs that can be formulated, implemented and managed. In this way, each molecule is empowered to represent a pattern corresponding to a domain, such as culture, process, strategy, or information. When we align molecules, we build more complex patterns representing collections of domains. Typically, patterns are associated with two separate but interrelated dimensions: crystallization and manifestation (Morabito, Sack, and Bhate 1999). The first dimension concerns process development. An idea may initially be unformed or only vaguely understood. As we continue the design, our initial idea becomes more concrete. Each successive stage of development operationalizes the idea into something more tangible. That is the idea behind the dimension of crystallization. The second dimension concerns the visibility of a pattern. Along each stage of crystallization, the emergent characteristics associated with patterns must be made evident to achieve organizational success. Tellingly, unformed ideas are neither visible (i.e., manifest) nor operationalized (i.e., crystallized). This characterizes the initial planning phase of a new idea or an organizational pattern.

Designing Organization Lattices

We refer to those complex arrangements of patterns as *lattices*, which are associated with specific, enduring emergent characteristics considered as sources of competitive advantage for the organization. Designing lattices is an exercise in building an enduring organizational architecture. We often start with organizational philosophy and invariant, conceptualize our organization in terms of organization domains, identify corresponding molecules, instantiate and align those molecules. As we construct and implement molecules, the level of emergence of an organizational characteristic is proportional to the level of fit in its underlying lattice – the number of domain instantiations (specific design decisions) that reinforce one another. In fact, the process of achieving fit – of continually changing organizational pieces and their linkages so that they work together more effectively, and consequently, create the desired emergent characteristics – can be considered as an instance of organizational change. This ability to change is often interpreted as the dynamicity of an organization, and it is considered as a function of three important concerns. The first concern is the level of alignment (fit) within and among molecules. This property governs how well an organization executes in a changing environment (i.e., maneuverability), and is associated with the level of horizontal correspondence among organizational domains to withstand changes in its environment. The second concern is the set of specific instantiations in a given pattern or lattice. It is associated with the character of the organizational domains which governs how well an organization is able to change other patterns vertically in a continuum of development as patterns emerge in the organization (i.e., adaptability). The third concern is the timing of change. Change is more easily attained during the early stage of crystallization because of its fluid nature. Once implemented, the pattern is fixed; change then requires de-crystallization back into a fluid state, new specifications and alignment, and finally operationalization back into a fixed state.

INNOVATING ARCHITECTURAL COMPONENTS FOR LEARNING ORGANIZATION

Indeed, we believe the creation of an organizational model is an important ongoing process to support the continual architecting of a learning organization. Moreover, we are interested in expressing the inter-relationship among the relevant architectural components. Put it simply, we conceive the organization architecture of a learning organization to be composed of the following components: the Information System (IS), the Individual Learning (IL), the Organizational Learning (OL), the Intellectual Property Management (IPM), and the Knowledge Management (KM).

- *The IS-component.* This component operates on the information system (IS) paradigm (King 1996; King 1999) 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 explicit knowledge (routine reports and responses to inquiries). Principally, IS directly relates to managing data and information rather than knowledge and learning. But the IS infrastructure, including the application programs which transform data into more valuable information relating to particular decisions, functions or activities in the organization, is of fundamental importance to implementing any of the other architectural components in a learning organization. It is also considered as part of the *structural capital* of the organization.

- *The IL-component.* The individual learning (IL) (Kim 1993) component focuses on cultivating *human capital* of the organization. It serves to provide training and education for individuals through the institution of workshops, apprenticeship programs and the establishment of informal mentoring programs. Typically, an IL component provides free use of the IS infrastructure to access unstructured material in order to pursue an explicit educational path, and to access structured learning material purposely designed for online self-learning.

- *The OL-component*. The organizational learning (OL) component focuses on cultivating the *social capital* (Grant 1996; Probst and Buchel 1997) of the organization. It is characterized by the use of communities of practice approaches, leading to the formation of collaborative groups composed of professionals who share experiences, knowledge and best practices for the purposes of collective growth. The conceptual basis is that social capital, in the form of various group and organizational competencies and capacities, can be developed, refined, and enhanced to enable the organization to adapt to changing circumstances and demands, through such processes as teamwork, empowerment, case management or development-centered career paths.

- *The IPM-component.* This component deals with the issue of intellectual property management (IPM) (Stewart 1997; Sveiby 1997; Wiig 1997) underlying 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. The conceptual basis for this component is that such codified knowledge assets may be thought of as the realized human and social capital in the form of *intellectual capital* [Becker 1993].

- *The KM-component.* The knowledge management (KM) component focuses on the acquisition, explication, and communication of mission-specific professional expertise that is largely tacit in nature to organizational participants in a manner that is focused, relevant and timely (Grant 1996; King 1999; van der Spek and De Hoog 1995; Wiig 1993). The conceptual basis is that the organization's *knowledge capital* in the form of tacit knowledge (O'Leary 1998) can, in part, be made explicit, and leveraged through the operation of KM-related processes and systems developed for knowledge sharing.

More precisely, we could express the inter-relationships of the various architectural components within the overall organization architecture of a learning organization as:

<Organizational Architecture> ::= <Structure Capital> + <Human Capital> + <Social Capital> + <Intellectual Capital > + <Knowledge Capital>

Using the idea of an organizational molecule, we might further define the individual architectural components as:

<Structure Capital> ::= Molecule <IS-component>
<Human Capital> ::= Molecules {<IL-component>, <IS-component>}
<Social Capital> ::= Molecules {<OL-component>, <IS-component>}
<Intellectual Capital> ::= Molecules {<IPM-component>, <IS-component>}
<Knowledge Capital> ::= Molecules {<KM-component>, <IS-component>}

According to our previous discussion in organization modeling, we have assigned a specific domain name to each of the above architectural components. Also we might elaborate such domains by refining their respective constituent constructs according to the situational contexts of the expressed molecules. For example, the enumerated molecules could possibly be expressed in terms of the underlying domains, using some linear specification of a generic molecule as:

Organizational-Molecule ::=
Association Name: association-type (Domain Name, {Organization Construct$_1$, … Organization Construct$_n$ })

And the instantiated molecules of the various molecules mentioned above could become:
Molecule<IS-component> ::=
IS-Formation: C-S (IS, {Power, Environment, Human, Process, Tool})
Molecule<IL-component> ::=
IL-Formation: C-S (IL, {IS, Structure, Information, Learning})
Molecule<OL-component> ::=
OL-Formation: C-S (OL, {IS, IL, Learning, Community, Culture})
Molecule<IPM-component> ::=
IPM-Formation: C-S (IPM, {IS, IL, OL, Incentive, Communications})
Molecule<KM-component> ::=
KM-Formation: C-S (KM, {IS, IL, OL, IPM, Technology, Interactions})

The underlying assumptions employed in these improvised examples of molecule specifications include the context of the composite-subtype association (C-S). Namely, with an organization molecule, the composite represents a domain specification, while the components represent its implementation. This separation of concerns leads to the potential reuse of either the composite or components. Thus, a composite specification may be implemented with a variety of constituents, while components may be shared and used to implement any number of specifications.

CONTEXTUALIZING THE META-MODELS FOR LOIS SUBSYSTEMS

For each of the architectural components enumerated in the overall organizational architecture, we have to conceive the appropriate LOIS services to support its mission. The alignment issue among different organizational domains thereby becomes important. Typically, the meta-models created for individual LOIS subsystems, encompassing different sets of specific services, have to be identified, perhaps through a use-case analysis. Nonetheless, there are generally three important contexts: automating, informating, and knowledging, worthy of our attention. In the past decade, we have witnessed the organization's continuous move from a principle of automation to one of integrative processes. While automation involves the removal of the individual from a process, the principle of *informating* (Zuboff 1988) suggests a form of process abstraction and integration between the individual and the computer system. Basically, informating refers to the effect IT may have on the understanding and transparency of a process. It makes people more productive through their use of, and process integration with IT. It serves to increase the capacity of people to understand the entire value-adding business process. Thus, informating concerns itself with the connection people have with their specific tasks as well as the whole flow of work. On the other hand, the idea of *knowledging* (Savage 1990), refers to individual and organizational learning, and is characterized by the process of knowledge creation and the active involvement of the individual with his or her work. Knowledging includes a dynamic interaction between the explicit and the tacit forms of knowledge (Nonaka and Takeuchi 1995; Spender 1993). Each successive organizational progression from automating to informating to knowledging, as required in today's learning organization, requires higher levels of process abstraction and a broad range of process integration and alignment. Therefore, the creation of a meta-model for a specific LOIS subsystem must be situated in a context of adaptability. This organizational concern is always a big challenge for today's information systems architects. And we need the cooperation of the organizational architect, a new figure responsible for designing structures across organizational boundaries, engineering processes into strategic capabilities, developing individual competencies into a learning organization, aligning information technology with organizational imperatives, and integrating the disparate pieces that constitute the organization.

REMARKS FOR CONTINUING CHALLENGES

The key technical issue in developing an information system (IS) is why we need an organizational architecture in IS construction? We could provide a number of reasons to support the provision of an organizational architecture. First, we need this architecture to ensure that the IS environment is aligned with the organization's imperatives. Namely, this architecture provides the basis for IS professionals and organizational architects to ensure that the proposed IS system is properly aligned with the mission, objectives and processes of their business. Such an alignment supports typical organizational goals as enhancing the capabilities of existent information systems and taking advantage of new strategic opportunities. Second, we need the architecture to help us build an IS environment that can be easily changed and extended, so as to retain its alignment with changing business imperatives in the learning organization. Third, we need architecture to communicate appropriate views of the solution to, and among the various stakeholders so as to ensure that the solution get built, on time, within budget, while fulfilling the intended requirements. Fourth, we need architecture to help keep our IS environment intellectually manageable. We recognize that information systems are very complex. The control of complexity, and through it the ability to keep our systems understandable, is the biggest single challenge in the IS construction. One of the most important functions of the architecture is to support a "divide-and-conquer" approach. Other functions include to provide a framework for making and communicating technology choices, to give us freedom of choice of IS components and to maximize our efficiency in building and evolving the IS environment through reuse of earlier work. In other words, it is too important for IS professionals to neglect the essence of the organizational architecture – the very reminder of a whole sequence of organizational and technological concerns. It is our belief that fulfilling such concerns is essential to arriving at a truly working version of an organization model applicable to the electronic transformation of today's enterprises towards a digital learning organization.

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