December 1995

Knowledge Acquisition and Storage in Organisational Learning : A Conceptual Model and Some Empirical Evidence

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ABSTRACT

"Organizational learning" is a concept that has intuitive appeal, and the concept has face validity as a way to explore the roles for information systems groups in organizations. However, a more descriptive and suggestive model is needed in order for the model to be more amenable for research and application. One approach is to use the Kolb model of learning and development, a well-established recursive model of human learning and development, and map into this model those organizational practices that are associated with learning. Viewed this way, the model suggests that different organizations may have different learning styles and this may explain some of the empirical evidence associated with the adoption of new information technologies. The model is used to illustrate differences in learning style in US and Japanese organizations.

INTRODUCTION

Stata (1989) and Senge (1990) argue that learning is the only sustainable competitive advantage for enterprises in the global business environment. They use the concept of a feedback system to discuss how organizations, like people, learn from experiences. Underlying their discussion is the metaphor of the living organism (i.e., a person) in referring to "memory" and "genetic structure." Also underlying their discussion is a presumption about the nature of competition, a presumption that may need to be challenged in order for the learning model to be fully exploited.

The history of the metaphor of the organization as a living organism extends back at least to Haire (1959) and Bennis (1966) but more recently has served as a foundation for the concept of the intelligent organization (Marsden and Pingry, 1988; Paradice, 1988; Mason, 1992). This metaphor provides the conceptual framework for the discussion of the adapting, surviving organism (Boulding, 1956) envisioned by Huber (1984). It is an underlying concept for the writings about organizational learning that predate Stata and Senge (e.g., Hedberg, 1981; Fiol and Lyles, 1985; Levitt and March, 1988) and also those that have appeared in the last few years (e.g., Huber, 1991; Mason, 1993). As noted by Mason (1993), the metaphor, while it suggests new approaches and ideas, needs to be further developed in order to be useful for researchers and practitioners of corporate strategy and information systems management and design.

This paper explores the use of Kolb's model of human learning and development (Kolb, 1984) as the basis for developing and using the metaphor for information systems research and practice. In particular, the paper proposes that the model is useful as a unifying framework for previous studies and provides a practical guide for future research and management practice.

The next section reviews and critiques Huber's research on organizational learning. In this section, it is argued that Huber's work, although sweeping in scope and instructive in how different bodies of literature look at organizational learning, is insufficient as a model to guide research and practice. It also is argued that subsequent work (e.g., Mason, 1993) that builds on and extends the model suggested by Huber did not go far enough in bridging the conceptual gap revealed in Huber's work.

The next section describes the Kolb model and outlines how it can be used as a descriptive framework for organizational learning. This section shows how the model can be used to integrate Huber's model with extensions of his model, bridging the gap between his model and other concepts about how knowledge is created, stored, and communicated in organizations.

The next section shows how the organizational learning model (OLM) can be used to understand the results of empirical and field studies on the implementation of integrated information systems, international joint ventures, and differences in the acquisition and storage of information in Japanese and US organizations.

The paper concludes with suggestions for research and practice in information systems.

Organizational Learning and Information Systems

Huber (1991) summarized and critiqued the literature on organizational learning and articulated four constructs that are associated with organizational learning: knowledge acquisition, information distribution, information interpretation, and organizational memory. Each of these four constructs has its own literature and Huber notes that much opportunity exists for systematic investigations which integrate these relatively disparate bodies of study. For each of these constructs, information systems can play a major role in the enactment of corporate strategy. Huber's model can be enhanced to overcome some of the restrictions that limit its utility in applications to organizational learning.

The following paragraphs review Huber's findings in the literature on the nature of learning, examine its relationship to strategy, and review the role of information

technology in the four constructs associated with learning. We add a hierarchical dimension to our consideration of information and knowledge. Together, these provide a conceptual structure for considering strategic applications of IT.

The Nature of Learning

Huber, drawing on an extensive literature review, makes three assumptions about the nature of learning. Each of these assumptions present problems as we examine the relationship of information systems with the strategic nature of organizational learning. Consequently, Huber's model of organizational learning requires some extension and modification for our purposes.

Huber points out that the literature does not require that learning result in observable changes in behavior. Friedland (1983) notes that learning involves the organism becoming aware of differences and alternatives and making choices. The result of learning may be a revision of understanding (e.g., a modification of a cognitive map) rather than an immediate behavioral change. Revised understanding can be the basis for different decisions, thus resulting in later changes in behavior; the fundamental change is in cognition, not in observed actions. Consequently, Huber defines learning as a process which changes the scope of potential behavior. In his words, an entity learns "*if, through its processing of information, the range of its potential behaviors is changed*" (Huber, 1991, p. 89 [emphasis added]). In this definition, information processing is fundamental to the learning process. [While the expectation is that the range of behavior will be wider, information processing might *reduce* the range. For example, the organization, through learning, might be able to establish more accurately the risk of a potential venture and thus decide against a particular action.]

From a practitioner's viewpoint, however, learning that is not associated with behavior has little value. Without the application of new knowledge, learning can not be, as Senge argues, a source of competitive or strategic advantage. Moreover, Weick's concept of enactment (Weick, 1979; 130)) is that an organism requires this interaction with its environment as the raw material for sense-making and ecological change. Learning arises from the organism's applying the information being processed to its actions. Perhaps more precisely, an essential aspect of the processing of additional information is its application to practice. (This assertion is revisited when we examine a model of learning that incorporates both conceptual and experiential knowledge.)

Huber further assumes that an organization learns if any of its units acquire knowledge that it recognizes as potentially useful. This means that an organization learns if only one of its units learns something. This assumption also is problematic--each part of an organization does not automatically receive and assimilate knowledge that is gained by another part. Ideally, this would be the case, but there are too many practical and conceptual barriers to this ideal. The problems include, for example: individuals constraining knowledge flow to secure exiting power or authority relationships and individuals who are unaware of the roles of others and thus are not motivated to share newly-acquired information with them.

Finally, Huber acknowledges that he treats information and knowledge as being identical for his purposes. The literature in knowledge and types of knowledge (e.g., Migliarese, 1985; Weick, 1990; Badaracco, 1991; Nonaka, 1994) suggests that making this equivalency assumption oversimplifies the framework; important aspects of both information and knowledge can be lost.

Dimensions of Learning

Huber proposes four dimensions that may be used to measure organizational learning: existence (defined above in the four constructs), breadth, elaborateness, and thoroughness. He asserts that organizational learning occurs when either of these measures increase. For example, more organizational learning occurs when more organizational units develop a uniform comprehension of various interpretations. These dimensions have implications for both strategy and information organization, as discussed below. However, understanding these implications requires some elaboration of the concepts of knowledge and information. Mason (1993) modified a hierarchy of information suggested by Ackoff (1988) that shows how knowledge is created by from information by codifying and organizing the information in ways that enable the information to be used in interpolating data, developing models, and creating new information. The hierarchy is one of increasing abstraction. Knowledge is more abstract than information, just as information is more abstract than data. The table below (adapted from Mason, 1993) illustrates this hierarchy. This hierarchical model of information is an important component in developing the concept of a learning organization. It illustrates that learning can occur not only by acquiring *new information and knowledge* (as suggested by Huber) but also by codifying and interpreting *existing information* to *create new knowledge*. A new viewpoint, for example, one that arises when a group decides to "make sense of" data in a different way, or a new paradigm (Kuhn, 1970), creates new knowledge by revealing patterns that were previously undiscovered. [Analogous to a new image of the organization or a new personal construct (Kelly, 1965).]

The Kolb Experiential Learning Cycle Model

Figure 1 illustrates a well-established model of individual developmental learning articulated by Kolb

(1984). Kolb's model synthesized and extended the developmental learning models of Piaget, Dewey, Jung, and others. The model illustrates that learning requires activities at the ends of each of two dimensions. As shown in Figure 1, the vertical dimension ranges from the concrete to the abstract and the horizontal dimension ranges from the active to the reflective. In the vertical dimension, Kolb refers to the concrete as *apprehensive* learning and the latter and *comprehensive* learning. In other words, the former is learning achieved by reaching out and interacting with the environment, the latter learning comes from reflection on the experience.) a learning from empirical (concrete experience) and conceptual (abstract) and both active and reflective activities. Learning is complete only if the entire cycle is completed.

The two dimensions--the concrete-abstract and the experience-reflection--form a model framework that is visualized as four quadrants in the two-dimensional space formed by the intersection of lines representing these two dimensions. Learning is possible in each of the dimensions. Indeed, individuals have preferred learning styles, and one can determine this style through a self-administered test (Kolb, 1981, 1985). However, Kolb argues that true learning and development occurs when an individual moves through each of the quadrants, acquiring both reflective and active knowledge and both experiential and abstract knowledge. Although abstract learning is possible, the model ascribes equal validity to experiential learning. Thus someone who "knows" an idea in the abstract truly learns only after being able to put the idea into practice. Similarly, experienced events are part of a person's knowledge base but may become understood in the broader sense only after they are linked with conceptual or abstract models. [The "single loop" and "double loop" learning suggested by Argyris (1977) may be related to learning in a single quadrant, for example.] Huber's assertion that behavioral change is not required for learning to take place seems consistent with learning that is limited to a single quadrant--the learning is purely conceptual or abstract and does not include experiential learning or concrete experience.

Now consider combining this learning cycle model with the hierarchical model of information shown in Table 1. The learning cycle provides a way to include both ends of the hierarchy in a learning model. Data (concrete experience), upon reflection, is codified and incorporated into less detailed, more abstract, models. The models themselves can be further abstracted and codified; the assumptions that enable the model to be formulated and some data discarded become a part of the tacit knowledge base of the individual, affecting behavior in ways that are not readily apparent. Only when there are sufficient data that are in conflict with the hidden assumptions (Schein, 1987) does one, upon reflection, change the model. Thus "double loop" learning requires the completion of the cycle--the engagement of both abstract and concrete activities and both reflective and active behavior.

The direction in which the cycle is less important than the coverage of each point in the cycle. It is easier to imagine a person going through the points in sequence, however. Table 2 shows an example of how a new product development manager might progress through the learning cycle.

The model is consistent with other models of problem solving, the scientific method of observation and theory-testing, the precepts of quality programs. Although developed as a model for human learning and development, the model can be used as a framework for organizational learning as well (Dixon, 1994). As noted by Kim (1993), this learning model is remarkably similar to the Deming quality cycle; one can "map" the quality cycle activities into the Kolb learning cycle. The model has been used to describe strategic management and as a way to explain failures and shortcomings in strategic planning (Ramnarayan and Reddy, 1989). Note that if one posits that learning is the--or even a--key factor in maintaining competitiveness (as in Senge, 1990, Mason, 1992, and others), then the model may help explain why organizations recently have valued so highly alliances and collaborative arrangements. In an alliance, one partner may excel in reflective observation and abstract conceptualization (e.g., universities and some large mature enterprises), while others may have strong competencies in active experimentation and concrete experience (e.g., industrial enterprises and

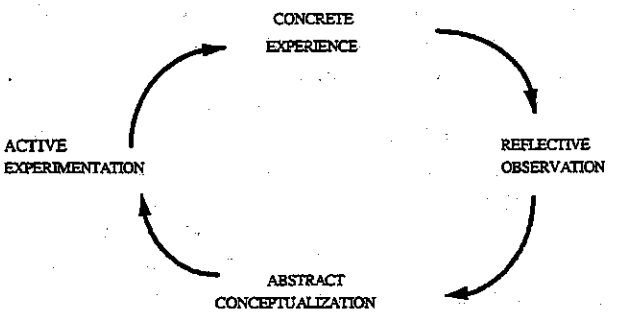

Figure 1. Kolb Learning Cycle

entrepreneurial firms). The collaboration enables each partner to maintain an "open system;" and together the partners can go through all four aspects of the learning cycle.

An Integrated Organizational Learning Model

The Kolb learning cycle becomes the framework for an organizational learning model (OLM) that can integrate the other dimensions of Huber's model and the information hierarchy above. With this framework, we may gain additional insight into the organizational processes by which learning occurs and compare different

organizational learning styles. Two aspects of Huber's model seem especially important in considering the role of information systems in organizational learning: memory (the storage of information) and the acquisition and exchange of information.

Organizational Memory

As Huber and others have noted, organizational memory is an important aspect of learning. Not only does memory serve as the storehouse of new knowledge, memory also can serve as a filter, highlighting aspects of the environment and hiding other aspects. Because of this filtering effect, some writers have argued in favor of "selective forgetting" as a means of initiating change in organizations (Starbuck and Hedberg, 1977; Hedberg, 1981).

Walsh and Ungson (1991) identify five "retention bins" of organizational memory: individuals, culture, transformations (the logic that guides the transformation of inputs), structures (such as individual role behavior), and ecology (physical structure of workplace). For this discussion, we emphasize the forms listed in Table 3.

Archives are one mechanism for storing what has been learned, but these often are viewed as remote, little used, storehouses of data or information that might be relevant for particular instances (e.g., an audit). More immediate are forms of memory such as policies and procedures have an impact on the day-to-day operations of the enterprise. Software are embodiments of policies and procedures that may have become embedded in routine operations. Culture is used to describe an overall memory characteristic of an enterprise that incorporates the underlying value systems and the foundations of the decision-making policies and routines. The culture of an organization often is not stated explicitly but rather is made up of implicit values and tacit rules that become a part of "how things are done" in an organization.

The basis of the popularity of "reengineering" is that it explicitly examines many of these memory mechanisms that are not routinely examined for current relevance to enterprise efficiency or effectiveness. In terms of the OLM, the components of organizational memory represent active, concrete routines that actualize (AE, CE) the abstract conceptualizations (ACs) of prior learnings. Unless there is deliberate reflection (RO) within the enterprise, these procedures and policies may continue beyond the limits of the relevancy and appropriateness of their underlying concepts. "Reengineering" is a deliberate attempt to reflect on the purpose of the overall business process and observe whether or not the current procedures are still appropriate. Reengineering thus seeks to incorporate *reflection* into the learning process and to take a fresh look at procedures that have become embedded in organizational practices. The expectation is that this will result in a new way of creating value that is less costly than the existing methods--in effect, the organization develops a new abstract conceptualization of how to get the work done.

Acquisition and Sharing of Information and Knowledge

Huber assumed that knowledge acquired by one part of an organization becomes part of the organization's knowledge base. This assumption is conceptually consistent with his model, but most enterprises find that knowledge in one part of the organization needed by another part of the organization is not always communicated routinely. The popularity of project and design teams, comprising members from a range of functional departments and organizational units, is a structured approach to assuring that all the necessary information within an organization is available when necessary to formulate plans and make decisions. As enterprises move from centralized, mainframe-based information systems toward distributed databases in file server and network environments, it becomes difficult to control the access of information. In particular, it is more difficult to assure that individuals or groups that need relevant information stored elsewhere in the enterprise (a) know of the existence of the information, (b) know of its relevance, and (c) are able to access the information in a timely way.

The question is, how can this be accomplished in what are increasingly less hierarchical organizational structures that are often distributed geographically and in which individuals are more empowered? If there is a strong, collective organizational culture that emphasizes (a) an awareness of the role and information needs of other organizational units and (b) the responsibility of sharing relevant information, then an enterprise may find that appropriate information routinely is available as needed.

Some field studies indicate that some organizations are able to enhance the sharing of information and strengthen their capabilities for learning, and the findings described below suggest how these organizations are able to accomplish this.

The OLM as a Basis for Interpreting Empirical Findings

The OLM is an abstract concept. By applying it as a way of analyzing the results of field studies (i.e., active experimentation), the resulting concrete experience provides an informative framework for reflection and may suggest additional models and experiments. In the following paragraphs, two studies are highlighted: one that examined the implementation of integrated information systems and the other looked at international joint ventures and examined differences in the acquisition and

storage of information in the participating Japanese and US organizations.

Implementation of Integrated Information Systems

A study of five organizations judged by their peers to be leaders in the implementation of integrated information systems examined the differences and commonalties among them (Nelson and Mason, 1994). [In this study, integrated information systems (IISs) were defined as systems that provided to everyone in the product life cycle all information needed--business as well as technical--in digital form.] The question addressed was why these organizations had been successful (in the eyes of peer organizations) when so many others that recognized the benefits of integrated systems had not.

The results were somewhat surprising. First of all, each of the organization judged themselves to be in a continuous process; none felt that it had achieved its goal of an integrated information system. None believed that its system was complete. Second, the common factors were, with a single exception, managerial and cultural, not technical. The only technical factor in common was that each of the organizations had the objective of capturing 100% of its business and technical data where the data originated--they wanted to avoid any rekeying of data from forms. The research team expected to find common characteristics in the technologies being applied and in the managerial approach followed. Instead, the organizations exhibited a wide range of technical and managerial approaches. The common business and cultural characteristics identified are shown in Table 4.

The findings are consistent with the subject organizations being "learning organizations." Some of the firms had tried to implement an IIS and failed. "We needed to make a cultural change first," they reported. "Only after we had changed how we viewed our organization could we effectively implement the integrated system." The technology itself, even if it worked, was not sufficient. One organization even admitted that they had installed an integrated system and found that they were operating **two** systems: the old one--tried, trusted--and the new one that was sometimes used, but not with the same confidence. As a consequence, the expected benefits of the new system were not being realized since the organization was burdened by the requirements to support both the old and the new systems.

Another organization noted that after installing the new integrated system, initial systems costs increased over what had been experienced with the older, manual system. Some of the staff argued for discarding the new IIS, since costs were higher with it than before. However, top management prevailed and managed to communicate that the organizational culture and expectations needed to change. "Initial costs were higher," managers said, "because the new system was forcing us to work together at the front end of the product cycle. Before, we were able to delay some coordination and design issues until later in the cycle. The costs of resolving these issues later were much higher, resulting in higher life cycle costs--only we did not see these costs until much later in the cycle."

In other words, the organization's image of itself and how it operated had to be changed along with the implementation of the new technical system. The organizations that tried to implement the system without first undergoing this step were trying to "learn" by skipping the step of reflective observation. Once they realized this (reflective observation), they were able to articulate a new vision (abstract conceptualization) that associated the benefits of the new IIS with competitiveness and life cycle costing. Under the old image of what stages of the product design cycle should cost, the learning stages of active experimentation (tracking costs) and concrete experience (actual costs) did not make sense ("the new system is costing more").

The successful organizations were able to have a communal culture through the characteristics listed in Table 4. The vision established the direction for the enterprise. The vocabulary and metrics enabled each individual and each part of the organization to communicate with others about the effectiveness of the ways the organization was pursuing its vision. The customer focus and the sense of urgency provide underlying values for the culture. These values and communications tools enabled the organizations to communicate the vision and achieve some enterprise integration without the technology itself. As one manager put it, "We achieved 80% of our benefits from the change in culture; only 20% came from the technology--but we needed the technology to stimulate the change in our culture."

Differences in Learning: US and Japanese Participants in Joint Ventures

Two studies provide data on differences in operations and procedures of participants in US-Japanese joint ventures that suggest differences in approaches to learning by the participating companies. The OLM is a useful structure for understanding some of these differences.

Analyses of findings from interviews of participants in US-Japanese joint ventures (Lynn, 1991; Lynn and Mason, 1994) found sharply different approaches to learning emerged from Japanese and US organizations. "US and Japanese firms clearly collect and process information differently, and this equips them to learn in distinct ways." (Lynn and Mason, 1994) Although it is not clear that national cultural differences are the only (or even the primary) reason for these differences, they are consistent with the cultural differences that might be expected from the works of Hofstede (1980), Hofstede, et al (1987), Hall and Hall (1987), and Aoki (1988).

One major difference appeared in the mechanisms for organizational memory and in the sharing of information learned by one person or part of the organization. In the US organizations, there seemed to be little formal structure for sharing information not directly related to technical design or business issues. Japanese organizations, on the other hand, exhibited norms of considerable information sharing.

For example, the Japanese engineers in the joint ventures reported spending hours each day composing and sending faxes back to their home organizations in Japan. When asked what happened to these faxes, the engineers were not sure, but they believed that the faxes were filed in a large central database to which other members of the organization could refer if, for example, they expected to be working with the US company (or any US company) in the future. (This procedure was indeed confirmed with later interviews.) The faxes were archived, and the archive became part of the corporate memory of the Japanese company.

In contrast, the US companies had no such archive. The Japanese even expressed concern that there was little corporate learning on the part of the US companies. "In Japan, if one person learns something, we expect that everyone in the company will know it. In the US, if one person learns something, then leaves the company, the knowledge goes with him."

In some cases, the knowledge learned by the different companies was viewed differently: As noted by Hall and Hall (1987), the Japanese culture is classified as a "high context" culture, in contrast to the classification of the US as a "low context" culture. Information that might be considered to be relevant to making a decision by a Japanese might be viewed in a US company as irrelevant (and the requesting of such information might even be illegal).

Lynn and Mason (1994) note that some authors have suggested that these differences: low context culture and the lack of systematic memory maintenance by the US companies and the high context, systematic organizational memory development and maintenance by Japanese companies prepare the two cultures to learn differently. US firms, it is argued, with a relatively weak organizational memory, may be better able to undergo double-loop learning (change abstract conceptualizations more easily) than the Japanese, and the Japanese, with a stronger, more easily accessed organizational memory, may be better able to do incremental learning.

Although not explored in any depth as a difference in organizational learning styles, Mason and Nelson (1994) found differences in US and Japanese engineers that were consistent with these ideas. The Japanese reported meeting more (as a department) and using "production stories" to disseminate information. The US engineers seem to depend more on computer databases for necessary information. Similarly, the US and Japanese engineers responded differently to the statement, "Turning out perfect work the first time is impossible..." The Japanese agreed; the US disagreed. This latter difference is consistent with a Japanese view of continuous improvement (kaizan) and with the US view of redesigning a system that then will be used for some period of time to "turn out perfect products." In other words, the Japanese view appears more consistent with an evolutionary ecology (continual learning, as through evolutionary changes) and the US view appears more consistent with a "punctuated equilibrium" or revolutionary ecology of learning at particular times.

Discussion: Implications for Information Systems in Learning Organizations

This paper illustrates the value of the OLM based on the Kolb learning cycle for individuals. The OLM enables us to highlight aspects of organizational learning and points toward an integrative model that encompasses a range of abstract, concrete, experiential, and reflective knowledge and data.

Because organizational learning is about acquiring and processing information, it is clear that information technology can be a significant support tool for organizational learning. By using the OLM framework to review prior studies of organizations that were successfully implementing integrated systems, we find that each of the activities is critical to successful implementation. In particular, the organizations report that success did not happen until there was a change in the organization's culture. Information technology by itself does not assure a learning organization. This leads to the question of the value of information technology to support learning. Does information technology (IT) support each of the four types of activities in the OLM?

Clearly, IT has been useful in collecting data from concrete experiences (transaction processing systems) and in supporting reflective observation (decision support systems). Management information systems, it could be argued, because they simplify and consolidate disparate data, assist managers in the learning step of reflective observation.

Recent studies on executive information systems (EISs) suggest that IT also is supportive in triggering reinterpretation of information and in supporting the evaluation of alternative conceptualizations of the firm. Vandenbosch and Higgins (forthcoming) characterized EISs as performing two roles: EISs enable executives to exploit opportunities within their mental model of the firm's niche in the environment (a model maintenance or model exploitation role--leading to efficiency), and EISs raise issues that cause the executives to question their old mental models (a model building role--leading to effectiveness). Vandenbosch and Higgins found that executives attributed greater value to their EIS's role of *challenging* their mental models than to the EIS's role of model exploitation. In terms of the OLM, the EIS was

supporting the executives in their abstract conceptualization activities.

It is not clear, however, that IT is fulfilling its potential in supporting organizational learning. Additional studies--even a reexamination of previous research--that use the OLM framework might reveal additional opportunities for IT to contribute to the different steps in the learning cycle.

The preferred style of organizational learning, like individual learning, appears to be dependent on organizational and national culture. It would interesting to develop an "organizational learning style inventory" or OLSI analogous to the LSI (Kolb, 1980 and 1984) for individuals. Such a tool could be useful in additional cross-cultural studies on organizational learning. A knowledge of preferred organization learning styles would aid in the development of applications that support the higher valued activities (preferred learning style) and of applications that would enable the organization to perform the other learning steps more efficiently. The OLSI might also be useful in arranging organizational alliances in which the partners have complementary learning styles.

Level	Type	What is included	Utility/ability	Requirements
1	Signals	sense of change	awareness	instrumentation, sensors
2	Data	symbols	communication	symbols associated with output of sensors
3	Information	answers to questions	to make inquiries	data associated with questions
4	Knowledge	know how	to predict	organized, codified information
5	Understanding	know why	to construct theories; learning	models based on knowledge
6	Wisdom	know what	to make decisions about relative importance	value system(s); knowledge of multiple stakeholders' values

Table 1. An Information Hierarchy Model

Activity	Model Stage
collect data on sales of existing products in different market areas	**Concrete Experience (CE)**
notice that sales of small bags of lawn fertilizer are large in the inner city and high density areas; speculate about alternative reasons for these high sales in these areas	**Reflective Observation (RO)**
decide that sales of small portions are high because apartment dwellers and inner city residents grow house plants and fertilizer is less expensive than plant food for house plants	**Abstract Conceptualization (AC)**
ask purchasers of small bags of lawn fertilizer how they use the product and why they purchased lawn fertilizer	**Active Experimentation (AE)**
learn that product is used on house plants and potted outdoor plants; cost is an important factor in the purchase decision	**Concrete Experience (CE)**
imagine how a low cost plant fertilizer can be packaged and marketed	**Reflective Observation (RO)**
design a new product and marketing plan	**Abstract Conceptualization (AC)**
test market the new product	**Active Experimentation (AE)**

Table 2. Example of Learning Cycle in New Product Development

Form	Examples
Archives	Lab notebooks, official histories, journals; external (former employees, the press)
Procedures	Written and unwritten standard work practices; established business processes
Software	Human resource records, design software, cost estimating models, marketing models, routine report generators
Culture	Value system (often undocumented except in organizational stories and "legends;" tacit assumptions about priorities

Table 3. Forms and Examples of Organizational Memory

Characteristic	Comment
Vision of the future of the organization	a business vision--articulated by top management
Vocabulary and language shared by both technical and business functions in the organization	the shared language provides the means by which the vision is translated into functional goals
Overall business metrics shared by the entire organization	progress toward the vision and functional goals are measured by a shared set of metrics
Sense of urgency	without the urgency, progress was slow
Customer-focus; collaborative approach to working with others	business focus on value creation for both internal and external customers
Goal of 100% data capture at the origin	the only "technical" characteristic

Table 4. Characteristics of Leading Implementers of Integrated Information Systems

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