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Abstract

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Introduction

It is well agreed that knowledge development processes in organizations differ substantially. Organizations use a combination of strategies toward knowledge creation, knowledge adoption, knowledge distribution, and knowledge review and revision processes. Some of these strategies are for knowledge assimilation, some others are for knowledge controls, and some others are for knowledge applications. Organizations, however, face typical problems in the knowledge development process, because the knowledge development process is chaotic and unsystematic (Davenport *et al.*, 1996). A few studies have addressed knowledge strategies briefly, but these studies, at best, can be described as personal viewpoints and opinions as they lack theoretical rigor and practical applications (e.g. Drucker, 1995; Freedman, 1992; Webber, 1993).

Researchers and managers, alike, agree that the knowledge development process is different from the manufacturing production process (Basili and Caldiera, 1995; Drucker, 1995; Quinn, 1992). Therefore, the principles of manufacturing production strategies cannot be applied in the knowledge development cycle. Unlike, manufacturing and operational processes, knowledge development processes are difficult to repeat, because knowledge activities are unstructured, intuitive and often result in intangible products (Davenport *et al.*, 1996). Therefore, production strategies as presently applied in manufacturing and operational processes cannot be grafted to knowledge processes (Basili and Caldiera, 1995). In knowledge works, organizing strategies should be defined and initiated based on knowledge development phases (e.g. knowledge creation, knowledge adoption, knowledge distribution, and knowledge review and revision). Each phase, in the knowledge development cycle, needs to be evaluated in context of its characteristics on repetition, standardization, reliability, and specifications. The present paper presents such a framework to show how different organizing strategies can be applied to the knowledge development process.

The main aim of this paper is to examine some of the organizing strategies that can be matched with different phases in the knowledge development cycle and provide a

framework between the knowledge development cycle and knowledge strategies. This paper makes important contributions to academicians and practitioners. The academic community has seen a rapid shift in understanding of firms as knowledge-based systems. The competitiveness of organizations is determined by organizational capabilities and core-competencies. By increasing our focus on the organization of the knowledge development cycle, we can sharpen the knowledge-based view of the firms. To managers, this research is important for two reasons. First, while the manufacturing industry has adopted a number of organizing strategies for process and product improvements, not much is known about the effectiveness of various knowledge strategies in the knowledge development cycle. Seeing that, in the present time, when most of the jobs are becoming ever more information intensive, and a majority of employees are moving to knowledge intensive industries, this paper, by providing an initial theoretical framework, offers some guidelines to managers to increase the effectiveness of knowledge works in knowledge-based-firms. Second, with increasing capabilities of information systems, such as Internet, Intranet, and telecommunications, an understanding of different knowledge strategies has become much more important (Burrows, 1994).

The reminder of the paper is organized as follows. The first section presents the concept of knowledge and the knowledge development cycle. The next section describes knowledge organizing strategies that can be associated with different phases in the knowledge development cycle. The paper ends with concluding remarks.

Concept of knowledge in organizations

Defining knowledge accurately is difficult. However, it is well agreed that knowledge is an organized combination of ideas, rules, procedures, and information. In a sense, knowledge is a “meaning” made by the mind (Marakas, 1999, p. 264). Without meaning, knowledge is inert and static. It is disorganized information. It is only through meaning, information finds life and becomes knowledge.

Information and knowledge are distinct based on their internal organization. Information is disorganized, while knowledge is organized (Koniger and Janowitz, 1995). For example, Darwin's observations, that the species adapt by gradual small changes, brought order out of the confusion to set the stage for evolution. Similarly Mendel's work on heredity, a simple organizing concept, opened the door to the science of genetics. Thus, the distinction between information and knowledge depends on users' perspectives. Knowledge is context dependent, since "meanings" are interpreted in reference to a particular paradigm (Marakas, 1999, p. 264).

During the industrial era, the foundation of knowledge was based on technical rationality and order. Knowledge was considered representative of a fixed reality, in which "knowing" was considered isomorphic with the objective fact (Dervin, 1994). However, present at, "knowing" is believed to be based on interpretations and discourse between different members. A part of knowledge, thus, becomes public-goods that is continually examined and interpreted by different social members (Raelin, 1997).

Knowledge dimensions

A number of researchers, such as Nonaka (1994), Nonaka and Takeuchi (1995), have used Polanyi's (1967) concept of explicit knowledge and tacit knowledge in defining knowledge dimensions. Explicit knowledge is easy to articulate, capture, and distribute in different formats, whereas tacit knowledge is difficult to capture, codify, adopt, and distribute, because individuals cannot easily articulate this type of knowledge. For example, an expert would not be able to verbalize clearly how she reached a conclusion about the causes of a problem, because tacit knowledge is deeply rooted in individual work routines (Kogut and Zander, 1992; Nelson and Winter, 1982). Experience, personal-interactions, and craftsmanship of experts, for example, cannot be articulated through procedures and recipes.

Knowledge development cycle

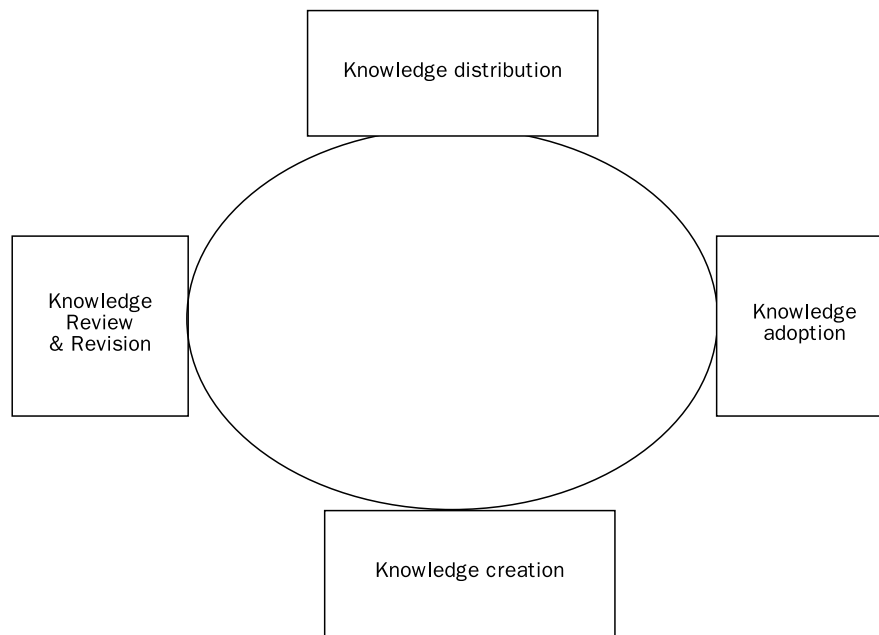
Present society is often referred to as knowledge society (Bell, 1973; Drucker, 1995). This categorization is, however, a crude one, as it does not tell the relative

relevance of knowledge for knowledge workers. For example, the works of a secretary, who is typing a memo, and a noteworthy novelist, who is scribbling a few lines to compose a new novel, are considered knowledge-based. Yet closer scrutiny reveals that typing a memo is more like a mechanical process, while composing a novel is more like an imaginative and a creative process. The secretary can easily specify how the final memo will look, but for the novelist, it is almost impossible to define clearly how the final novel will turn out. Both the secretary and the novelist have objectives and goals. However, the secretary has a clear beginning and an end, but as the novelist moves through a series of plots, scenes, and storylines, the beginning and the end, and the purpose of the novelist slowly begins to change. The shape of the final and completed novel could be quite different from the one that the novelist had initially anticipated.

From the above illustration it is clear that the process of knowledge creation, knowledge adoption, and knowledge reviews is higher for the novelist than for the secretary, even though their works could be referred as knowledge-works (Menou, 1995). In this paper, the knowledge development cycle is defined as the process of knowledge creation (Nonaka, 1994), knowledge adoption (e.g. Adler, 1989, Alder *et al.*, 1999), knowledge distribution (e.g. Prahalad and Hamel, 1990) and knowledge review and revision (Crossan *et al.*, 1999). Knowledge development work includes such activities as research and development (R&D), consulting, education, law, and accounting and is performed by professionals and technical experts (Davenport *et al.*, 1996). Based on the above definition, handling customer orders by a clerk through an information system will be considered a mechanical process, while developing a new product or a new tool will be considered a knowledge process.

At the individual level, knowledge creation and knowledge adoption may be sufficient to form a knowledge development cycle. However, since organizational knowledge is not equated with individual knowledge in the firm, therefore, the last two phases of the knowledge development cycle (e.g. knowledge distribution, and knowledge review and revision) become crucial for converting individual knowledge to organizational knowledge (see Figure 1).

Figure 1 Organizational knowledge development cycle



This view is consistent with Nonaka and Takeuchi's (1995) assertion that individual knowledge moves to group level and finally assimilates at the organizational level, through upward spiral of knowledge creation. It is in line with Argyris and Schon's (1978) argument that organizational knowledge is individually shared knowledge that individuals come to understand and interpret in a particular organizational context. Huber (1991) takes a similar view arguing that organizations learn through their people by developing and sharing ideas and meanings.

Individual knowledge, if not shared with others, will have much less effect on the organizational knowledgebase. Therefore, important tasks of management become to facilitate the process of interactions between organizational members and make them sensitive toward environmental stimuli so that individual knowledge in organizations is amplified and internalized to contribute to organizational knowledge base (Nonaka, 1994). Knowledge spiraling is important because often this process brings forth new perspectives on individual knowledge by checking its validity through debates and critiques at the group level, so that it becomes a "reality" of the organizational knowledgebase (Weick, 1979).

Figure 1 does not show specific directions in the phases of the knowledge development process, because several feedback and feedforward loops occur simultaneously at

different phases, making it difficult to depict the direction of knowledge flow clearly. For example, when a firm creates knowledge, it adopts and uses a number of metaphors and analogies based on the existing knowledge. Similarly, when a firm acquires and adopts knowledge from others, it modifies knowledge to make it suitable and practical for its own use. The knowledge distribution and sharing could occur either before or after knowledge is reviewed and revised.

Despite the complexity and ambiguity involved in distinguishing different phases in the knowledge development cycle, one can always make necessary judgment in inferring the knowledge development phases. For example, a research institution will be more preoccupied with knowledge creation, knowledge distribution, and knowledge reviews and revision, while a law firm will be more occupied with the knowledge adoption phase. A financial institution will be concerned somewhat equally between knowledge creation and knowledge adoption phases.

All of the phases in the knowledge development cycle are apparently interdependent. Knowledge creation, despite its originality and adaptive flexibility, is dependent on knowledge adoption to a large extent, even though the adopted knowledge may be put to different tests, combinations, and reconfiguration. For example, in a research school, one of the professors

commented[1], “Most of the research we publish from this school is of high quality that critically summarizes extant research and ties the crucial pieces to address new problems and their solutions.” Similarly, knowledge adoption may require “originality” so that the acquired knowledge is modified to the use of specific organizational circumstances. As a professor in one of the teaching schools recalls, “we may exchange notes, and teaching aids from other schools, but we make our own judgment which topic should be covered in the class and how a topic should be taught.” Knowledge review and revisions may go hand-in-hand with knowledge creation and knowledge adoption processes.

Knowledge creation

Creativity refers to the ability to originate novel and useful ideas and solutions (Marakas, 1999, p. 440). Even though some researchers argue that knowledge creation is basically an individual thought process (e.g. Crossan *et al.*, 1999), some others have recently shown that creativity can be learnt and taught (Marakas and Elam, 1997). In either case, we believe that knowledge creation in the organization is led through individuals, i.e. an organization creates knowledge through its individuals, who learn and generate new “realities” by breaking down rigid thinking and assumption (e.g. Argyris and Schon, 1978).

Knowledge creation is not a systematic process that can be planned and controlled (Lynn *et al.*, 1996; Mayo, 1959, p. 59). The process is, rather, continuously evolving and emergent. Motivation, inspiration, and pure chance play an important role in knowledge creation. The success of knowledge creation is a chance event, based on the convergence of the world reality and the structure of one’s thinking (Horgan, 1996). Creation is only a fearful possibility of finding a meaningful relation in uncovered combinations (Horgan, 1996, p. 153).

The knowledge creation process is evaluated based on its originality and adaptive flexibility to facilitate the solution of a problem in different contexts. The process of knowledge creation and evaluation not only requires organizations to alter their cognitive frameworks (Weick, 1979), but also forces organizational members to view reality in new perspectives (Weick, 1995).

Knowledge adoption

Because knowledge creation is an extremely difficult activity, many firms choose a simpler route – they acquire knowledge from other sources and adopt it for their use. Knowledge adoption may or may not be directly related to knowledge diffusion, because often, many firms are found to make use of knowledge adoption surreptitiously. Whatever the mechanisms of knowledge adoption, the strategy of knowledge adoption is believed to hedge firms against a lot of risks and save huge resources without worrying to manage the knowledge creation process. Despite the fact that knowledge obtained from outside cannot be easily imitated by competitors, many firms make prudent choices in carefully evaluating and adopting knowledge from outside. Only until a few years ago, many Japanese companies were (dis)credited for imitating knowledge from their western competitors and then using it for their own advantages (Aoki, 1988).

Depending on business objectives, an organization may choose different knowledge adoption strategies: imitation, replication, and substitution. Imitation has always been viewed as a defensive strategy for the organization, however, when markets are distinct, and customers are more style-oriented than product-oriented, imitation may prove to be a successful strategy. The example of many Japanese firms illustrates the case in point, how, over time, Japanese firms had improved on the imitated western knowledge and modified it to suit their national and organizational cultures (Aoki, 1988).

Replication is the strategy of duplicating one’s experience learned in a project-setting to other situations. Even though a firm may find it difficult to duplicate all the best-practices learned at a situation to other situations, it can still adopt and analyze some of the experiences in different settings. The example of New United Motor Manufacturing, Inc. (NUMMI) illustrates how General Motors had successfully replicated the experiences learned at NUMMI to its other plants (Adler *et al.*, 1999).

Substitution is the strategy of offering alternate offerings of popular products, processes, and practices, which can offer almost similar functionalities. For instance, many publishing companies offer CD-ROMs,

instead of the instructor's manuals and teaching aids. Airlines offer tickless tickets, instead of paper tickets. Furniture companies offer modular furniture pieces, which can be assembled easily by the customers, rather than selling the assembled furniture. All of the above practices do not encompass major breakthroughs in knowledge creation. They simply show adoption of new practices on available knowledge.

To some firms, knowledge adoption is a necessity, as they do not rely on inventing knowledge, but interpret past knowledge in new light. For example, a law firm does not need to invent new knowledge for the success of its cases, rather it analyzes its cases in light of the outcome of the similar cases that had only taken place in the past. Similarly, the aim of an accounting firm is not to come up with new knowledge, but use existing laws, regulations, and accounting standards as accurately as possible (Joyce, 1988).

Knowledge distribution

Knowledge needs to be distributed and shared throughout the organization, before it can be exploited at the organizational level (Nonaka and Takeuchi, 1995). In reality, distribution and sharing knowledge is not an easy task (Davenport, 1994). To what extent a firm succeeds in distributing knowledge depends on organizational culture and the amount of explicit knowledge available in the firm. An organization relying on traditional control and authority relationships finds it difficult to distribute knowledge, because a management mentality on supervision and order often limits the opportunities for the formation of social-units and groups to come together, considered necessary to convert individual knowledge to organizational knowledge (Argyris and Schon, 1978; Huber, 1991). Gurvitch (1971) asserted that social structures are knowledge-based systems. How organizations are structured can have direct bearing on knowledge distribution.

Organizational structure, based on traditional command and control, does offer the benefit in reducing "noise", but this kind of structure will be quite inflexible in distributing and sharing knowledge laterally and across the teams. By ordering knowledge distribution across a predetermined channel, i.e. from top to bottom, knowledge does not come under intense scrutiny and, consequently, create conflict with the performance of other

business units. On the other hand, if knowledge distribution channels are informal, developed based on trust and cooperation, knowledge distribution can be quicker and honest, and consequently, it can be put to a higher level of scrutiny (Broadbent and Lofgren, 1993).

The other concern for firms is to convert tacit knowledge into explicit knowledge, because tacit knowledge cannot be easily codified and put to use for other members in the firm.

Therefore, firms must create an environment that would make it simpler to convert tacit knowledge into explicit knowledge. The use of simpler sets of technological applications is one way through which a large amount of tacit knowledge is converted into explicit. For example, manipulation of a graphical user interface is far easier, explicit, and expressive than a text-based user interface in the application of a computer.

Knowledge review and revision

It is widely believed that an organization is a distributed knowledge system, which comprises of knowledge clusters or components (Walsh and Ungson, 1991). If these clusters are not reviewed and modified, they usually become passive (Leonard-Barton, 1992; Spender, 1996). Therefore, one of the important tasks for management becomes to review and replenish knowledge clusters continually in the organization.

The critical property of knowledge clusters is that they can be reviewed, revised, and reconfigured (Spender, 1996). For example, Canon has developed a variety of products, such as copiers, facsimile machines, laser printers, scanners, and cameras, based on reconfiguring and modifying its knowledge-base (Meyer and Utterback, 1993). Review and revision of knowledge clusters is important to deal with environmental stimuli, solve current organizational problems, and assess the applicability and risk of knowledge in current circumstances. Review and revision of knowledge is also important because a large part of knowledge, if not used, can easily be forgotten or ignored.

This phase in the knowledge development process is of special concern to firms, which are operating in highly dynamic technological and globally competitive environments. Educational institutions and other

state-owned firms, which for years insulated themselves from changing environmental realities, have also become targets of critics who contend that these institutions and firms have not kept pace with the changing realities to provide up-to-date knowledge to their customers. These institutions and firms are, therefore, advised to refine their past routines, working structures, and training methods to meet the present needs of the customers in the market.

Organizing strategies in the knowledge development cycle

The following section describes different knowledge strategies that can be applied in the knowledge creation, knowledge adoption, knowledge distribution, and knowledge review and revision phases. The strategies presented are not exhaustive, only illustrative. The main idea is to sensitize researchers to appreciate how different phases in the knowledge development cycle require different strategies to organize knowledge.

Organizing strategies in the knowledge creation development cycle

Probe and learn

The knowledge creation is the most chaotic and unsystematic phase in the knowledge development cycle. As the success of knowledge creation is a probable event, probing and learning, through a series of experiments can provide crucial insights in pursuing the knowledge creation phase (Lynn *et al.*, 1996). The examples of Corning's optical fiber program, GE's CT scanner experience, Motorola's cellular phone development, and Monsanto's NutraSweet invention have been well documented by Lynn *et al.* (1996). They have shown how Corning, GE, Motorola, and Monsanto brought radical innovations in the markets through a series of probing and learning processes. Probing and learning is an iterative process that narrows the field of focus in successive steps as to come closer to the success of the final "product", and each iterative process in probing becomes a learning opportunity to refine the thinking. A very similar experience was described by one of the professors in a research school, "We never know when we will find something radical. However, the main aim of the faculty

members and researchers in this school is to work tirelessly if they believe logically and intuitively that they have a chance to discover something new."

The above description of probing and learning is similar to Sitkin *et al.*'s (1994) assertion that total quality management (TQM) consists of two related and complementary goals, e.g. total quality control and total quality learning. These two goals, according to them, need to be balanced through exploitation and exploration as argued by March (1991). Control refers to organizational need for an activity to be done repeatedly in some standard fashion. The focus on repetition and standardization presumes a well-established understanding of the phenomenon under study. However, in unsystematic and ambiguous situations, extrapolation and deduction techniques are not considered appropriate. The focus in these situations is on learning to explore the unknown and pursue novel solutions (Garvin, 1993, p. 80). In this phase, the focus shifts from reliability of the process toward discovering new domains of knowledge and products.

If the main concern is with knowledge improvement, rather than radical discovery, the knowledge creation phase can run through structured processes, such as idea generation, screening, selection, development, testing and commercial launch. In idea generation, companies try to formulate numerous possible potential concepts. In screening, the feasibility of different ideas is checked. In selection, potential ideas are culled for further development. In development, the company tries to work with selected ideas to deliver new products or processes. In testing, different prototypes are checked for technical and market potential. In the commercial launch, full-scale introduction of the delivery is launched. This multi-phase process, according to Lynn *et al.* (1996), is analysis driven, in which the emphasis is on "getting it right the first time." In discontinuous knowledge discovery process, there is more emphasis on probe and learn rather than analysis. This is because discontinuous innovation processes are unsystematic and involve much more uncertainty and ambiguity in searching for the right combination of knowledge elements. Therefore, the main aim in discontinuous

knowledge development is to maximize learning.

Knowledge consistency

Consistency of knowledge is an important criterion for creating organizing knowledge (Hu *et al.*, 1998). Despite the use of such techniques as free association, lateral thinking, and provocation for creation of new knowledge, the consistency of knowledge is considered instrumental to provide a common frame of reference to evaluate the applicability of knowledge in different contexts. To obtain a sense of broader reality, a synthesis of knowledge from different sources and techniques can be used to integrate disparate knowledge items across a common frame of reference.

The synthesizing capacities of organizational actors are considered quite critical in knowledge creation. If organizational actors find it difficult to synthesize knowledge, they are likely to create redundancies and inconsistencies in knowledge, and may suffer from information-load.

Organizing strategies in the knowledge adoption phase

Knowledge reusability

Knowledge adoption is a structured process, because a large part of knowledge that an organization adopts for its use is already well established. In this phase, firms look for efficient ways to categorize, store, and catalogue knowledge. Some of the knowledge that firms store is repetitive and needs little modification. However, some of the other knowledge requires extensive modification before it can be used. For example, knowledge of accounting, law, and public administration acquired in a country may not be that useful in other countries until it is modified to fit the conventions and rules of those countries.

In the knowledge adoption phase, firms do not always reinvent knowledge anew. They try to standardize knowledge by capturing and storing routines, knowledge objects, and modules that are common among multiple projects. For example, a number of routines, practices, and programs, including reusable codes, are common to several software projects. In some cases, acquisition of easy-to-use and simple templates become important for providing common experience to knowledge workers. For example, common

forms, applications, and routine, captured electronically provide the opportunity for collective learning (Basili and Caldiera, 1995).

In a few projects, use of common objects and modules is an important way to provide competitive advantages to businesses. Basili and Caldiera (1995) have suggested firms use standardized codes for well-defined problems. For example, in systems development, software reusability has become a major source to increase programmers' productivity (Joyce, 1988). Object-oriented approaches seem to offer most promising methods for generating reusable software and composing systems. Similarly, law firms, accounting firms, and auditing agencies, which are dependent on interpreting past knowledge in new realities, the reusability of applications, methodologies, and scenarios can offer several opportunities to increase the productivity of people in the firm.

Knowledge validity

Validity of knowledge is important during the adoption phase. If acquired knowledge is not valid, it is likely to result in waste of time and efforts. The validity of knowledge refers to the extent to which knowledge-base produces socially accepted solutions of the problems. Organizations can use a number of perspectives such as matching the acquired knowledge with the required specifications and problems. Some of the dimensions that need be checked in knowledge validity are (see Marcot, 1987): adaptability of knowledge for modification and revisions so that knowledge can be easily used for current and future organizational problems, adequacy of knowledge to provide different perspectives on the organizational issues, coverage of knowledge to detailed conceptualization of solutions of problems, robustness of knowledge to map different levels of problems with correct solutions, and modularity of knowledge components to help in controlling the focus of the knowledgebase in the organization and the kinds of knowledge one needs to develop.

Organizing strategies in the knowledge distribution phase

Understand knowledge fundamentals

Individual knowledge is not equated with organizational knowledge, as individual knowledge needs to be distributed and shared

throughout the firm. When individuals in the firm become aware of the “fundamentals of organizational knowledge,” they, on their needs and cognitive preferences, can modify, readjust, and elaborate knowledge (Pralhad and Hamel, 1990). In other words, people in the firm begin to reinvent knowledge, based on the “fundamentals” of knowledge.

Knowledge needs to be distributed to achieve the firm specific goals. How organizational members in the firm interact with each other and with customers can have a direct effect on the premise of knowledge-base in the organization. Articulation and distribution of knowledge within the firm offers opportunities to uncover the reasoning behind the knowledge. As in our studies of three schools, two research and one teaching, different kinds of trends in the knowledge distribution emerged. In both of the research schools, there was intense communication between the members of each group, while in the teaching school, the conversation between group members was more formal and modest. In research schools, the group members were loosely knit to work a project, and sometimes, faculty members also worked in other groups (unless there was an intense rivalry or dislike between the members of two or more groups). In the teaching school, members in their groups were closely knit and associated only between themselves.

Media selection

The law of requisite variety states, “the variety within a system should be at least as great as the environmental variety against which it is attempting to regulate itself” (Ashby, 1956). That means if knowledge to be communicated is complex, the medium should be as complex as to handle the complexity of the knowledge. This line of thinking is described by Daft and Lengel (1986) through media richness theory. A rich medium, according to Daft and Lengel (1986), has a high level of capability to convey multiple verbal and nonverbal cues, allow for immediate feedback, and has personal focus. Daft and Lengel (1986) categorized face-to-face communication at the richest medium, followed by telephone, e-mail, and print communication media.

The other concern that is likely to affect distribution of knowledge is based on the authenticity of the knowledge source and the capacity of the knowledge receiver to the interpretation of the “meanings.” If the

source is not trustworthy and its intentions are perceived as “less than clear,” receivers need to check the authenticity and veracity of the knowledge communicated. Probably it is one of the reasons why a large part of information that is distributed through Internet and Intranet is never read or analyzed. The role of the knowledge receiver is important in its understanding and decoding of the meanings of knowledge. If a receiver is unable to make sense of the information and finds it difficult to comprehend the relevance of information, the well-intended knowledge could be irrelevant and out-of-context from the receivers’ views. Therefore, the structure, organization, and format in which knowledge is exchanged determines the effectiveness of knowledge distribution.

Organizing strategies in the knowledge review and revision phase

Reinterpret knowledge-base

Developing knowledge is not a simple task that can be furnished with a single stroke. In the earliest form knowledge is quite ambiguous and crude and requires continual improvement based on experimentations and prototypes before it could be adopted in the firm. Members in the firm may self-reflect on each piece of knowledge that they generate and go through a chain of “what-if” choices, but this process becomes susceptible to singular view and leaves little scope for further improvement. Therefore, knowledge needs to be reviewed and refined from multiple perspectives and interpretations.

Reviewing and refining knowledge means making knowledge more active and relevant for the firm in creating values. For example, Intel has been on the forefront to upgrade and improve the design and speed of its microprocessor continuously. Similarly, by improving continuously its position in the liquid-crystal-display (LCD), Sharp has become a dominant player in the LCD market. With a different aim, AT&T is now beginning to review its knowledge in multimedia (Collis and Montgomery, 1995).

Self-managed team

Self-managed teams in a firm and collaborative arrangements provide firms many with opportunities to manage knowledge review process (Inkpen, 1996). In many universities, faculty members are encouraged to use

Table I Organizing strategies and the knowledge development phases

Strategic actions	Knowledge processes			
	Knowledge creation	Knowledge adoption	Knowledge distribution	Knowledge review and revision
Plans	Experimentation	Standardization	Diffusion	Refinements
Control mechanism	Consistency	Reusability	Information access and retrieval	Thoroughness
Measurement goals	Early checks to eliminate inconsistencies	Early checks to find the relevance of existing knowledge	Flexible format in information/knowledge representation	Checks to refine knowledge
Issues	Freedom to experiment	Knowledge storage	Infrastructure connectivity	Training and expertise
Prime objectives	Innovation	Interpret past in terms of current realities	Assessing changing knowledge requirements and relevance	Collaboration and peer supports

peer-reviews to critique, revise, and refine each other's ideas and skills. The use of teams and collaborations becomes especially useful to collective learning within firms.

In self-managed teams, each team, by itself, is self-sufficient to manage its functions, while at the same time, self-managed teams can coordinate their activities and functions through learning, negotiations, and adjustments. Continuous learning, negotiations, and readjustments are necessary to enhance the dynamics of the knowledge development process. Many firms such as Federal Express, 3M, Exxon, and Chaparral Steel are making use of self-managed teams continually to develop and reinvent the knowledge process (Daft *et al.*, 1993). Collaborative arrangements serve a similar function, however they are much more critical to maintain because collaborations are created between two or more firms with some specific objectives in minds. For example, American-Japanese joint ventures (JVs), the suppliers to the automotive industry, recently entered collaborative arrangements with American partners. American partners signed a broad global technology agreement in return to understand product designs and scheduling systems, share successful human resource practices, and learn continuous improvement practices from JVS (Inkpen, 1996).

Organizing strategies and the knowledge development cycle

Based on the above discussion, a framework between knowledge organization and the

knowledge development process is shown in Table I.

In the knowledge development cycle, the knowledge creation phase is unsystematic and chaotic. Probing, learning, and evaluations are common means of managing the knowledge creation phase.

In the adoption phase, past applications of existing knowledge can be of immense use to a firm. By capturing common knowledge modules, objects, processes, and practices, a firm can standardize a large stock of reusable knowledge. The use of common knowledge modules, objects, processes, and practices saves considerable time and resources, and reduces conflicts and inconsistencies in the organizational knowledge-base (e.g. Pawson *et al.*, 1995). Knowledge modules, objects, processes, and practices which are of a general nature can be used in variety of contexts and applications.

In the distribution phase, knowledge infrastructure, media selection, and knowledge-fundamental are important so that a firm, as a whole, can be more responsive to customers. If employees can easily access, share and manipulate knowledge, firms can take timely actions to customer suggestions in products, processes, and services to meet customer expectations.

In the review and revision phase, knowledge is put to the test under different conditions. Peer reviews and clarifying of knowledge-premise are important to make knowledge active and relevant to the existing organizational realities. Since firms do not operate in static environments, knowledge, once created and developed, needs to be put

under tests for checking its validity and reliability. Reviews and revisions can offer new perspectives about existing knowledge to offer new insights to the organizational members.

Conclusion

Organizational knowledge is distinct from individual knowledge. A knowledge development cycle in an organization consists of knowledge creation, knowledge adoption, knowledge distribution, and knowledge review and revision phases. A firm needs to choose different strategies to organize knowledge in different phases in the knowledge development cycle. In the knowledge creation phase, a firm should provide several occasions for conducting planned and unplanned experiments to learn from uncertainty, instability, randomness, and chaos. In the knowledge adoption phase, a firm should acquire and standardize specific knowledge objects, modules, practices, and processes. In the knowledge distribution phase, a firm should ensure that each member has equal opportunity to access, retrieve, and share knowledge within the firm. In the knowledge review and revision phase, a firm should promote various and diverse views to offer sufficient avenues for learning.

Many organizations create new knowledge through experimentations and cross functional debates. Experimentations and debates not only generate new knowledge, but also reject unfit proposals quickly. Access to and distribution of information among organizational members is found to bring fresh perspectives on organizational routines. The challenge for organizations is to create an environment that demands and allows generation and processing of information continually. When an individual becomes a part of the organization, the individual and the organization begin to share knowledge for enhancing each other's knowledge-base, yet many times, the sharing is kept at minimum only to erode knowledge-base of the individuals as well as the organization. The integration between individuals and the organization increases not only organizational's learning capability but also organizational knowledge. The complementary process of sharing knowledge in itself is a big reason for the emergence of the organization.

Note

1

The categorization of schools as teaching school and research school is based on the amount of external grants brought by the faculty members in the school each year. Over the last four years, the research school has brought over \$1 million each year in contrast to \$33,000 per year by the teaching school.

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