Knowledge management in organizations: examining the interaction between technologies, techniques, and people

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Abstract

Argues that the knowledge management process can be categorized into knowledge creation, knowledge validation, knowledge presentation, knowledge distribution, and knowledge application activities. To capitalize on knowledge, an organization must be swift in balancing its knowledge management activities. In general, such a balancing act requires changes in organizational culture, technologies, and techniques. A number of organizations believe that by focusing exclusively on people, technologies, or techniques, they can manage knowledge. However, that exclusive focus on people, technologies, or techniques does not enable a firm to sustain its competitive advantages. It is, rather, the interaction between technology, techniques, and people that allow an organization to manage its knowledge effectively. By creating a nurturing and "learning-by-doing" kind of environment, an organization can sustain its competitive advantages.

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Introduction

In recent years, knowledge management has become a critical subject of discussion in the business literature. Both business and academic communities believe that by leveraging knowledge, an organization can sustain its long-term competitive advantages.

The resource based view (RBV) of organizations and competencies perspectives highlight the reflection of this changing trend in the business strategy arena (Nelson and Winter, 1982). Although management is aware of the potential that can be realized from knowledge resources, there is not a consensus about the characteristics of knowledge and the ways these knowledge resources should be used. Researchers and academics have taken different perspectives on knowledge management, ranging from technological solutions to the communities of practices, and the use of the best practices. For example, a majority of business managers believe in the power of computers and communication technologies in knowledge management, as they argue that information technology (IT) can provide an edge in harvesting knowledge from piles of old buried data repositories, consisting of point of sales (POS), customer credit cards, promotional sales, and seasonal discount data. Some others, however, contend that knowledge resides in human minds and, therefore, employee training and motivation are the key factors to knowledge management.

This paper takes a comprehensive view on knowledge and argues that defining knowledge management through technological or social systems alone engenders the bias in overemphasizing one aspect at the expense of the other. As we will show later, technologies and social systems are equally important in knowledge management. The conversion between data and information is efficiently handled through information technologies, but IT is a poor substitute for converting information into knowledge. The conversion between information and knowledge is best accomplished through social actors, but social actors are slow in converting data to information. That is one of the reasons we believe that knowledge management is best carried out through the optimization of technological and social subsystems. The roots of this view can be found in the sociotechnological perspective of the

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organization (Emery, 1959, 1967; Trist, 1981; Trist and Bamforth, 1951).

Despite the fact that a number of researchers highlight the competitive advantages of 3M, Hewlett-Packard, Buckman Laboratories, Scandia AFS, and Xerox as a result of knowledge management projects, they do not clearly describe the principles and procedures of knowledge management. This paper clarifies the concept of knowledge management and shows why technological as well as social systems become critical in knowledge management.

This paper makes important contributions to academic and business circles. The academic community is beginning to consider organizations as repositories of knowledge. The competitiveness of organizations is determined by organizational capabilities and core-competencies. By focusing on knowledge management, we hope to strengthen the knowledge-based view of the firms. To managers, this research is important for two reasons. First, while they have heard a lot of discussion on knowledge management, they are baffled with divergent perspectives carried on knowledge management. Seeing that, in the present time, most jobs are becoming ever more information intensive, and a majority of employees are moving to these industries, this paper provides a theoretical framework on knowledge management. Second, by emphasizing the capabilities of information technologies such as Internet, intranet, and telecommunications, and social systems such as employee training and motivation, this paper explains why an understanding of knowledge management has become much more important.

The outline of the paper follows. The paper begins by describing data, information, and knowledge. Next, we explain the concept of knowledge management. Later, we describe the importance of technological and social systems in knowledge management. The paper ends by describing the major implications and the conclusion of the study.

Data, information, and knowledge

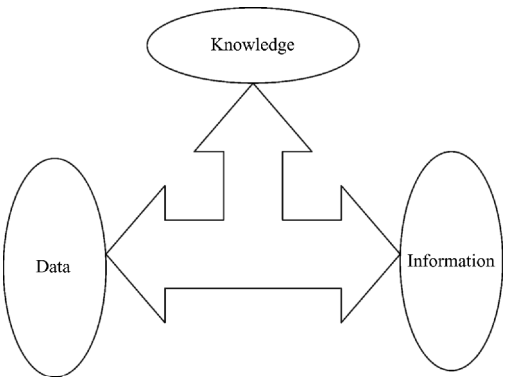
Defining data, information, and knowledge is difficult. Only through external means or from a user's perspectives, can one distinguish between data, information, and knowledge. In general, data are considered as raw facts, information is regarded as an organized set of data, and knowledge is perceived as meaningful information.

This paper posits the idea that the relationship between data, information, and knowledge is recursive and depends on the degree of the "organization" and the "interpretation" as shown in Figure 1. Data and information are distinguished based on their "organization", and information and knowledge are differentiated based on the "interpretation".

To understand this difference, let us take an example of a patient's visit to a doctor's office. The doctor elicits a lot of "information" from the patient. Some of this information becomes relevant as the doctor considers it important for the medical diagnosis of the patient. Some of the information elicited by the patient, however, is irrelevant for the doctor and becomes "data". The doctor quickly assimilates the acquired information in his (her) "knowledge base", and after finding a useful pattern in the information prescribes medication to the patient. If the doctor is unable to find a relevant pattern in the information, the doctor may recommend further lab-tests, and/or refer the patient to a specialist, who may be in a better position to find a useful pattern in the information.

Let us take the following possibilities now. If the doctor recommends the patient for some lab-tests, he (she) may try to elicit more information from the patient and may find some other pieces of information through the lab-tests. The information acquired through the lab-tests may confirm or disconfirm the doctor's initial hypotheses about the diagnosis. It may also happen that the preliminary analysis of the "data" (which was insufficient and incomplete without lab-tests) could be

Figure 1 The recursive relations between data information and knowledge



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quite relevant to the doctor for medical diagnosis of the patient. The point is that the doctor moves back and forth, recursively, between data, information, and knowledge.

If the doctor recommends the patient to a specialist, the specialist might elicit quite a different sort of information. It could also happen that the specialist may find some pieces of information quite relevant, which were earlier discarded by the doctor in making his (her) preliminary diagnosis of the patient. The point is that data, information, and knowledge are relative, because "data" for the doctor, in fact, become a critical part of the "information" for the specialist, which in part assists him (her) finding a useful pattern of the medical diagnosis (knowledge).

Looking from the above perspective, it is evident that "knowledge base" often dictates the distinction between data, information, and knowledge. This could be one of the reasons that in the knowledge intensive environment, many firms can sustain their competitive advantages. It is because the prior state of the knowledge base generates a positive feedback to support the creation, validation, presentation, and distribution of knowledge. Cohen and Levinthal (1990) explain this fact in arguing that knowledge expansion is dependent on learning intensity, and prior knowledge. In other words, accumulated prior knowledge increases the ability to accrue more knowledge and learn subsequent concepts more easily.

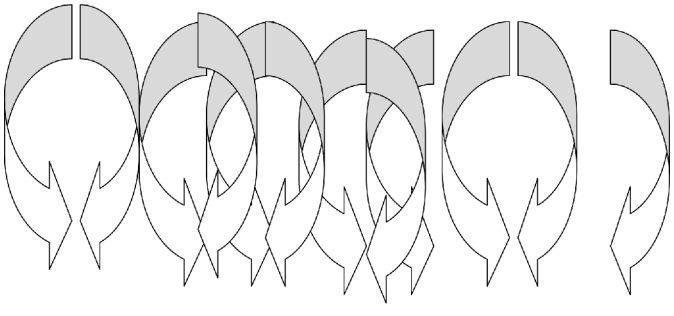
Therefore, we argue that knowledge is an organized combination of data, assimilated with a set of rules, procedures, and operations learnt through experience and practice. In a sense, knowledge is a "meaning" made by the mind (Marakas, 1999, p. 264). Without meaning, knowledge is information or data. It is only through meaning, that information finds life and becomes knowledge (Bhatt, 2000a). 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).

Nature of organizational knowledge

Individual knowledge is necessary for developing the organizational knowledge base; however, organizational knowledge is not a simple sum of the individual knowledge (Bhatt, 2000a). Organizational knowledge is formed through unique patterns of interactions between technologies, techniques, and people, which cannot be easily imitated by other organizations, because these interactions are shaped by the organization's unique history and culture.

The implication of the interactions between technologies, techniques, and people has profound consequences on knowledge management. It is because the pattern of interaction between technologies, techniques, and people is unique to an organization that it cannot be easily traded in the marketplace and imitated by other organizations. In general, organizations possess foreground knowledge and background knowledge. Foreground knowledge is much easier to capture, codify, and imitate, while background knowledge is tacit and sticky, which makes it difficult to replicate and imitate. It is dependent on organizational history and its unique circumstances. However, we believe it is not the intensity of the background knowledge that enables a company to achieve its superior performance. It is, rather, the intensity of the symbiotic relationship between foreground and background knowledge that forms the core-competencies of the organization and offers sustainable advantages to the company, as shown in Figure 2 (Prahalad and Hamel, 1990; Leonard-Barton, 1992). That is one of the reasons that core-competencies cannot be unbundled into the foreground knowledge or the background knowledge (Bhatt, 2000a).

Figure 2 The interaction between background knowledge and foreground knowledge



Note: Only shaded part of knowledge is visible, a large part of knowledge remains elusive to codification and imitation

Source: adapted from Bhatt, 2000a

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Knowledge management

We refer to knowledge management as a process of knowledge creation, validation, presentation, distribution, and application. These five phases in knowledge management allow an organization to learn, reflect, and unlearn and relearn, usually considered essential for building, maintaining, and replenishing of core-competencies (see Figure 3).

Knowledge creation

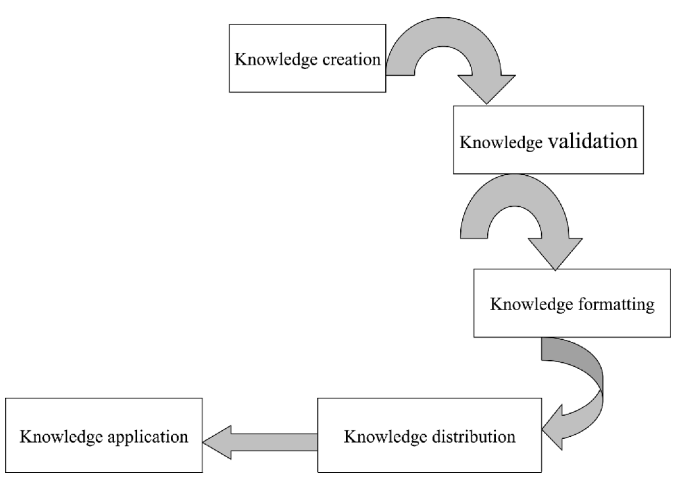
Knowledge creation refers to the ability of an organization to develop novel and useful ideas and solutions (Marakas, 1999, p. 440). By reconfiguring and recombining foreground and background knowledge through different sets of interactions, an organization can create new realities and meanings.

Knowledge creation is an emergent process in which motivation, inspiration, experimentation, and pure chance play an important role (Lynn *et al.*, 1996). The extent to which knowledge is considered to be novel depends if it solves existing problems more proficiently and effectively or may lead to innovations in the marketplace.

However, we do not recommend that, in every situation, an organization should create new knowledge from scratch. There are several other ways that can be pursued in combination with a "fresh-start" (Bhatt, 2000b). For example, a firm may reconfigure and recombine existing pieces of knowledge, along with the strategy of imitation, replication, and substitution. In some cases, an organization may develop its competence by focusing on its capabilities and limiting its shortcomings. By strengthening its research and development (R&D) capabilities, by scanning and monitoring external environments, and by borrowing and employing external technologies, a firm can get a better perspective of its knowledge base and may include new knowledge from the outside (Bhatt, 2000b).

Some firms may choose to organize and interpret existing information in a new light. For example, an accounting firm may choose to use existing accounting standards through different methods, using different procedures of discount, depreciation, and overhead costs. On the other hand, some firms may choose the process of "probe and learn", through a series of experiments (Lynn *et al.*, 1996). For example, Corning's optical fiber program, GE's CT scanner experience, Motorola's cellular phone development, and Monsanto's NutraSweet inventions were perfected through a series of probing and learning processes (Lynn *et al.*, 1996).

Figure 3 Knowledge management process activities



Knowledge validation

Knowledge validation refers to the extent to which a firm can reflect on knowledge and evaluate its effectiveness for the existing organizational environment. Because with age, a part of knowledge may be obsolete that needs to be reconfigured and refined to the existing realities. Often, multiple and continual interactions between technologies, techniques, and people may be necessary to test the validity of the knowledge (Bhatt, 2000b). For example, when an organization employs new sets of tools and technologies, and processes and procedures, it may need to update or refine the skills of its employees so that they can swiftly adapt to the new competitive realities.

Knowledge validation is a painstaking process of continually monitoring, testing, and refining the knowledge base to suit the existing or potential realities. As the realities change, so does the need arise to convert the parts of "knowledge" into "information", and "data", which may finally be discarded. It is because the development in a discipline may often constitute new information, rules and theories, and a part of the old rules and theories become outdated. Therefore, for organizations it becomes important that they continually review, test, and validate their knowledge base to keep up with the latest

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knowledge in the discipline and discard the outdated knowledge.

The question of knowledge obsolescence is a paramount concern to shape the core-competencies of the organization. The core-competencies cannot be easily imitated; they nevertheless become obsolete if not matched with the existing development in the fields (Nonaka and Takeuchi, 1995). For example, a firm that is competing through bricks and mortar cannot ignore the competition coming from click and the mouse. The competition between Amazon.com and Barnes & Noble illustrates this point.

Knowledge presentation

Knowledge presentation refers to the ways knowledge is displayed to the organizational members. In general, an organization may devise different procedures to format its knowledge base. However, organizational knowledge is distributed and scattered in different locations, embedded into different artifacts and procedures, and stored into different mediums such as print, disks, and optical media. Each of them requires different means of knowledge presentation. Because of these different presentation styles, organizational members often find it difficult to reconfigure, recombine, and integrate knowledge from these distinct and disparate sources. For example, there could be many departments or divisions, which may be processing data through their own devised conventions, often creating redundancy and incompatibility in data standards, formats, and programs. Though organizational members may find the relevant pieces of information by organizing data into separate databases, they will still find it difficult to integrate and interpret information different perspectives.

Organizational members work with a set of styles. If they are required to learn different sets of "work-styles", delays in integrating and internalizing new knowledge are common. Therefore, an organization may choose to employ similar codification, standards, and programming schemes or make use of predefined templates and schema to present data, information, and knowledge.

Knowledge distribution

Knowledge needs to be distributed and shared throughout the organization, before it can be exploited at the organizational level. The interactions between organizational technologies, techniques, and people can have direct bearing on knowledge distribution. For example, organizational structure, based on traditional command and control, minimizes the interactions between technologies, techniques, and people, and thus reduces the opportunities in knowledge distribution. Similarly, knowledge distribution through supervision and a predetermined channel will minimize the interactions and consequently reduce the opportunity to question the validity of the transferred knowledge. On the other hand, horizontal organizational structure, empowerment, and open-door policy speed up knowledge flow between different participants and departments. The application of e-mail, intranet, bulletin board, and newsgroup can support the distribution of knowledge throughout the organization and allows organizational members to debate, discuss, and interpret information through multiple perspectives.

Knowledge application

In general, organizational knowledge needs to be employed into a company's products, processes, and services. If an organization does not find it easy to locate the right kind of knowledge in the right form, the firm may find it difficult to sustain its competitive advantage. When innovation and creativity are the hallmark of the present competitive arena, an organization should be swift in finding the right kind of knowledge in the right form from the organization.

There are a number of ways through which an organization can employ its knowledge resources. For example, it could repackage available knowledge in a different context, raise the internal measurement standard, train and motivate its people to think creatively and use their understanding in the company's products, processes, or services. For example, by comparing the practices of gas compression in fields, a Chevron team learned that it could save $20 million a year by adopting the best practices in the field; with its implementation of Lotus-Notes and making a central group to capture and distribute information throughout the organization, PriceWaterhouse significantly improved its documentation process (APQC, 1999).

Knowledge application means making knowledge more active and relevant for the

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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).

The criteria of evaluating the usefulness of knowledge are not often readily apparent. However, if a company believes in the usefulness of knowledge in supporting its practical, and day-to-day common activities, management should provide sufficient latitude to the communities of practice for experimentation to assess the potential of the knowledge. Certainly, a number of factors, including time period of the completion of the project, its cost, and uncertainty of benefits, need a thorough evaluation. However, often management's understanding of the scope and potential of knowledge can have a dramatic effect on the outcome of the project's future.

Knowledge creating cultures

To direct individual knowledge for the organizational purposes, an organization should develop and nurture an environment of knowledge sharing, transformation, and integration between its members (Nonaka and Takeuchi, 1995). The organization should coach its people to coordinate their interactions in a meaningful way. To expand its "collective knowledge", an organization should make every effort in developing meaningful interactions between the communities of practice. In brief, knowledge management refers to changing corporate culture and business procedures to make sharing of information possible. It becomes as much a feat of developing technological solutions as working through the social and culture subsystems.

In a dynamic environment, organizations face a series of unexpected problems and unforeseen situations, which are difficult to control by one individual in the organization. Yet by coordinating the pattern of interaction between its members, technologies, and culture, an organization can work with complex and novel situations (Hutchins, 1991). Weick and Roberts (1993) refer to these interaction patterns as the "collective mind" of the organization. That also means that none of the members in the organization possesses all the relevant knowledge in accomplishing complex tasks; however, it is interaction between people, technologies, and techniques that support an organization in accomplishing complex and novel tasks. Therefore, one of the critical tasks of the management is to coordinate different packets of knowledge through information exchange and sharing.

The interaction between technologies and social systems

Certainly, as an organization becomes efficient in data processing, it can generate more information. The use of high-powered computers and communication networks can support an organization in data mining. However, the problem of the interpretation still remains, as only for a narrow range of problems has IT successfully been used for interpretation purposes. In a dynamic business environment, where an organization faces unexpected and novel problems, IT, at best, can be used as an enabler to turn data into information. It is only through people, that information is interpreted and turned into knowledge.

As argued earlier, the cycle between data, information, and knowledge is recursive. Therefore, an organization should be swift to turn data into information and information into knowledge. At the same time, the organization should not be overly attached to its knowledge base, so as to neglect the process of (re) conversion from knowledge to information and from information to data. In other words, once a piece of knowledge no longer fits to the existing context, the organization should be swift to discard it from its knowledge base.

In this sense, technical artifacts are enablers to organize data into information, and people are endowed with interpretative capabilities. Therefore, to manage knowledge, an organization will need to shape and redefine interactions between its people, technology, and techniques. The techniques employed by the operators or the users will determine how adroitly the technology is used and how the meanings of information are comprehended.

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By recognizing the criticality of the interactions between technology, techniques, and people, one can realize why there are often multiple interpretations of the same situation. For example, Orr (1996) discusses how two experienced technicians exchange quite different views regarding the malfunction of a Xerox machine. One technician interprets the error code from the machine literally, while the other technician considers the error code as a symptom of some deep-rooted problems. However, by exchanging their interpretations, technicians build their own communities and share efficient techniques of working through different situations.

In brief, an organization is not an exclusive artifact of a technological system, nor does it represent a social system. It is a system of personal experience, social relations, and technologies. Technologies enable coordination between communities of practice by minimizing a number of human and physical constraints. For example, IT enables the searching, storing, manipulating, and sharing of a huge amount of information per unit of time, by minimizing the limitations of time and space. However, the essence of offering a "meaning" depends on individuals. As individuals in organizations interact with others (including technologies, and techniques), they are likely to understand and share their views of the same situation in a different light. This interaction process is helpful in developing a holistic view of the realities, thereby facilitating the integration of a diverse body of knowledge in the organizations.

Implications

Knowledge management shapes the interaction pattern between technologies, techniques, and people. For instance, IT can capture, store, and distribute information quickly, but it has its limit on information interpretation. Organizations which have been successful in obtaining long-term benefits from knowledge management, are found to carefully coordinate their social relations and technologies (Bhatt, 1998).

Technological solutions can be captured and grafted. But to manage knowledge, organizations need to construct an environment of participation, coordination, and knowledge sharing. According to Ernst & Young, 56 per cent of executives believe changing people's behavior is one of the critical implementation problems in knowledge management (Glasser, 1998), because knowledge management projects force a company to redefine its traditional work procedures, power structures, and technologies. Therefore, a company needs to gradually assimilate the principles of knowledge management over the company's entrenched behavior.

In general, implementing knowledge management programs requires a change in organizational philosophy. For example, traditionally a number of companies collaborated on the basis of transaction cost economics; however, a knowledge management philosophy emphasizes learning collaboratively so that they can add more value to their products and services for the customers.

Conclusion

This paper has shown that knowledge management is not a simple question of capturing, storing, and transferring information, rather it requires interpretation and organization of information from multiple perspectives. Only by changing organizational culture, can an organization gradually change the pattern of interaction between people, technologies, and techniques, because the core-competencies of an organization are entrenched deep into organizational practice. When environment is dynamic, and complex, it often becomes essential for organizations that they continually create, validate, and apply new knowledge into their products, processes, and services for value-addition.

In general, organizations may use technologies or may take an informal approach in knowledge management. But to sustain long-term competitive advantage, a firm needs to create a fit between its technological and social systems. Technologies can be used to increase the efficiency of the people and enhance the information flow within the organization, while social systems such as communities of practice improve on interpretations, by bringing multiple views on the information.

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Knowledge management is a comprehensive process of knowledge creation, knowledge validation, knowledge presentation, knowledge distribution, and knowledge application. The coordination of these phases is critical, because short-circuiting any of the above phases may result in less than optimum outcome of the knowledge management.

If management is serious about making knowledge management as a priority in the organization, it will require reconsidering and analyzing the balance between technological and social facet of the organization. Putting too much emphasis on people or technologies is not sufficient; rather, management must revisit the interaction pattern between technologies, people, and the techniques people employ in using these technologies. Only by changing the interaction pattern in their favor, will managers be able to leverage knowledge for the competitive advantages of the organizations.

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