

Knowledge Management: Assessment of Strategies and Innovative Technologies

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Abstract—This paper is a focused study of knowledge management, its importance and benefits. It surveys the major knowledge management strategies and technologies and their role in enabling knowledge generation and discovery. Our ongoing research project is presented, that is related to a proposed knowledge management model for a computer science department. Finally, knowledge management research is assessed in the light of future major technological trends.

Index Terms— Knowledge management (KM), KM model, KM research, KM technologies, intellectual capital.

I. INTRODUCTION

Today's economy is increasingly thirsty and dependent on knowledge. One of the most important aspects of modern competitiveness is the ability to create, process, and globalize knowledge. In this economy, employees are empowered with knowledge, and hi-tech products are developed through knowledge-based processes. User needs have evolved to become more sophisticated than ever before, and have led to the development of products and services that are user-friendly, reliable, convenient, available everywhere and whenever. Also, the recent great strides made in the hardware and software technologies have resulted in inventing the internet, the world wide web, and multimedia. These advances have in turn made exceptional contributions in making knowledge abundant at an extremely large scale. As a result of all these developments, organizations are constantly reinventing themselves to incorporate knowledge in all its different layers so that to be able to develop products and services that are highly knowledge-based, intelligent, and adaptable. Organizations have realized the crucial importance of knowledge by restructuring themselves in order to be able to acquire new knowledge, store it, implement it, and share it. Indeed, organizations are constantly searching for and refining strategies, tools, and technologies that will help inventing knowledge-based concepts and intelligent mechanisms, in making cost-effective and competitive products and services.

Knowledge Management (KM) is rapidly rising, and has morphed into a set of applications like web portals, content management, and e-learning. In order to support this positive

spin and embrace a knowledge strategy, a culture will have to be nurtured whereby mutual trust and collaboration are widely and readily espoused. There is widespread acceptance that KM could have a high impact on business. The next challenge is to innovatively leverage precious intellectual assets to advance business and scientific causes. For forward-thinking companies, in order to face up to the economic challenges, they focus on channeling their most precious experience, and collective know-how. Therefore, a new breed of managers is emerging, who are competent at creatively and proactively generating and applying knowledge in order to enhance their organization's ability to innovate, compete and connect with their customer base. KM endorses practices and technologies that not only expedite the creation and exchange of knowledge, but also sponsors collaboration between business partners, suppliers and customers.

II. KNOWLEDGE MANAGEMENT DEFINITION

Knowledge management is the systematic leveraging of collective expertise and wisdom to enhance innovation, reuse and efficiency. It has roots in many fields such as:

- Cognitive science.
- Linguistics.
- Information systems.
- Database technologies.
- Library information science.
- Education.
- Sociology.
- Psychology.
- Communication.

Knowledge management deals with knowledge, information and data aspects. Some of the key attributes of KM are related to the ability to:

- Create new knowledge.
- Transfer knowledge.
- Access knowledge from outside sources.
- Use knowledge in decision making.
- Integrate knowledge within processes, products and services.
- Describe knowledge in documents, images, databases and software systems.
- Measure the value of knowledge holdings and their impact.
- Permit knowledge development through social and other incentives.

Though there is no one single definition of KM, it can be thought of as a systematic approach to managing intellectual capital in a way that improves employee performance and

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contribution, and provides the company with a competitive edge. Besides clarifying what knowledge management exactly entails both in theory and practice, the related terms of data, information, knowledge, and intellectual capital need also to be explained.

Data: Are quantities or figures that result from observation, experiment, or numerical calculation.

Information: Is the intelligence derived from the collection of data and related interpretations, and analysis regarding a given object, event or process.

Knowledge: Is information that is ordered, systemized, synthesized with a purpose to increase awareness, scholarship, understanding, and expertise. Knowledge is of three types: Tacit, implicit, and explicit.

1) *Tacit knowledge:* Is complex and personal, and is ingrained in individual experience over a long period of time. Tacit knowledge can be very valuable to an organization. However, because it involves such intangible aspects as intuition, perspective, and instinct, it is, therefore, difficult to reproduce quantitatively and to explain to others. Also, because tacit knowledge rules are deeply embedded in his acts, an individual with such knowledge will apply it in one, intuitive, way, and has to teach it in quite another, systematic, way. Most tasks involving pattern recognition skills are related to tacit knowledge. The most efficient way to transmit knowledge within an organization is face to face such as through mentoring, apprenticeship and communities of practice. Examples include making diagnostic decisions by radiologists in visually looking at radiographic films, and by pathologists in examining cell and tissue preparations.

2) *Implicit Knowledge:* Like tacit knowledge, implicit knowledge is owned by the expert. However, unlike tacit knowledge, implicit knowledge can be codified and extracted from the expert and reproduced and made shareable. Therefore, implicit knowledge requires some tools and techniques to translate tacit knowledge to assets that can be leveraged for the organization. However, not all tacit knowledge can be translated to implicit.

3) *Explicit Knowledge:* Can be transmitted from an expert to others through oral or written synchronous and asynchronous communications. Unlike tacit and implicit knowledge, explicit knowledge can be found in a book, web site, electronic media, guide or operational manual. The challenge with explicit knowledge is to deal with the great volume of information available.

While each type of knowledge has got its own challenges, the common challenge facing all three is to establish a reliable link between knowledge inquirers and suppliers.

While KM underscores the re-use of previous experiences and practices, it primarily focuses on innovation in order to sense and keep pace with evolving market forces. Therefore, by relying on both "experience" and "competencies" (creativity and potential to find solutions for future problems), a corporation can possibly provide responses to future dynamics for change.

Intellectual capital: In modern, knowledge-based, corporations, intellectual capital exists side-by-side with physical capital. Intellectual capital is made of three major

components: Employee capital, customer capital, and structural capital.

1) *Employee capital:* Is made of the expertise and experience of all the personnel in the organization. The intellectual assets are the sum total of what employees know and what they know how to do. A well maintained KM is important because the company is able to keep employees' skills and competencies even in the case when some employees leave the company.

2) *Customer capital:* This represents the company's relationships with its customers, including customer loyalty, customer buying behaviors, licensing, communications, and distribution methods. Loyal customers usually form close relationships with an organization through salespersons or customer representatives. Therefore, customer capital is shared by both employee and employer. At all times, a customer capital can be contained within a well designed KM system.

3) *Structural capital:* Is independent of the employees who creates it, and is the collection of structures, processes, research activities and inventions, classified documents, trade secrets, trademarks, intellectual properties, and information infrastructures.

III. IMPORTANCE OF KNOWLEDGE MANAGEMENT

There is an increased interest today in the application of KM concepts and techniques mainly because of the following major reasons:

- *Globalization of business:* Corporations have become today more multinational, multicultural, multi-location, and multilingual.
- *Quality and pace of work:* Employees are expected to be equipped with hard and soft knowledge and skills in order to be able to work a lot more intelligently, accommodate the required workloads, meet quality standards, and perform at very competitive time paces.
- *Knowledge continuity:* Because knowledge elements evolve constantly and the workforce move frequently, corporations are required to establish adequate mechanisms that ensure their knowledge bases are continually well preserved, maintained, grown, and updated.
- *Ubiquitous connectivity:* Because of the widespread real-time and global communication, workers are expected to acquire and use the latest tools and technologies in order to remain proficient in efficiently running almost real-time business everywhere and anytime.
- *Personal care:* In order to stay healthy, focused, and thus productive, the "intelligent" worker is required to be smart enough to afford quality time for personal pursuits and obligations.

IV. BENEFITS OF KNOWLEDGE MANAGEMENT

- Helps individuals solve problems and make learned decisions.
- Supports more effective collaboration.
- Helps the organization to plan strategically.
- Helps to develop better knowledge-based products and services.
- Increases opportunities for research and innovation.
- Helps build up-to-date, and specialized organizational knowledge bases and intellectual assets.
- Drives the corporation to stay competitive.

V. STRATEGIES AND TECHNOLOGIES [1]

1) Knowledge Creation Technologies

1. Content Management Systems

A content management system (CMS) is a software system used to create, edit, manage, distribute and publish content in a consistently organized fashion. CMSs are typically used for storing, indexing and searching text and multimedia content. CMSs are very useful for websites where the content is designed and developed by more than one person or department, or where maintenance is carried out by non-technical staff.

There are many benefits to deploying a CMS, including: streamlined development process, quicker turnaround time for new pages, greater consistency, greater capacity for expansion, and reduced site maintenance costs.

The operation of a CMS involves content creation, content management, and content publishing.

Content creation provides a development framework, mostly web-based, that allows non-technical people to create new pages or update content, without having to know any HTML.

Content management involves saving a page into a central CMS repository, that allows all page versions and changes to be saved, maintains access rights, and ensures integration with relevant information technology applications.

Content publishing publishes the content by allowing the appearance and page layout of the site to be applied automatically to one or more sites. Content publishing also deals with the automatic publication of a single source into different formats (e.g. PDF, Word, XML, etc.)

2. Data Mining and Knowledge Discovery

Data mining is the process of extracting useful information, patterns, and trends often previously unknown from large databases. It uses a combination of database management, machine learning, statistical algorithms, neural networks, and visualization. Data mining problems include association (making associations between data), classification (segmenting data into classes), and sequencing (ordering data).

The goals of data mining typically include market segmentation, improving marketing, customer profiling, fraud detection, and predicting future trends. In all of these applications, data mining technologies, mostly software systems, are used to discover and create knowledge.

3. Blogs

A blog is a web log, or open journal, that is frequently updated, and publicly accessible. Web logs have started as personal open forums of communication, and have evolved to become very efficient information bases that can provide very useful content. Blogs have gained so much widespread popularity that organizations are capitalizing on these to use them as effective means of communication for different purposes. Examples include using well maintained blogs to disseminate information, market products, collect customer feedback, provide customer service, exchange information about research and development, and project proposals. Blogs can be either text or multimedia-based. Blogs represent, therefore, an open space forum for knowledge to be created and shared.

2) Knowledge Dissemination Technologies

1. Networking Technologies

Networking technologies describe networking infrastructures, intranets, extranets, knowledge repositories, knowledge portals, and shared web spaces. Knowledge repositories store and document dynamic information, experience, and expertise about a specific field. Knowledge portals provide access to user-centric contents, communities, expertise, and services. They serve to connect people, processes, knowledge content and knowledge workers.

2. Groupware and Collaboration Tools

Groupware is defined as a software that permits group collaboration over a network. Groupware examples include e-mail and messaging, voice over IP, group calendaring and scheduling, shared authoring tools, video conferencing, file sharing and distribution, online forums and newsletters.

3. Wikis

Wikis are web-driven software that enables users world-wide to create and edit a web site's content. Basically, wikis allow user participants to write web pages and then appropriately link these with hyperlinks. Wikis, therefore, allow people to collaborate in generating useful knowledge.

3) Knowledge Application Technologies

Pattern Matching Tools: In the modern world of computers and the internet, where lots of data is available, information filtering becomes very useful in making the data more manageable. Knowledge workers (managers, technical and marketing staff) can thus better make use of such filtered data.

Pattern matching can be carried out through the implementation of intelligent agents. These are software systems that are autonomous, responsive, and cooperative. These can act on social content adaptively and proactively to produce personalized outcome. Intelligent agents acquire information from databases, the intranet or the web.

Intelligent agents, which can be web based or resident on a PC, use natural language processing (NLP) (a pattern matching technology) in automatically formulating queries for search engines. Intelligent agents can assume many roles such as filtering e-mail, filtering news, locating products and services for purchasing, scheduling appointments and air

traffic control. These agent roles can be grouped into the following categories [1]

- Agents that watch for specific information.
- Agents that can learn from a user's past experiences.
- Agents that shop for the best value item.
- Agents that intelligently search for information.
- Agents that act without human interaction.

Intelligent agents can reduce information overload, and thus help reduce cost and time. Hence, intelligent agents can greatly improve the interaction between knowledge workers and knowledge bases.

In all, knowledge application technologies dig deeper into the available data in order to extract and discover as much hidden yet useful knowledge as possible.

VI. OUR CURRENT RESEARCH PROJECT (IN PROGRESS): A KNOWLEDGE MANAGEMENT MODEL FOR A COMPUTER SCIENCE DEPARTMENT

Our ongoing research project deals with the development of a knowledge management model for a computer science Department. This takes into account the assessment/audits of student resources, professor resources and Department resources. The said KM model is expected to use these resources with a view of generating and sharing knowledge. The aim is to study the impact of such a model on students taking responsibility for their own learning, students connecting with the professors and Department resources to maximize their learning, on professors to enhance their duties vis-à-vis students, and on the Department in creating a better learning field featured by motivation, enthusiasm, and high expectations. The results of such a project will be disseminated in a future publication.

VII. KNOWLEDGE MANAGEMENT FUTURE RESEARCH

Knowledge management has been growing for decades and has caused many transformations in business and corporate culture. It is expected to continue to do so, even perhaps at a faster rate; as it shapes the state of the economy. Because the product of knowledge management is intellectual capital, companies will be increasingly valued not only on their physical assets but by their knowledge assets as well.

Today, knowledge management can be thought of being made of art, science, and technology. In the future, it will be almost unthinkable to make KM devoid of technology. In fact, technology will achieve great strides in shifting KM from being the property of a few to becoming the property of all workers. However, with the proper technology platforms in place, this can only happen if there is a culture that accepts and supports KM. The future of KM relies not only on creating knowledge systems, but also on building communities bound by a culture that embraces and shares knowledge anytime, anywhere. In this regard, technology will propagate knowledge beyond the geographical boundaries and time restrictions. The resulting collective knowledge base can thus be shared by businesses, suppliers, and customers. Pattern matching or classification tools can

subsequently be applied in order to aid in knowledge discovery.

As information technology continues to permeate the corporation's makeup, the future of KM looks very bright indeed. With the widespread application of many related tools, technology-enabled KM is set to achieve many future business goals such as authentic and up-to-date content, privacy, customized web interfaces and personalized products and services, system level and human computer interface (HCI), smart workplaces, and proactive marketing. Some of the technological trends include: knowledge-based content management, business intelligence, knowbots, intelligent agents, knowledge discovery tools, the great global grid (GGG), and virtual knowledge management.

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