KNOWLEDGE MANAGEMENT CAPABILITIES & INFRASTRUCTURE FOR E-COMMERCE

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ABSTRACT

Executives in leading organizations are increasingly recognizing that in order to maintain or gain competitive advantages, organizational knowledge needs to be managed and integrated with their corporate e-commerce systems. Organizational knowledge, also known as the intellectual capital, is a pivotal corporate asset, and therefore, organizations require an infrastructure to create, structure, disseminate, and apply the knowledge at the right time to the right people or to the right e-commerce applications.

This article defines what capabilities will be required for enabling knowledge management, describes the various technology elements required for knowledge management, and provides a technological framework for knowledge management capabilities and infrastructure for e-commerce which should assist organizations to identify and build innovative knowledge management solutions that meet their complex business requirements.

INTRODUCTION

In the new millennium, most companies are setting up or expanding new e-commerce systems (which is conceptualized as a subset of e-business systems), hence seeking new capabilities for managing Web-based interactions with their suppliers, partners, and customers. The primary uses of such e-commerce systems have been to provide effective coordination between (a) the purchasing operations and its suppliers; (b) the logistics and transportation providers; (c) the sales organization and wholesalers or retailers who sell their products; and (d) the customer service or support and the customers. One of the key ingredients necessary for the success of the above uses is the continuous availability, accessibility, and application of the appropriate organizational knowledge within these e-commerce systems. These include knowledge of many different types such as business processes, business rules, customer profiles, products, problem solving, and expert insights.

Executives in leading organizations are increasingly recognizing that in order to maintain or gain competitive advantages, organizational knowledge needs to be managed and integrated with their corporate e-commerce systems (10, 12, 16). Organizational knowledge, also known as the intellectual capital, is a pivotal corporate asset, and therefore, organizations require an infrastructure to create, structure, disseminate, and apply the knowledge at the right time to the right people or to the right e-commerce applications.

The focus of the article is on technology solutions that enable business practice of knowledge management in e-commerce. In particular, its purpose is to assist organizations to identify and build innovative knowledge management solutions that meet their complex business requirements with the assistance of the presented technological framework for knowledge management capabilities and infrastructure for e-commerce.

The rest of the article is organized as follows. Section 2 provides the distinction between information management and knowledge management. Section 3 provides an overview of the knowledge management environment in terms of its objectives and processes. The knowledge management capability framework and a brief discussion of the technologies supporting these capabilities are provided in Section 4. Section 5 presents the knowledge management infrastructure in terms of its architecture, its standards for e-commerce, and its capabilities integration; and the final section presents the concluding remarks.

INFORMATION & KNOWLEDGE MANAGEMENT

The primary difference between the terms information and knowledge is in the level of understanding of their underlying organizational data. The accumulation of transactional data into a meaningful context provides information. The next level of higher understanding is characterized as knowledge. Well-managed information that is properly cataloged and structured, available and accessible by the right people and processes at the right time becomes knowledge.

Information management can be characterized as organizational document or content management. Information management tools enable users to aggregate, manage, and deliver content over the company's Intranet. Knowledge management treats knowledge as a resource by exercising selectivity, imposing order on information resources, adding structure to ill-structured information - such as the insights, understanding and intuition of experts for solving specific problems - to increase its value, and proactively capturing information that might be useful in the future.

Thus, knowledge management incorporates careful identification of the target user community and its needs, meta-information that defines the types of information to be included and how they will be categorized and summarized, and administrative tools providing quality control and high availability. The primary distinction between knowledge management and information management is that the content itself is different. The former is inevitably less structured and ideally incorporates informal problem-solving experience and expertise rather than being limited to automated data manipulation and reporting.

In a broad sense, knowledge management is a business concept, which includes concerted, coordinated, and deliberate efforts to manage the organization’s knowledge through the processes of creating, structuring, disseminating and applying it...
to enhance organizational performance and create value (5, 13, 14, 17). The knowledge management strategy of an organization is predicated on shared learning, collaboration, and the sharing of knowledge (6, 15). Furthermore, it is based on the belief that significant organizational productivity improvements can be achieved through retaining and reusing knowledge across the organization (1, 17).

An organization's e-commerce and knowledge management strategies should complement each other because success in a competitive marketplace depends critically on the quality of knowledge that organizations apply to their key business processes.

**KNOWLEDGE MANAGEMENT ENVIRONMENT**

Environment Objectives

The main objectives of the knowledge management environment in an e-commerce-based organization are as follows: First, to provide effective and timely access to corporate knowledge at all levels - strategic, tactical and operational. Second, to transform the diverse organizational members, with specialized skills and experience, into a knowledge work community of practices. And, lastly, to enable evidence and/or knowledge-based decision-making at all levels - strategic, tactical and operational - to improve the quality and timeliness of the decisions made.

Environment Processes

An organization's knowledge is its professional intellect such as know-what, know-how, know-why, self-motivated creativity, best practices, concepts, values, beliefs and method of working that can be shared and communicated. The knowledge may be explicit, which means the knowledge is in a structured form that is suitable for easy storage and processing such as knowledge stored in databases and knowledge bases; or it may be tacit, which means the knowledge is in a subjective (non-structured) form that needs to be structured before it is used for storage and processing such as ideas, insights, values, and judgments of individuals (13).

The knowledge management environment (Figure 2) consists of four processes, namely, knowledge creation, knowledge structuring, knowledge dissemination, and knowledge application. A brief description of each is provided below.

The knowledge creation process includes knowledge acquisition and knowledge representation. Knowledge can be created from several sources and methods such as R&D center, organizational learning outcomes, lessons-learned analysis, and innovation. The procedure for and the method of acquiring knowledge from both internal and external sources need to be developed. The knowledge is represented using the formal representation methods developed by the organization for processing.

The knowledge structuring process includes defining, storing, categorizing, indexing, and linking digital objects such as documents and images to knowledge units. Mapping the existing and available knowledge (including expertise and skills) in terms of its context, relevance, and locations helps in the classification of the knowledge into taxonomies. Storing the knowledge in properly indexed and Inter-linked knowledge repositories such as company yellow pages of expertise and knowledge, skills inventory, best practices inventory and lessons learned inventory are then performed.

Devising a classification system is the key to building knowledge taxonomies. For example, each topic heading in yellow pages directories of business is an example of a category in taxonomy. The classification system groups similar documents together and fits them into topical categories, which can be generated by manual or automated means, or a combination of the two. To truly add value to knowledge spread across the enterprise, organizations must provide multiple ways to categorize it. This allows knowledge management system users to slice through the knowledge using the method best suited for their specific problem (2, 3).

The knowledge dissemination process primarily involves knowledge sharing and collaboration. Presenting, which includes searching for (pulling) and subscribing to (pushing), automatically relevant content to users on the basis of their needs and interests, with sufficient flexibility to render it meaningful and applicable across multiple contexts of use. It includes, among other categories of knowledge, the transfer and diffusion of best practices. Knowledge sharing is done using different means, some of which are automatic and some manual, such as training and education, company Intranet, communities of practice, external or internal benchmarking, documentation and newsletter, and cross-functional teams.

The knowledge application process involves applying, which includes retrieving and using, knowledge in support of decisions, actions, problem-solving, developing competency maps to place people in best jobs and teams for improving productivity, establishing communities of interest, automating routine work (for example, workflow), providing job aids (for example, customer support), and training to bring people up to speed quickly (7).

**KNOWLEDGE MANAGEMENT CAPABILITIES FRAMEWORK**

In order to implement the aforementioned four processes to create the knowledge environment, organizations need to provide and support several categories of knowledge management capabilities through the deployment of currently available technologies. This section identifies many different kinds of knowledge management capabilities, organizes them into several logical categories, and describes each category. Figure 2 presents them as a capabilities framework. Additionally, examples of currently available technologies that support each capability in the framework are provided in Figure 3.

A brief discussion of each category of the framework and the currently available technologies that support these categories are presented below.

Knowledge creation and capture are performed by both humans and software agents incorporated into tools. Knowledge creation is the formal process of acquiring the knowledge from the source and using a representation method for its capture. Knowledge capture is the process of inputting the acquired knowledge in the system using the chosen representation method. Several authoring softwares are available for knowledge capture. Example technologies for this category include PC PACK, WinEnte, Trellix, and Folio Views. PC PACK is a portable package of integrated tools for requirements and knowledge engineering.

Knowledge organization and storage techniques contribute to the effectiveness of knowledge retrieval and distribution. Major techniques for organizing knowledge include categorization, indexing, standardization, and navigation. Several technologies for knowledge classification and indexing are available. The creation of a knowledge repository involves collection, summarization, organization and integration of knowledge across multiple information sources in an
organization. Data warehouses using multi-dimensional database structures that let users analyze large amounts of knowledge from many perspectives are commonly used. Document management also provides the same capabilities, for unstructured and semi-structured knowledge in documents (3). Documents can be searched for, retrieved, and managed based on a combination of the meta-knowledge fields and full-content indexing. Example technologies for this category include Documentation, GrapeVine, Intraspect, and Aeneid.

Knowledge retrieval relies on advanced searching features such as natural language searching, proximity searching, search by metadata fields, and concept searching. Users are able to set up search software agents for monitoring knowledge warehouses based on full text searches, knowledge map categories, author names and other metadata fields (9, 11). Knowledge of data mining software and agents are available for sifting through large amounts of knowledge to produce knowledge content relationships to identify particular new patterns or trends between and within knowledge categories (4, 8). Example technologies for this category include WebIntelligence, SmartFinder, InfoSlleuth, Intelligent Miner, IDIS, and Fulcrum Knowledge Network.

Collaboration and Workflow technologies span a broad continuum, including ad hoc information sharing through e-mail and common access to documents and more structured systems for document creation, approval, publication, and use. The Workflow technologies help one define all the steps in a collaborative process from start to finish, including all exception conditions, usually based on established business rules. Key to workflow management is the tracking of process-related information and the status of each instance of the process as it moves through an organization. Example technologies for this category include Microsoft Outlook/Exchange, Lotus Notes, ChangePoint, eRoom, Groupwise, NetMeeting, and Consilium. Some of these technologies, including Lotus Notes, are used for asynchronous conferencing, voting, signoff, and reviews.

An emerging technology called Peer Communication Network is a Web version of existing technologies like Lotus Notes. It is designed to let users work collaboratively and communicate with their colleagues online without using proprietary software. Users can use a variety of shared applications like designing a new product or visiting a Web site as a group. The software can automatically update information on client computers when users reconnect to the network workspace.

Distribution technologies automate the transfer of knowledge to users using push, publishing, or notification methods. Although e-mail has been traditionally used for this purpose, emerging Web-based technologies have better presentation, real-time updates and the ability to push applications as well as content for electronic publishing. Software agents are frequently used to develop push technology. Example technologies for this category include InfoMagnet, DIDS, and Insight. These technologies are built around a knowledge delivery architecture that provides Web document delivery and report distribution services. These services are delivered as knowledge packages at each user's preferred location — printer, Web browser, inbox, or e-mail.

Assimilation technologies facilitate interpretation, summarization, visualization, explanation, and interactive exploration of time-oriented information and the multiple levels of meaningful concepts that can be abstracted from the information. These technologies help reduce the information overload problem of the user. An example technology for this category is KnowledgeX, which has a suite of knowledge management software that can be utilized individually or together for assimilation of knowledge. The suite includes KnowledgeX Analyst, KnowledgeX Context Miner, KnowledgeX Site Harvest, and KnowledgeX Viewer.

Transformation technologies for knowledge management include the embedded tagging capabilities for XML. It has the potential to provide the ability to treat a collection of semi-structured documents, which means non-tabular data representation, as though they were in a relational database, thus imposing the appearance of structure and allowing the documents to be acted on by procedural logic in the same way that data in a relational database can be. This will be possible through the development of XML schema and query technologies, which are currently underway.

**KNOWLEDGE MANAGEMENT INFRASTRUCTURE**

Information technology infrastructure for knowledge management must be designed to provide relevant, effective, timely, and accurate knowledge to every employee and business process that may need and use it. A knowledge management environment built using such an infrastructure would assist a company to gain competitive advantage in its e-commerce endeavors. The knowledge management infrastructure is presented below in terms of its architecture, its standards for e-commerce and its capabilities integration.

**Knowledge Management Architecture**

The architecture envisioned in this research is Intranet and Extranet based. Intranet, an organization's private network whose sites can be located centrally or distributed among departments or divisions, is ideal for sharing information that is both dynamic and richly linked and for allowing collaborative work. Extranet is a set of Intranets connected for specific objectives that allow access to designated systems and people outside the enterprise, such as partners, customers and suppliers. Extranets will play an increasingly large role in knowledge management because knowledge bases built on information drawn from partners, customers, and suppliers will become essential for companies to compete in an e-commerce environment.

The architecture, presented in Figure 4, is designed around the principles and capabilities of enterprise knowledge portal. Using a portal architecture allows for a common interface to knowledge from different knowledge sources such as documents, applications, and data warehouses (2, 10). The architecture is designed to accelerate the penetration of knowledge management within organizations because the users, who most likely are familiar with the portal concept through the use of Internet portals such as Yahoo will expect that the interface component of the architecture to offer similar capabilities for knowledge management, such as search engines and automatic document summarization, across the enterprise-wide collection of documents.

The architecture, at a high level, can be explained in two parts. First, it is designed to leverage existing knowledge and to enable creation of new knowledge through a continuous learning process denoted by the knowledge learning loops. And second, the capabilities component of the architecture is denoted by the rectangular, labeled boxes. Brief description of each of the capabilities is provided below.

Presentation involves personalizing both the access to and displaying the results of user interactions with the system. It is designed to let every organizational user know where to go to find the organization's knowledge through a single browser-based point of entry to all information that the user needs.
Personalization provides the ability to customize what types of information are relevant to a user and how that information is presented.

The personalization function helps personalize content and services to deliver tailored content or information to users based on several user criteria or preferences. The primary capabilities of this function include creation of personalization profile of individual users or groups or departments or divisions, providing personalized navigation, providing personalized notification, and the ability to personalize the content categorization. Personalization is often accomplished by using software agents, commonly called spiders, to get the information and handle user profiling.

The collaboration function is designed to connect people with people through communities of practices; to preserve the discussions; and to stimulate collaboration by integrating the knowledge repositories and collaboration applications such as workflow.

The process function allows users to participate in relevant business processes in the context of their own roles. Through this function, users have access to knowledge management applications such as knowledge or evidence based decision support system applications that enable increased responsiveness to customers and partners.

The publishing and distribution function provides the means and a platform for users to easily capture and distribute the particular kinds of knowledge assets they need to monitor without requiring them to learn complex programming syntax. Software agents are used extensively for this function. These agents are designed in such a way that users can set up and control them. The users can specify in them the type of knowledge he or she wants to publish, distribute, and receive. The frequency (by time and/or quantity) and method (by e-mail or Web page) are important parameters that should be set up by the users.

The integrated search function is designed to reduce the information overload and usefulness of search results to the users. Integrated search across all repositories are performed by default but users can also identify the repositories they want to search such as Web pages, e-mails, and discussions. This function should also provide the ability to automate indexing and to crawl frequently to keep the index current.

The categorization function allows users to browse, create, and manage knowledge categories. It establishes a process and guidelines for authoring and publishing knowledge categories by the users. Business groups or departments or divisions are made responsible for creating and managing their own subject area taxonomies.

The integration function ensures seamless and consistent navigation among and between the above functions and knowledge sources such that all individuals can use the organization's combined knowledge and experience in the context of their own roles.

Knowledge Management Capabilities Integration

The integration of knowledge management capabilities is conceptualized and presented in Figure 6 using three layers, namely capability, structure and organization. The capability layer shows the flow of knowledge through the knowledge management capabilities. New relationships and knowledge are created and captured, and tagged, using knowledge from existing taxonomies and personal and/or environment profile information. The new knowledge is organized and stored and personalized based on the existing taxonomies and profile information. Retrieval and assimilation are user-initiated processes independent of the structure level. Assimilation of extracted knowledge leads to new knowledge and/or relationships, which in turn feed back to create and capture capability.

The structure layer acts as the conceptual glue that holds together the capability and organization layers. The organization layer shows the entities responsible for developing and maintaining the knowledge objects in the structure layer.

CONCLUSION

The article presented a technological framework for knowledge management capabilities and infrastructure for e-commerce. It is very important for us to understand that while technology is a vital component, it alone is not a complete knowledge management solution. A complete solution would require an equivalent study and understanding of its other components, namely the establishment and administration of the knowledge management processes, the members of the knowledge management group and their roles to implement, maintain, and grow knowledge management in the organization; and the development of an appropriate organizational culture that sees the values of and promotes knowledge management.

Knowledge management is an emerging capability in many organizations—that offers the promise to combat information overload, find critical information more efficiently, push time-sensitive information to decision-makers, utilize staff more effectively, and organize knowledge for rapid retrieval and reuse. But most importantly, it provides ways to improve the interactions with enterprise partners such as customers, suppliers and collaborators. The success of e-commerce will increasingly depend on these knowledge management capabilities. However, like any emerging discipline, knowledge management faces many challenges. Among others, knowledge management tools are still developing and therefore, tool integration is yet to be addressed; and the technical infrastructure needs to be stable and standardized.

REFERENCES


FIGURE 1
The Knowledge Environment

Hard or explicit knowledge

Soft or tacit knowledge

Knowledge Creation
Research
Observation
Innovation
Invention
Brainstorming
Strategizing

Knowledge Structure
Develop training
Models
Specifications
Write procedures
Write books
Create libraries
Web pages

Knowledge Dissemination
Use libraries
Inter/Intranet
Take seminars
Reading
Conferences
Take Training
Seminars

Knowledge Application
Making decisions
Making choices
Lowering cost
Imp. performance
Improve TPT
Improve efficiency
FIGURE 3
Knowledge Management Technologies

<table>
<thead>
<tr>
<th>Category</th>
<th>Example Technologies</th>
</tr>
</thead>
<tbody>
<tr>
<td>Knowledge Capture &amp; Creation</td>
<td>Wincite, Trellix, FolioViews</td>
</tr>
<tr>
<td>Knowledge Organization &amp; Storage</td>
<td>Documentum, grapevine, Intraspect, Aeneid</td>
</tr>
<tr>
<td>Knowledge Retrieval</td>
<td>WebIntelligence, SmartFinder, InfoSleuth, Fulcrum Knowledae network</td>
</tr>
<tr>
<td>Collaboration &amp; Work Flow</td>
<td>Outlook/Exchange, Lotus Notes, ChangePoint, eRoom, Groupwise, NetMeeting, Consillium</td>
</tr>
<tr>
<td>Distribution</td>
<td>InfoMagnet, DIDS, Insight</td>
</tr>
<tr>
<td>Assimilation</td>
<td>KnowledgeX</td>
</tr>
</tbody>
</table>
FIGURE 4
Knowledge Management Architecture

Knowledge Learning Loop

Presentation
Personalization
Collaboration
Process
Publishing & Distribution
Integrated Search
Categorization
Integration

Knowledge Sources
Documents
Data Warehouses
Applications
Best Practices
Discussions
FIGURE 5
Standards for Knowledge Management in E-Commerce

Knowledge Management Applications
- Knowledge Atlas for Decision Support
  - Competency Maps
  - Attribute Matching
  - Knowledge-based Training

Knowledge Services Infrastructure
- Security, portals, catalogs

Messaging Infrastructure
- EDI, e-mail, HTTP

Content & Publishing Infrastructure
- HTML, Java, WWW

Network Infrastructure
- Telecom, cable, wireless, IP

Computing Infrastructure
- Servers, Clients, Operations

Public Policy
- Legal
- Crypto
- Privacy
- Tax
- Control
- Economics

Technical Standards
- Documents
- Security
- Privacy
- Network
- Computing
FIGURE 6
Knowledge Management Capabilities Integration