

New Roles For Information Technology: Managing Internal Knowledge & External Relationships

Lindsley G. Boiney, (E-mail: lboiney@pepperdine.edu), Pepperdine University

Abstract

The evolution of the application of information technology in business reveals two major trends: helping firms more systematically manage both internal knowledge and external relationships. These two roles are supported by information technologies that: (a) provide centralized access to integrated, coordinated information; (b) sift through voluminous data for patterns, relationships and knowledge; (c) support group decision making, virtual teams, and knowledge management across the organization; and (d) facilitate broad-based communication, external relationship building, and supply chain management. Applied examples of information technologies supporting these new roles are described, including enterprise resource planning systems and data warehouses, data mining and artificial intelligence, groupware and Internet based technologies.

Introduction

Traditionally, information systems have assisted managers and other key decision makers by providing more timely and accurate data, easier access to those data, better models for analysis, and more optimal solutions. "Early information technologies were designed to assist managerial and professional workers by processing and disseminating vast amounts of information to organization-wide management information systems" (Alavi & Leidner 1999, p3). Information systems have been used to help perform tasks more quickly and more cost-effectively, and have greatly assisted managerial decision-making.

But several forces have dramatically altered the business environment over the last few dec-

ades, ultimately changing business processes, management challenges, and the role of information technology. One of these forces is the emergence and strengthening of the global marketplace. The globalization of the world's industrial economies brings tremendous new market opportunities, as well as new threats and increased competition. It greatly enhances the competitive value of information to the firm, and presents new challenges and complexities in communicating, controlling, and coordinating information and operations across the far-flung corporation. More tasks are now done in a distributed environment by people scattered across different regions, countries, cultures, and time zones. The relatively recent explosion of electronic commerce has greatly facilitated this globalization, making it ever simpler for customers to quickly identify and make comparisons of price and quality across worldwide competitors.

Readers with comments or questions are encouraged to contact the author via e-mail.

A second force changing the business environment is the transformation of major industrial economies into information-based service economies in which knowledge and information become the key ingredients in creating value. Recent Census Bureau figures indicate that knowledge and information work currently account for over half of the American gross domestic product, as well as over half of the labor force. Both information itself and the technology that delivers, integrates, processes, and distributes it have become critical strategic resources for businesses. The very type of information required has expanded from primarily internal information on organizational processes and performance to incorporate external data on customer preferences and demographics, client requirements, supplier inventories and timetables, competitor information, and product/market characteristics. In order to bring all the necessary facts, knowledge and expertise to bear on a task or decision, work must increasingly be done cross-functionally, and by teams rather than individuals. The greater availability and importance of information is resulting in more information sharing and decentralized decision-making.

New Roles for Information Technology: Internal Knowledge Management & External Relationship Management

In response to these changes, the role of information technology is being transformed both within businesses and between them. Internally, traditional data analysis must now be augmented by the capture and leveraging of more elusive corporate knowledge or "intellectual capital." Externally, information technology is being used to span corporate boundaries and forge previously unheard of communication links and *interdependent relationships* with suppliers, customers, and even competitors.

The shift in information technology's internal role can be seen clearly in three areas. First,

the traditional emphasis on fast access to data gathered in functional departments is shifting towards more centralized access to *integrated and coordinated* data to support decision-making, including real time as well as historical data, and external as well as internal information. Instead of primarily trying to answer the question "How are we doing?" businesses find they must also use information technology to help them answer the broader question "*What does the business environment look like?*"

Second, information systems are being designed to focus less on simply summarizing large volumes of data in reports, and more on sifting through the endless data for potential problems or opportunities, hidden patterns and meanings. In this instance, information technology is helping to answer the question "*What have we learned?*"

Third, there is increased need for and availability of technologies that support effective organizational communication, document sharing, knowledge sharing, and group decision making, particularly among virtual teams and global organizations whose members are separated by time and distance. Today's organization must not only ascertain and capture what they have learned; they must share that information within the organization.

The emerging role of information technology for external relationship management is evidenced by the fact that most systems are now connected to the outside world via Internet technologies to facilitate communication and relationship building with partners. This includes partners all along the supply chain, including customers, clients, industry partners, and even competitors.

Different types of information technologies, as described in the following section, support these functions and roles.

Table 1
Changing Role of Information Technology

<u>Traditional Roles of IT:</u> Save time and money.	<u>Emerging Roles of IT:</u> Manage internal knowledge & external relationships.
Fast access to internal, functional information	<i>Internal Roles:</i> Centralized access to integrated and coordinated information, real time + historical, external + internal. [Data Warehouse & ERP]
Summarize data in reports	Explore data and experiences for patterns, relationships, & hidden knowledge. [Artificial Intelligence tools]
Support individual decision making	Support decentralized & group decision-making, virtual teams, & organizational knowledge sharing. [Groupware & Intranets]
Support internal communication	<i>External Role:</i> Support broad-based communication, external relationship building, supply chain management. [Extranets]

Integrating Information: “What does the business environment look like?”

errors, and greatly facilitates the transformation of data into useful information.

Data Warehousing

Technologies that gather, integrate, and facilitate centralized access to data are the foundation of many value- and knowledge-creating activities. Data warehousing is the creation and maintenance of a large special-purpose database containing up-to-date and unified data from all functional units, as well as easy-to-use query, analysis, and reporting tools. It pulls data from the various departmental systems, and typically from external sources as well, and puts them into a separate warehouse enabling users to access and analyze the information without endangering the original systems or data. This centralization of data about a company’s business, products, and customers eliminates redundancies and errors, and allows all employees to draw upon a wide range of information without having to make multiple requests of different departments. The fact that one standardized set of analytical, query, and reporting tools can now be used across the board reduces training costs as well as

The National Benefit Fund, which delivers healthcare benefits to over 225,000 workers, established a healthcare data warehouse and decision support system to provide its analysts and decision makers with better information about member health status and the provision and consumption of healthcare services. In the case of asthmatics and diabetics, they’ve been able to reduce emergency room visits for a savings of 13.2 million – a 15 to 1 return on investment (Gibson 1999).

Blue Cross Blue Shield of America (BCBSA) is also using a data warehouse to improve patient care. They feed data from their 52 locally owned companies into the Federal Employee Program data warehouse which enables BCBSA companies, via online analytical processing, to more easily wade through data to make decisions. Providers can locate and learn from peer companies that successfully treat ailments at a lower cost, applying those same practices to cut their own operating costs while en-

hancing patient care and giving them a competitive edge (Neil 1999).

Enterprise Resource Planning

Another technology supporting centralized access to integrated information is an Enterprise Resource Planning (ERP) system. An ERP is a relatively recent and advanced management tool for information management. It integrates all facets of the organization, including inventory and logistics planning, manufacturing, sales, human resources, payroll, and finance, by coordinating the flow of information between them. This flow of information is critical because it means that as a transaction is processed in one area, such as receipt of an order, its impact is immediately reflected in all other related areas such as accounting, production scheduling, and shipping. Manufacturing automatically receives the order information and can then begin fulfilling the order if the item's not in stock, while accounting formulates the invoice and shipping notifies the shipper of the upcoming delivery (Robinson & Dilts 1999). Data need only be entered into the system once, which reduces entry errors and ensures that all applications use data that are consistent, complete, and uniform. The goal of an ERP system is not just to drive down costs, but also to be able to respond to changing conditions quickly and pursue new opportunities aggressively (Leibs 1999). ERP systems are designed for quick response and can be changed without disrupting the course of business.

Fortune magazine recently described ERP systems as "the stuff that puts the information age to work for corporations". In 1997 more than 20,000 firms paid 10 billion to ERP vendors, and with a growth rate of 37% a year, ERP revenue is expected to top 52 billion by 2002 (Robinson & Dilts 1999). Par Industries is one user of ERP. They report that a year after implementation of an ERP, the company had reduced lead time to customers from 6 weeks to 2 weeks, improved on-time delivery performance to over 95%, and cut work-in-progress nearly

60% (Robinson & Dilts 1999).

Many businesses are finding the coordinated approach of an ERP far preferable to the old, functional way of doing business because the centralized system greatly facilitates data gathering, sharing and ultimately decision making. Businesses also find that cross-functional communication and information sharing among different business units is easier and more likely with a consistent and integrated system.

From Information to Knowledge: "What have we learned?"

Knowledge Management

Once data is collected and centralized, the process of transforming it into information and knowledge can begin. Vance (1997) defines information as data interpreted into a meaningful framework, whereas knowledge is information that has been authenticated and thought to be true. Maglitta (1996) suggests that data are raw numbers and facts, information is processed data, and knowledge is "information made actionable."

The effective capture and leveraging of vital organizational knowledge, known broadly as "knowledge management," is a difficult and relatively new challenge for businesses. Research on managers has shown that many of them associate knowledge management with organizational learning, communication, and intellectual property cultivation (Alavi & Leidner 1999). In practice, the term means somewhat different things to different organizations. IBM's Senior Vice President of Strategy defines knowledge management as "a process that enhances the value of data or information by adding human insight and professional experiences. For a sales director, organizational knowledge gathering might involve building a customer profile database supplemented with field notes from the sales force. A chief operating officer might want daily information from plant managers or factory

workers who are using a new piece of machinery. A human resources manager might want direct employee feedback on benefits programs. These types of information systems depend to some degree on intangibles – the bits of information that are inside people’s heads” (Technology Forecast 1997, p19).

Grant (1996) and Davenport (1997a) argue that the major challenge of knowledge management is less the creation of knowledge than its capture and integration to allow sharing. Businesses are indeed finding the capture of tacit information “inside people’s heads” a significant challenge. Moreover, simply capturing such information does not automatically make it useful. While information is the raw material for knowledge, more information doesn’t necessarily lead to enhanced knowledge creation and sharing. In fact, it can easily lead to information overload. “Universal networking will result in an unprecedented stream of information being generated, with less time for people to absorb it all. The result is that the biggest remaining issue for newly deployed knowledge management applications may be how well they...enable people to avoid information overload in large and diverse organizations” (Technology Forecast 1997, p358). Time and attention, rather than data, have become the scarce resources. Today’s information systems and technologies must help pressured organizations and individuals sift through the mountains of data to find the useful wisdom within.

Case-Based Reasoning

Several artificial intelligence tools can help this process of finding meaning in data by uncovering patterns, relationships and organizational lessons learned. Case-based reasoning is an artificial intelligence technique that can be used to capture the collective organizational knowledge and expertise that has accumulated over years of experience. To implement case-based reasoning, the descriptions of past experiences of experts and specialists are represented

as “cases” and stored in a database. When someone in the organization encounters a new business situation (case) that may have some similar features to something previously encountered, the system searches for stored cases similar to the new one, finds the closest fit, and applies the old solutions to the new case. Unsuccessful solutions can also be stored and are helpful when coupled with explanations as to why the solutions did not work. The knowledge base is continuously expanded and refined by users.

For example, Compaq Computer of Houston, Texas is highly customer-service oriented and typically flooded with customer calls for help. They began giving away expensive case-based reasoning software to customers purchasing a particular printer. Rather than waiting on hold and laboriously describing their problems to the support staff, customers were then able to run the software on their own machines, search for key words such as “smear” or “jam” and have the system retrieve related cases to help them determine the problem. Customers can now solve most of their own problems quickly without phoning Compaq, and the company saves \$10 to \$20 million annually in customer support costs (Laudon & Laudon 1998).

Data Mining & Neural Networks

Data mining is an advanced analytical technique for uncovering nuggets of information within vast quantities of data, such as that stored in a data warehouse. Data mining actually uses a variety of analytical techniques such as advanced operations research algorithms, statistical analysis, and artificial intelligence techniques to identify patterns, anomalies, correlations, or trends. The analytical tools provide a means of extracting previously unknown, actionable information from the growing base of accessible data in data warehouses to create competitive advantages. Data mining provides bottom-up, discovery-driven analysis known as “knowledge discovery” as opposed to more traditional top-down, query-driven analysis. Data mining techniques are typi-

cally applied to more “granular” or detailed data than other information support tools.

One artificial intelligence technique that is typically a component of data mining software is a neural network. A neural network emulates the processing patterns of the biological brain in order to recognize patterns within large quantities of data. A neural network has a large number of sensing and processing nodes and interconnections that continuously interact with one another. By repeatedly feeding the network data and providing feedback on correct or incorrect responses, the network can be “trained” to correctly recognize patterns, a process called adaptive learning. Neural networks are unusual in this generalized capacity to learn and can be re-trained over and over on new classes of data with different types of patterns.

Data mining and neural networks enhance the organization’s knowledge base by suggesting solutions to specific problems that are too massive and complex to be analyzed by human beings in a short time. They have many valuable applications, such as market segmentation (identifying the common characteristics of customers who buy the same products from your company); customer churn (predicting which customers are likely to leave your company and go to a competitor); fraud detection (identifying which transactions are most likely to be fraudulent); interactive marketing (predicting what each individual accessing a Web site is most likely interested in seeing); and market basket analysis (understanding what products or services are commonly purchased together, e.g., beer and diapers).

For example, Wal-Mart’s system collects and analyzes item information from approximately 2900 stores to track buying trends department-by-department, shelf-by-shelf, and item-by-item. It handles some 50,000 queries per week. Medical and pharmaceutical researchers also use data mining applications to identify successful therapies for illnesses and to discover new or improved drugs. Dozens of state reve-

nue departments have deployed data mining to uncover patterns in tax data and are reporting substantial increases in collected revenue and voluntary filings as a result (Menon & Sharda 1999). BankAmerica employs neural nets to evaluate commercial loan applications based on past experiences and determine which applicants are likely to default. Mellon Bank employs artificial intelligence to speed up recognition of fraudulent credit card transactions by detecting “unusual” spending patterns. American Express uses them to read handwriting on credit card slips and identify fraudulent signatures. Oil giants Arco and Texaco use the technology to help pinpoint oil and gas deposits below the earth’s surface based on geological data patterns.

Disseminating Knowledge: Organizational Collaboration & Communication

Technologies such as a data warehouse or ERP gather and organize critical information. Artificial intelligence tools such as case-based reasoning, data mining and neural nets sift through information in search of patterns that might suggest useful organizational learning about internal business processes or the business environment. But capturing information and knowledge is only part of the process; it must then be efficiently disseminated within the organization and applied to real problems.

Groupware

Groupware applications have emerged to support the information-sharing needs of teams within global organizations. Groupware typically includes structured e-mail, security features, software for group scheduling and workflow, and remote Web access to shared group items such as documents, task lists, and workspaces. In general, groupware has two major functions: as a data repository and as a data routing infrastructure.

As a repository, it serves as a “virtual home” for all information that may be required,

efficiently organized into separate databases created specifically for particular project teams or for all employees. For instance, one database might summarize a team's daily activities on a client project, while another database provides a searchable set of names and contacts, another lists company "best practices" or guidelines, and another contains client contracts, specifications, and communications. Schneider Automation, a division of Schneider Electric, realized their company expertise and knowledge was getting lost in the confusion as they went global. They used groupware to develop a multilingual repository of knowledge for 130 different countries with over 3,000 registered users (Lotus Development Corp. 1999).

As a data routing infrastructure, the software facilitates location independence and communication. Virtual teams working from different locations can set up their own discussion databases, accessible remotely over the Internet. Because of these capabilities, it is a natural place for teams to coordinate project schedules, jointly hash out details of project documents, and keep team members up to date. The software helps to safeguard information as well as share it, since each database can be customized to admit or restrict specific users as appropriate. American Management Systems, an international business and IT consulting firm headquartered in Fairfax, Virginia uses groupware for e-mail, document management, an organizational knowledge repository, and to support communication for its virtual teams (Cramton & Boiney 1998).

Intranets & Web-based Platforms

While an effective knowledge management system (KMS) can be created with different technologies depending on the organization's size and infrastructure, most require a variety of technologies across several functional areas in order to systematize, facilitate, and expedite sharing of firm-wide knowledge. This may include database management systems, data filtering and retrieval tools (such as data warehouses),

artificial intelligence technologies (such as neural nets, data mining, and case-based reasoning), and communication and messaging technology (such as groupware). Seamless integration between these is key, and suggests internet-based platforms such as intranets.

Intranets are internal information systems or "private internets" that use Internet software and standards to make corporate information easy to find and use within company walls, at client and customer sites, and on the road. An intranet can be an effective platform for collaboration using groupware. As organizations increasingly work with external partners on projects, groupware vendors are responding to the growing demand for web-based collaboration in real-time (Kramer 1999). Intranets are also effective platforms for employees to access vital corporate information such as contact information for clients or other employees, databases containing company best practices, answers to frequently asked questions, or current data on anything from design changes to parts shortages to production schedules to inventory status.

External Relationship Management: "Who can we learn from/work with?"

Web-based Systems for Leveraging Knowledge

Businesses recognize the growing importance of communicating and forming alliances with both customers and suppliers so they can adapt quickly to the ever-changing environment. "Supply chain management" refers to the integration of supplier, distributor, and customer logistics requirements into one efficient and cohesive process. The goal is to eliminate delays and cut the amount of resources tied up along the way, facilitate the flow of information, and create more efficient customer response systems. Web-based technologies are increasingly being used strategically for supply chain management. For example, extranets are private intranets made accessible to select outsiders. They use firewalls to ensure that access to internal data is

limited and remains secure. Many top manufacturing companies are taking the next step beyond internal ERP systems, building secure extranets that allow them to share information with and tailor products or services for specific customers, and to treat key suppliers as integral parts of the extended enterprise.

For example, Colgate-Palmolive provides key suppliers with access to some of their ERP information through the web so that suppliers can take over management of the company's inventories. Their CIO said of the ERP system "The day we turned the switch on we dropped 2 days off our order-to-delivery cycle" (Moad 1999).

Dell Computer utilizes ERP technology for "virtual integration," blurring the traditional boundaries in the value chain between users, suppliers, and manufacturers. They focus on how to coordinate activities to create the most value for customers. Dell tells key suppliers exactly what daily production requirements are, and can share design databases and methodologies with suppliers and partners in ways not possible 5 to 10 years ago. They build data linkages for sharing information in real time with service providers. These advancements allow the company to work cooperatively to continually cut inventory and increase speed. The relationships extend to customers, as well. For over 200 of their largest global customers, Dell has developed customized intranet sites that give direct access to purchasing and technical information about the specific configurations purchased from Dell (Magretta 1998).

Similarly, Wal-Mart's "continuous inventory replenishment system" captures sales data via point-of-sales terminals at the checkout counter and immediately transmits electronic restocking orders directly to its suppliers. This system allows them to keep prices low and shelves well stocked, and lowers their overhead costs to only 15% of sales revenue.

Adaptec Inc, a Silicon Valley-based com-

puter chip company that obtains many of its products in East Asia, is using an extranet to give its suppliers access to purchase orders and factory-status updates. The company says this has made it more responsive, cutting the manufacturing cycle from 12 weeks to 8 and saving millions in inventory costs.

Chrysler's Supplier Partner Information Network (SPIN) allows 3500 of Chrysler's 12,000 suppliers selective access to portions of its intranet, where they can view the most current data on design changes, parts shortages, packaging information, and invoice tracking. The SPIN network can even automatically notify suppliers of critical parts shortages. Chrysler believes SPIN has reduced the time to complete various business processes by 25 to 50 percent (Laudon & Laudon 1999).

Conclusion

It is important but difficult for general managers to keep abreast of available information technologies, and to maintain some perspective about their potential benefits in a given business. This paper has placed various technologies within the context of two key trends that have emerged: applying information technology to systematically manage corporate knowledge within the organization, and to manage interdependent relationships with external parties. Technologies such as data warehouses and ERP systems facilitate both efforts by establishing a foundation of integrated internal and external data. Artificial intelligence tools help transform all these data into meaningful, useful information, rather than information overload. Groupware and internet-based platforms facilitate the effective capture and dissemination of that organizational information and knowledge. Extranets, which can be customized to provide access to portions of an ERP or a specific corporate database, permit powerful partnerships along the supply chain. The numerous corporate examples cited suggest the enormous potential of these technologies.

But it must be emphasized that the successful implementation of any information technology is a significant organizational challenge. As a result of their power to integrate, communicate, and distribute information, technologies such as enterprise resource planning systems, data warehouses, groupware tools, supply chain management systems and knowledge management systems necessitate concurrent and fundamental changes in the organization itself. In fact, the greater the potential impact and benefit from a system, the greater the implementation challenge is likely to be.

Consider enterprise resource planning systems: 44% of Fortune 1000 IT executives reported they had spent at least four times as much on ERP implementation as on the software itself (Robinson & Dilts 1999). The introduction or alteration of information systems has powerful behavioral and organizational impacts. New systems transform the way individuals and groups perform and interact, the way information is distributed and used, and the way power and knowledge is allocated. Such changes typically breed resistance and opposition to change. In order for the potential benefits of these information technologies to be realized, their implementation requires full support from management and involvement of potential users, and must go hand in hand with changes in organizational structure and culture.

Suggestions for Future Research

Future research must address ways to achieve both of these desired goals – knowledge management and relationship management – more effectively.

In a study about key managerial concerns with knowledge management, managers expressed concern about managing change, about being able to convince people to volunteer knowledge, and about convincing business units to share knowledge with others. They worried about avoiding information overload, making in-

formation truly usable, and keeping it secure and current. They also expressed concern over the difficulties in bringing together all the players involved for successful implementation of the knowledge management effort (Alavi & Leidner 1999). More research is needed on effective incentives and rewards that encourage knowledge sharing, and the best ways to ensure that growing repositories of organizational knowledge are current, accurate, secure, and easy to use.

Future research must address issues in relationship management, as well. Companies are making great strides at automating information sharing with suppliers and distributors in order to cut costs, save time, and increase adaptability. But future systems may be able to garner additional benefits by more creatively exploring customer relationships, beyond intranet access, for key customers. Smaller, individual customers possess a wealth of ideas about ways to make a business's product or service more desirable and therefore more valuable. Systems that can entice customers to provide such feedback, and to do so in a format that is neither as stilted as a "check the appropriate response" survey nor as difficult to analyze as a letter of complaint, will be increasingly valuable.

The technologies and their potential roles are evolving in response to the dramatic changes in the business environment. The real challenge for the new millennium is to apply them judiciously, with full understanding of their limits as well as capabilities, and to implement them wisely and effectively. □

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