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PLUGGING THE KNOWLEDGE DRAIN: STRATEGIES AND TECHNOLOGIES FOR ACQUIRING KNOWLEDGE IN LEAN ORGANIZATIONS

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ABSTRACT

Recent programs for organizational improvement (reengineering, downsizing, and outsourcing) have apparently resolved the productivity paradox by making organizations leaner and more efficient. However, these same programs have drained knowledge from organizations, threatening the future performance of lean organizations. Knowledge management, which focuses on the acquisition, internalization, and maintenance of an organization's intellectual assets, is currently a popular approach used to plug the knowledge drain. Designed and managed properly, knowledge management programs can repair significant damage to organizations affected by work force reductions. In this paper, we analyze the process of organizational knowledge acquisition, which most directly addresses the problem of knowledge drain. We discuss strategies and technologies for acquiring knowledge by restocking from external sources and by regenerating from internal processes. We conclude that the technological infrastructure for knowledge acquisition must be complemented by an organizational culture that is committed to learning. A commitment to learning not only values the acquisition of new knowledge but also the preservation of old knowledge.

INTRODUCTION

Many companies have pursued work-force reduction strategies during the last decade in order to contain costs and improve efficiency (Cameron, 1991; Brynjolfsson et al, 1994). Business process reengineering, outsourcing, and downsizing have all contributed to making organizations "leaner" by reducing firm size. Such programs, all enabled by advanced information technologies (IT), have been credited with the resolution of the so-called productivity paradox (Brynjolfsson and

Hitt, 1996). By using IT to enable new organizational structures and business processes, work can be performed more effectively. For example, "process-centered" organizations (Hammer, 1996; Ringhouse and Bruggeman, 1999) focus on activities that add customer value and reduce or eliminate non-value-adding work and waste. Moreover, "virtual" organizations may operate more effectively through a network of partners and alliances, all enabled by IT (Townsend, DeMarie and

Hendrickson, 1998). Thus, as the new millennium begins, many observers express satisfaction that IT has delivered on its promise to make business organizations leaner and more effective.

However, such diagnoses often overlook the longer-term consequences of work force reductions that accompany the creation of lean organizational forms. In the long run, lean organizations may suffer from decreases in employee confidence, loyalty, commitment, trust and participation. Indeed, the managers of lean organizations make few commitments to employees, as evidenced by the popularity of contingent work, outsourcing, virtual organizations, and removal of normal career paths. Employees who survive work force reduction may become increasingly fearful and politically sensitive, hoarding resources and information to preserve their threatened job security. Although such responses contradict the idealistic image of a more professional and empowered workforce (Boudreau and Robey, 1996), they are consistent with research results that show increased long-run costs of work-force reduction (Cameron, 1991).

A less obvious but potentially more significant long-term effect is the draining away of essential knowledge in lean organizations. It is increasingly acknowledged that the most valuable knowledge in an organization is the tacit knowledge that experienced workers at all levels learn over time (Nonaka, 1994; Raelin, 1997). With work force reduction, a large portion of local tacit knowledge is drained away along with payroll costs. In the short run, tacit knowledge may not be missed because of the gains in efficiency produced by new IT-enabled work processes. However, when those processes need to be revised in the future, the lean organization may lack the knowledge needed to make the change.

Recognition of the value of organizational knowledge is evident in the current popularity of knowledge management programs. During the latter part of the 1990s, managing knowledge became quite fashionable. More and more companies invested resources to acquire, internalize and maintain their intellectual assets (Alavi, 2000; Davenport, De Long and Beers, 1998; Wiig, 1997). Knowledge management's appeal is evident from the initiatives of major consulting companies, professional publications, and corporate programs. Information technology plays a central, yet not exclusive role in most knowledge management programs.

The objectives of this research are: 1) to analyze the role of knowledge acquisition in redressing the problem of knowledge drain in lean organizations; 2) to provide guidelines for the application of information technology to knowledge management; and 3) to identify requirements for an organizational culture that supports

knowledge management. We begin in Section 2 with a discussion of knowledge drain as an ironic consequence of actions intended to resolve the productivity paradox. In Section 3, we examine the process of knowledge acquisition and the applications of IT that help to restock and regenerate knowledge. Section 4 expands from the focus on IT to include an appraisal of cultural issues important to plugging the knowledge drain. We conclude in Section 5 by recommending a balanced commitment to acquiring new knowledge while preserving old knowledge.

KNOWLEDGE DRAIN

Three popular management practices undertaken in the 1980s and 1990s probably improved short-term efficiency at the expense of an organization's knowledge resources. First, corporate downsizing removed large numbers of individual employees from corporate payrolls and, along with them, their knowledge and experience. Although undertaken to relieve the financial burden of excess staff and middle management, downsizing also depleted sources of knowledge that could not be codified in documents or databases. Second, the practice of outsourcing removed entire functions and activities judged not to be "core competencies" and obtained these through market-based transactions. As long as core activities were retained, companies were unlikely to lose knowledge considered essential to corporate survival. However, in many companies outsourcing decisions were not examined as critically as they should have been, leading to serious competitive problems (Bettis, Bradley and Hamel, 1992). Assumptions that functions such as information resource management were not strategically important often proved to be unfounded, and many companies struggled in their efforts to compete in the emerging "knowledge economy." Third, many companies embarked on radical programs under the banner of reengineering to improve their core business processes. Reengineering included heavy doses of enabling information technologies configured to replace the tacit knowledge of persons performing "outmoded" processes (Grover and Kettinger, 2000).

The infusion of information technologies is commonly credited with producing the organizational changes needed to resolve the so-called "productivity paradox" (Brynjolfsson, 1993). The productivity paradox reflected the concern throughout the 1980s that corporate investments in advanced IT had failed to produce expected productivity gains. More recent findings, however, indicate that IT investments have paid off by enabling more efficient organizational forms (Brynjolfsson and Hitt, 1996). The revolutionary

alterations in business processes and the flattened hierarchies, all enabled by IT, finally yielded the expected increases in productivity and resolved the productivity paradox.

But what is the cost? Celebration over the apparent resolution of the productivity paradox, and the vindication of ITS role in organizations, may be premature. If present gains in productivity are won by draining corporate knowledge resources, future productivity is certain to be threatened. Ironically, organizations now face a more insidious knowledge drain in which information technology inadvertently reduces the long-term corporate capacity to know and learn while it helps to achieve short-term productivity gains through leaner structures and more efficient processes. Many organizations have unwittingly discarded useful knowledge, and its restoration has become a critical need. However, repairing knowledge drain cannot be accomplished by a simple reversal of the practices that caused it.

Knowledge drain is a critical problem because knowledge is increasingly viewed as a key component in innovating and sustaining competitive advantage (Davenport and Prusak, 1998). Although competitors can eventually imitate the products and services of industry leaders, leaders' knowledge resources cannot be duplicated. Knowledge drain not only removes a competitive resource from a leading firm, but it also redistributes it among competing firms. Successful organizations, therefore, need to understand the impact of knowledge drain and build technologies and organizational culture to support knowledge acquisition.

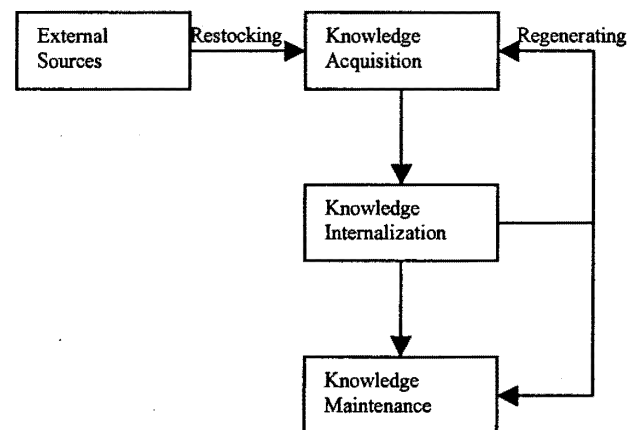
PLUGGING THE DRAIN: STRATEGIES AND TECHNOLOGIES FOR KNOWLEDGE ACQUISITION

A simplified overview of the knowledge management process, which includes the function of knowledge acquisition, is shown in Figure 1. Knowledge acquisition is arguably the most critical activity in the overall process of knowledge management. Knowledge acquisition seeks both to restock knowledge from external sources (customers, competition, suppliers, and government agencies) and to generate new knowledge from internal sources (employees, knowledge bases, databases, documents, and procedures). Following acquisition, knowledge is interpreted and transformed into a form that is internally useful. Internalization essentially establishes organizational knowledge in a knowledge base, or "organizational memory" (Stein and Zwass, 1995; Anand, Manz and Glick, 1998). Finally,

organizational knowledge must be monitored and maintained, that is, kept current and valid.

Of the three primary activities in this model, only knowledge acquisition can reverse the effects of knowledge drain. However, despite the apparent simplicity of the process depicted in Figure 1, knowledge acquisition is difficult and complex. The primary reason for such complexity is that knowledge itself is complex. The subjective relationship between the knower and what is known is captured in Davenport and Prusak's definition of knowledge as "a fluid mix of framed experience, values, contextual information, and expert insight that provides a framework for evaluating and incorporating new experiences and information. It originates and is applied in the minds of knowers" (Davenport and Prusak, 1998: p. 5). Thus, acquiring knowledge involves more than simply importing data, information or facts.

Figure 1
The Knowledge Management Process



Our analysis focuses on two primary strategies for knowledge acquisition: restocking and regenerating (Dretske, 1981). In its simplest sense, restocking treats lost knowledge as a commodity and suggests that knowledge can be replenished by obtaining it from sources external to the organization. By contrast, regenerating knowledge through processes internal to the organization recognizes that all knowledge cannot be obtained from external sources.

The most obvious example of the restocking approach is outsourcing, whereby a company contracts with an outside vendor to perform functions that were previously conducted internally. Outsourcing has proven to be most successful when the function to be outsourced

is not part of the strategic initiative of a company (Quinn and Hilmer, 1994; Di Romualdo and Gurbaxani, 1998). Viewed from the perspective of knowledge management, outsourcing non-strategic functions does not affect a company's tacit knowledge requirements. Because the knowledge needed to perform the outsourced functions is available to any number of vendors, it is easy to acquire this knowledge from those vendors.

Where tacit knowledge is drained away by outsourcing strategic functions, a company may find it necessary to regenerate lost knowledge internally rather than restock from external sources. In one reported case, for example, over 2,000 IT professionals were "transferred" to an outsourcing partner, yet they continued to work under contract with their former employer (Dubé and Robey, in press). Unfortunately, the tacit knowledge

embedded in former employees had become available as a commodity to other customers of the outsourcing partner, thereby eliminating any strategic advantage associated with applying that knowledge. Because the company's core competence was software development, it needed to regenerate the proprietary knowledge needed to bring competitive products to the marketplace.

Information technology can greatly assist the execution of each of both the restocking and regenerating strategies. As shown in Table 1, three types of IT play potentially important roles: Internet/intranets, database management systems, and collaborative technologies. Some of these are more useful for restocking knowledge from external sources while others are more useful for regenerating knowledge from internal processes.

Table 1
The Roles of Technologies in Knowledge Acquisition

Knowledge Acquisition Strategies	<i>Technologies</i>		
	Internet/intranets	Database management systems	Collaborative technologies
Restocking from External Sources	Communication platform, search tools, intelligent agents, and collaboration tools.	Storage and query processing on vast amounts of data from Internet, extranets, and other external sources.	Discussion groups and chat rooms.
Regenerating from Internal Processes	Collaborative technologies.	Data warehouses and data mining.	Issue-based and distributed cognition systems.

Restocking Knowledge from External Sources

Although restocking treats knowledge as a commodity, it is important for an organization to restock what it can in the most cost efficient manner. Several applications of IT can be useful in this regard. The most well known source of external knowledge is the Internet, which possesses useful features for restocking knowledge. The Internet's open communications architecture facilitates the sharing of information across hardware platforms. Powerful browsers and search engines enable the search for and retrieval of relevant information. The amount of knowledge available is vast because the Internet facilitates on-line publishing. Intelligent agents are useful in filtering out meaningless information and bringing more valuable information resources directly to

the user (O'Leary, 1997). Agents with learning capabilities can create search strategies tailored to individual user profiles so that information retrieved becomes more relevant with successive searches. Also, wireless communication technologies and hand-held computing devices facilitate the retrieval of knowledge from the Internet and its storage in portable, personal repositories.

Database management systems have traditionally served as gateways to corporate databases, enabling application programs to retrieve and analyze relevant data. The capacities of database management systems have grown tremendously, and access to data has become easier. English-like, natural query languages and their extensions have facilitated end-users' independence from systems professionals. Databases have also become

an integral component of the Internet, enabling not only the retrieval of data but also its storage and use. The development of XML by the World Wide Web consortium is positioned to be the predominant mark-up language of the web in the future (Chen, 1999). This has led to a keen interest by the database community to apply the tools and techniques of conceptual modeling to web-based applications. The result will be databases that better support all types of applications.

Although collaboration technologies are probably less useful for restocking knowledge from external sources, they do allow members of an organization to access the experiences of other organizations. Similar to a trade association or newsletter, discussion groups and chat rooms support sharing of knowledge across organizations. Contributors can easily share and acquire the Internet addresses of useful external information that was previously unknown.

Regenerating Knowledge through Internal Processes

Because knowledge is more than a commodity, knowledge acquisition inevitably involves more than restocking lost knowledge from external sources. A potentially more important source of new knowledge is regenerating it through internal processes. As Davenport and Prusak (1998) argued, knowledge originates through social processes and exists largely in human minds. Whereas knowledge generation depends in part on the ability to locate and retrieve material from internal repositories, it primarily focuses on creative organizational discourse wherein existing knowledge is challenged, reshaped, and recombined to produce new insights (Boland, Tenkasi and Te'eni, 1994; Nonaka, 1994; Robey, Boudreau and Rose, in press). Acquiring technical capabilities such as those documented in Table 1 does little on its own to generate knowledge in an organization. Rather, knowledge generation depends upon the successful employment of those technologies to support human creative energies.

Intranets have become a popular application of Internet technology that are designed to capture and represent knowledge that is internal to a company. Intranets are a useful medium for searching for documents and other forms of explicit knowledge that is specific to the organization. This information can be protected by firewalls that restrict external access and other security measures. Despite these features, however, corporate intranets do little to generate new knowledge without engagement of creative group processes. Intranets may provide the platform for members of an organization to share differing views and to engage in creative discourse.

But collaboration technologies, discussed below, are more suitable to generating new knowledge internally.

Since their development, corporate database management systems have become a corporation's greatest means of storing and manipulating internal data. Legacy databases store a wealth of data about an organization. High-level, non-procedural query languages, with SQL the de facto standard, have made it easier for the end-user to query a database. Only recently have these technologies been combined to create the potential for data warehouses and data mining. Because knowledge itself must be inferred from data, rather than stored directly, organizations must learn to exploit the vast quantities of stored data. The creation of a data warehouse, containing data obtained from both internal and external sources, allows data resources to be mined to produce knowledge that has direct implications for marketing and production decisions. We consider data mining to be a technology for regenerating knowledge through internal processes because it draws out these inferences rather than depending on simple retrieval of data. Currently, a great deal of research is being carried out in the area of data mining as organizations strive to best utilize their current and historical data.

In addition, database management systems are capable of guiding the conversion of legacy databases into forms that are more amenable to data mining. There are a large number of poorly documented legacy databases in use that would be more useful if their underlying data models were known. To deal with this problem, a number of reverse engineering procedures have been developed to extract the corresponding conceptual model (Chiang, Baron and Storey, 1997; Johannesson, 1994). Moreover, considerable research has examined the differences between the hierarchical and network data models, traditionally used for legacy databases, and the more contemporary relational and object-oriented data models. This research not only identifies the differences among these models, but also provides procedures for converting legacy databases to either relational or object-oriented data models (Fahrner and Vossen, 1995).

Finally, collaborative technologies can assist the regeneration of knowledge by providing a medium for communication and discourse (Boland et al., 1994). It is essential for members of an organization to engage in discourse about current practices in order to surface the assumptions underlying them. The traditional forum for such an examination has been the face-to-face meeting involving relatively few people. Through technologies designed to support collaboration among remote members, wider participation in the discourse can be accommodated. Boland et al. (1994) refer to this process as "distributed cognition," which recognizes that the

components of organizational knowledge are distributed among many individuals and embedded in many artifacts throughout a social system. By designing collaborative technologies to pull distributed threads together, an organization can examine what it knows and build new knowledge where necessary.

Although we have treated each type of IT separately and given a brief example of its use in knowledge acquisition, the whole portfolio of knowledge acquisition applications should share a common technical infrastructure. Ideally, the infrastructure would support an integrated, single-source system that encourages knowledge sharing across internal and external organizational boundaries. An infrastructure with common data objects and data definitions is far more useful than a conglomeration of disparate systems. Unfortunately, most knowledge management systems are conceived, designed and implemented by individual departments to address a specific need, thereby creating islands of information that are largely inaccessible to other employees or applications.

To build such an enterprise-wide technical infrastructure to support knowledge management, a single corporate data model must prevail. Standard definitions of data objects must be created and used. Open architectures and standard protocols are needed to enable individual applications throughout the organization to communicate with each other. Furthermore, the infrastructure must be able to integrate both internal and external data. The system must be able to manage knowledge shared by suppliers, distributors, customers, analysts and so on, and external data must be integrated with internal data. Most importantly, the technical infrastructure must span functional boundaries because the most useful new knowledge is likely to result from bridging functional approaches to understanding corporate problems. Rather than perpetuating the mistaken belief that knowledge can be generated and contained within traditional areas of responsibility, managers must seek ways to combine knowledge from different areas.

BUILDING AN ORGANIZATIONAL CULTURE FOR CONTINUOUS LEARNING

The IT applications described in Section 3 offer considerable hope that the knowledge drain can be plugged effectively. By capturing new knowledge through restocking activities, and assuring a stream of newly generated knowledge, organizations can counteract the consequences of knowledge drain. However, it is not sufficient to design and implement effective technology solutions. Advocates of knowledge management are adamant about the need to exercise ongoing surveillance

over technology solutions, lest they be seen as the panacea to all knowledge problems (Davenport and Prusak, 1998). In this section we discuss the challenge of managing the infrastructure supporting knowledge acquisition, including both technical infrastructure and organizational culture.

The need to monitor systems of any kind, and to adjust them continuously as needed, is a fundamental principle of organizational learning. Dubbed "double-loop learning" by Argyris and Schön (1996), the prescription is simply to monitor the usefulness and effectiveness of systems installed to solve more routine problems. Organizations that learn well are always "works in process;" their practices and policies are continuously evaluated and adjusted, as new conditions require.

Knowledge management practices, and knowledge acquisition in particular, must be sensitive to changing organizational needs. Otherwise, knowledge management may become another transitory practice that produces ironic consequences to be fixed by the next generation of faddish prescriptions. To prevent the failure of knowledge acquisition strategies, managers must regularly monitor the technical infrastructure installed to support knowledge acquisition. In addition, managers must make a sincere commitment to creating a "learning culture," where knowledge acquisition is accepted as an essential practice. A learning culture respects both the acquisition of new knowledge from external and internal sources and the preservation of relevant older knowledge so that future drains can be prevented. The primary managerial implications are that technology solutions must be monitored and that a culture conducive to continuous learning must be fostered.

Monitoring the Technology

Undoubtedly, the recent interest in knowledge management has been spurred by the appearance of powerful, enabling information technologies. Monitoring the technical infrastructure begins by making sure that systems designed for knowledge acquisition are so tightly integrated into the organizational workflow that it is not possible to point to some external system that is "managing knowledge." Rather, the access, storage and retrieval of knowledge assets should become a fundamental part of each employee's work process. This principle of integration reduces the risk that knowledge acquisition is seen as an activity that is independent of the "real" work processes of the organization.

Our earlier recommendation for an enterprise-wide technical infrastructure for knowledge acquisition needs to provide for ongoing monitoring of the infrastructure to fit the learning needs of the firm. An

unmonitored and inappropriate IT infrastructure can actually impede knowledge management by encoding inaccurate knowledge. For example, a corporate Intranet that publishes "best practice" web pages from employee experts may contain false or incomplete knowledge. If employees incorporate invalid knowledge when performing their tasks, the technology has actually corrupted organizational memory and disabled organizational learning. Because knowledge is embedded into IT, it may seem more legitimate or authoritative than it should. Proper checks and controls must be in place to guarantee the integrity of the knowledge in best practice and other knowledge sources.

The biggest mistake an organization can make is to assume that today's technical infrastructure will be adequate to deal with tomorrow's needs. It is important that these technologies are adapted and diffused into the knowledge management environment in a way that contributes to organizational learning. One notorious case of failure to adapt an information system to changing business conditions is Mrs. Fields Cookies, which was once a prime example of leveraging IT to achieve competitive advantage. Despite the early success enjoyed by Randy and Debbi Fields with their vaunted production scheduling system, they failed to realize that market changes dictated a departure from the assumptions embedded in the system (Gill, 1995). Although heavy reliance on information technology was responsible for much of the success enjoyed by the Fields, their systems failed to incorporate informal sources of knowledge and actually interfered with the organization's ability to adjust to changing market conditions.

Although it is readily acknowledged that IT may enable knowledge management, IT may also disable organizational learning by embedding organizational memory into machine code that is not easy to change. Inflexible, mainframe-based hardware platforms are not as conducive to knowledge management as are client/server and web-based architectures. A flexible and adaptable infrastructure is more appropriate for managing knowledge. The responsible Chief Knowledge Officer will build a technology infrastructure that is modular, flexible and that enables future expansion. Presently, the Internet is the preferred choice for knowledge management infrastructures.

Building a Learning Culture

As powerful as they may be, information technologies are inherently limited in their ability to handle tacit knowledge. For this reason, IT is not sufficient for building a learning culture. In addition to technical infrastructure, an organizational culture that

emphasizes the value of knowledge embedded in employees as well as the role that knowledge plays in business success must be created. One of the biggest obstacles to overcome is the residual fear that retained employees have after downsizing has occurred. Fear causes employees to be territorial and to hoard knowledge instead of sharing it because sharing knowledge might make them expendable. Employees need to understand the fundamental differences between downsizing initiatives and knowledge management. Downsizing essentially views employees as liabilities that can lead to cost savings if removed. Knowledge management, by contrast, views employees as corporate assets with embedded knowledge that can generate positive corporate benefits like product innovation and competitive advantage (Cameron, 1991). Knowledge training can give employees an understanding of the importance of knowledge management and motivate them to get on board.

A knowledge culture should encourage employees to actively share and use knowledge. Internal knowledge markets have emerged in some firms where employees are actually paid royalties when their contributions to a knowledge base are used by other organizational members. Rewards and incentives for knowledge sharing can play an important role in motivating employees but these individual rewards should reinforce the understanding that knowledge management brings true business value. Specific knowledge management practices should be linked directly to business outcomes and the results shared throughout the organization.

Many organizations are employing knowledge management professionals to help define the knowledge architecture and culture, implement the knowledge infrastructure and assist the organization in the use of knowledge management systems. Some knowledge management professionals focus on the systems and infrastructure while others direct training and education initiatives. An important role is played by knowledge liaisons, who seek to integrate infrastructure or cultural initiatives directly into the operations of the business. As they interact with employees throughout the organization and with each other, they are best poised to recognize cross-enterprise opportunities, thus facilitating enterprise-wide learning.

CONCLUSION

The impact on organizations of various work force reduction strategies has not always been positive. One of their major consequences has been the loss of valuable corporate knowledge embedded in the minds of

former employees. Knowledge management has emerged as a popular initiative for addressing the overall problems associated with managing a company's knowledge resources. As part of knowledge management, knowledge acquisition specifically addresses the problem of knowledge drain. Knowledge acquisition is aided by judicious investments in enabling information technologies and by sincere efforts to create an organizational culture committed to learning. Together, technical and cultural solutions may help to restock lost knowledge from external sources and to regenerate new knowledge from internal creative processes. Plugging the knowledge drain through knowledge acquisition should allow organizations to avoid the ironic consequences associated with earlier work force reduction strategies.

It should be clear from these arguments that knowledge management programs in general, and knowledge acquisition in particular, must value both old and new knowledge. The cost of plugging the knowledge drain is much higher if valuable old knowledge has already left the organization. Replacement through restocking may only be partially successful, and regenerating may require excessive time, even where aided by useful IT applications. Simultaneously, it is essential for organizations to acquire new knowledge when it is needed. It is not sufficient to celebrate past successes and assume that past knowledge is relevant to future success. Successful knowledge acquisition requires ongoing appraisal of existing knowledge, revising it when necessary through a combination of restocking and regenerating. Clearly, this is a formidable task, but one worth accomplishing. Given the importance of knowledge to corporate success, managing the acquisition of knowledge assets should command the attention of all executives.

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Professor Robey is the author of three books and numerous articles in such journals as Management Science, Organization Science, Information Systems Research, MIS Quarterly, Communications of the ACM, Human Relations, Journal of Management Information Systems, ACM Transactions on Information Systems, Information Systems Journal, Academy of Management Review, Academy of Management Journal, and Decision Sciences. His current research deals with the consequences of information systems in organizations and the processes of system development and implementation. This research includes empirical examinations of information systems development work and of the effects of a wide range of technologies on organizational structure and patterns of work. It also includes the development of theoretical approaches to explaining the development and consequences of information technology in organizations.

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