3

The Technology and Processes Subsystem

Information consists of facts and data that are organized to describe a particular situation or condition. Knowledge is subsequently applied to interpret the available information about a particular situation and to decide how to manage it. Knowledge consists of facts, truths, and beliefs, perspectives and concepts, judgments and expectations, methodologies and know-how. Knowledge is accumulated and integrated and held over long periods to be available to be applied to handle specific situations and problems. . . . We use knowledge to determine what a particular situation means.

(Wiig 1994, xiv–vx)

A fundamental purpose of knowledge management is to give all members of an organization the power that can be gained from shared and reusable knowledge. Designing a system for knowledge to be shared in an organization requires establishing the best combination of people, information, processes, and technology. In the public sector, knowledge management systems must enable the organization to develop and maintain the ability to (1) identify relevant information that is needed for completion of the agency's mission, (2) strengthen interagency collaborations, and (3) store, organize, and catalog everyday and invaluable knowledge so that it can be used in the near and distant future.

To avoid being blinded by the exorbitant claims often touted for KM, the public sector system designer must also keep in mind that not everyone believes that KM is the wave of the future in either the private or the public sector. Rather, KM has good intentions, but in the harsh glare of reality, it is only as good as the people who design and use it.

Not everyone believes that KM is worth the time and money required for its implementation. Some critics are even harsher in their opinion of the discipline. One critic (Fuller 2002, 32), for example, has offered the opinion that KM portends the end of knowledge in science and practice, as well as signaling the final disintegration of the university, among other calamities. As if this weren't enough, he went on to claim that, "Knowledge management updates the spirit that led to the burning of the Library of Alexandria and the stigmatizing of universities during the Scientific and Industrial Revolutions."

Adjusting for the obvious hyperbole in Fuller's comments, there is no denying the fact that the knowledge management discipline does contain many controversial features, misconceptions, and contending theories. Perhaps after reading this book, the stress that some readers may suffer from those controversies may be alleviated—and they may sleep more soundly knowing that the nation's libraries and universities are safe, at least for another generation.

Chapter Objectives

This chapter has been framed on a set of objectives that are designed to help readers:

- Recognize that, although opinions differ on the number and categories of fundamental components that go together to constitute a knowledge management program and/or the KM discipline, it is possible to see a consensus on five basic components.
- Know and understand the basic processes that make it possible for a knowledge management system to achieve its goals and objectives.
- Begin to understand the contributing, but not dominant, role that technology plays in the knowledge management concept.
- Understand the importance of integrating information and communications technologies with knowledge management systems procedures.
- Gain a brief understanding of the potential that mobile and wireless technologies have for influencing all agency delivery systems, as well as their knowledge management systems.
- Begin to see how performance measurement, one of the key components of KM, functions to improve performance and enhance accountability.

The Chief Components of KM

A government manager wishing to implement a knowledge management program will wish to begin by knowing which of the litany of components and processes are critical for success. One way to do this is to study what ele-

Table 3.1

Five-Model Comparison of Perceived Critical KM Components

	KM 4 pillars	European model	**KM 4 enablers**	KMAT model	Navy Dept.
Technology	√	√	√	√	√
Leadership	√	√		√	
Culture		√	√	√	√
Measurement		√	√	√	
Process		√		√	√
Organization	√	√			
Infrastructure			√		
Learning	√				√
Content					√

Source: Girard 2005.

ments leaders of other successful KM systems have identified as crucial for a successful implementation. John P. Girard reported on the results of just such a study in 2005. He surveyed 2,650 Canadian public-sector middle managers to identify what characteristics they felt were crucial for KM. Girard found that, with only minor variation, the majority of the respondents gave similar importance rankings to a list of items found in five different KM models. He compared the rankings in four theoretical models and one experience-based model developed by the U.S. Navy. Over all, these nine components were mentioned in the models: technology, leadership, culture, measurement, process, organization, infrastructure, learning, and content.

The four theoretical models were (1) the popular *four pillars* model developed by Stankosky at George Washington University, (2) a model based on research with European managers exclusively, (3) a *four exemplars* model based on a large-sample study by the American Productivity and Quality Center, and (4) a model based on findings of a study that employed the Knowledge Management Assessment Tool (KMAT). The Department of the Navy's (DON) model was the experience-based example studied. Table 3.1 summarizes the salient components listed in each model.

Five of the constructs clearly stand out in this five-model comparison as the most important for successful implementation of KM. They are technology, culture, leadership, measurement, and process. With very little modification, the factors are clearly as applicable in the public sector as they are in industry. Therefore, they constitute the fundamental components in all KM and KM systems applications. Technology and measurement are discussed in this chapter; culture and leadership are often considered to be mutually supporting factors in a larger construct and are, therefore, discussed together in a later chapter. Process is important enough to merit a chapter of its own; it constitutes the substance and content presented in the next chapter.

The nearly universal agreement that technology plays and will continue to play a dominant role in KM applications justifies including it first in this treatment of the processes that constitute the foundation stones of KM. Technology is approached from several different points: technology collectively, information technology (IT), and information and communications technology (ICT). All refer in the broadest sense to the concept of computer-enabled collection and transmission of data, information, and knowledge.

The Role of Technology in KM

The term *technology* is often used by government planners, managers, and administrators as a synonym for either information technology (IT) or information and communications technology (ICT), or for both. However, IT is generally considered to refer to computer-aided hardware and software used in the collection, storage, codification, and reporting of data and information. ICT, on the other hand, includes the computer-aided tools of IT and the variety of means for communicating information and knowledge both internally and externally. In the past decade or so, ICT has produced a number of new tools for knowledge management, including the Internet, intranet and groupware applications, mobile communication devices and systems, and many others (Sydänmaanlakka 2002). The label *information and communications technology* may include a number of subcategories, such as knowledge-providing technology, production technology, and innovation-development technology (Sundbo 2004).

The federal government is attempting to bring a measure of coordination and control to the technology side of knowledge management systems by implementing what is known as the enterprise architecture initiative. *Enterprise architecture* is the term used to mean information technology architecture that encompasses the entire organization, not just its component parts. *Information architecture* was first used in the 1980s to refer to an enterprise-wide model for all data creation and movement in an organization (McGee and Prusak 1993). Initially, the model attempted to account for and accommodate all of an enterprise's relevant entities with a use for data, including customers, products, employees, and all their data relationships. Although the original effort failed, it was reborn in today's enterprise architecture initiative. As incorporated into that initiative, the goal of the information architecture model is to develop a "map" of the organization's data needs, and then to construct an information system based on this map.

Implementing the information and communications technology architecture component of a knowledge management system begins with aligning the system with the agency's knowledge needs. Designing an agency's information technology architecture entails organizing the agency's entire knowledge and information technology resources to carry out the mission of the organization. There are two key parts to designing information technology systems architecture: information system architecture and technology system architecture. Although they are often considered as two almost identical versions of the same concept, significant differences exist. Information architecture deals with the logical flow of information within an agency, whereas technology architecture deals with the physical organization of the technical equipment and staff (Gardner 2000).

Information architecture is built from the sources and destinations of information and knowledge in the organization and the connections between the two that create a channel between sources and users. The computers, terminal, monitors, controlling software, etc. that transform data to information, and the storage locations and data repositories, where data and information are kept until needed, are all parts of the technology architecture. Sources and destinations are the information creators and users who determine the beginning and ending condition of the information. The condition, or state, of the information then influences the scale and scope of the ICT "problem." This refers to designing answers to the management question: How can the volume of information be delivered wherever in the world it is needed, in a form that is recognizable and useful, in a timely manner, and with an acceptable level of accuracy, openness, and security? The technology answer to this question results in establishing the performance specifications for information technology architecture. These performance specifications are, therefore, simply a differently worded expression of the communications problem.

It is generally accepted today that the technology architecture should be driven by the agency's information architecture—it must be user-needs driven, not entirely data or technology driven, as Gardner (2000) has suggested. This supports the contention of knowledge management systems designers and government knowledge users that the information handled by technology systems is far more valuable than the system itself. "The information is the asset; the system is the means to exploit it" (Gardner 2000, 142). In the final analysis, the fundamental point of the government's technology architecture initiative is to specify what equipment and staff goes where, and how much of each is needed.

Despite growing agreement with this idea, the communications and technology problem is, apparently, not going away. In a front-page article in the industry journal *KMWorld*, Jonathan Spira identified what he saw as a symptom of this disease still infecting this conflict in ideas—the wrong thinking that still characterizes many competing KM systems suppliers:

> It isn't any news to anyone reading this that [the two industry giants] have been fighting over the knowledge sharing and collaboration . . . space for many years. Despite the time that has passed, they have not begun to recognize the challenges ahead. The reason: They don't seem to understand what collaboration and knowledge sharing are; their products reflect a lack of perception about the needs of knowledge/information workers and how they work—and how they use the software they have been given. (Spira 2005, 1)

The solution Spira proposed was for collaborative enterprise knowledge software competitors to develop new systems that are designed from the beginning for knowledge and information work, which keeps knowledge workers focused on their tasks. Spira added emphasis to his proposed solution with the reminder that collaboration and sharing within and across agencies and knowledge sharing are "less a question of technology than of systems that facilitate people working together."

Key it Processes in KM

Designing a knowledge management system for a government agency requires consideration of the major processes that together make up what is now recognized as the knowledge management discipline. Alavi and Leidner (2001) concluded that there are five key processes extant in KM: knowledge creation, knowledge storage, knowledge and retrieval, knowledge transfer, and knowledge application. Each of these processes is supported by one or more ICT technologies, and each contributes to one or more knowledge application tasks. The processes and supporting technologies are displayed in Table 3.2.

Among the many ICT tools found in the creation, retrieval, and transfer processes in public-sector KM systems are data mining software, e-learning tools, electronic bulletin boards, intranets, knowledge repositories and directories, databases, discussion forums revolving around communities of practice, and others. Missing in the Alavi and Leidner list were Web-based systems. Where knowledge is applied, such tools as expert systems and workflow systems can be found.

Knowledge management systems are the logical culmination of a management system that uses ICT to facilitate the capture, combination, and application processes of knowledge within the organization. It is important to recall,

Table 3.2

Knowledge Management Process and Supporting ICT Tools

Knowledge management processes	Supporting information and communications technologies	What the information technologies enable	Example platform technologies
Knowledge creation	Data mining, e-learning tools	The creation and combination of new sources of knowledge; just-in-time learning	Knowledge "yellow pages"; stories, dialogues, and discussions
Knowledge storage and retrieval	Electronic bulletin boards, knowledge repositories, and databases	Support of individual and organizational memory; intergroup knowledge access	Groupware and communication technologies
Knowledge combination and transfer	Electronic bulletin boards, discussion forums, knowledge directories	More extensive internal networks and communication channels, and faster access to knowledge sources	Intranets; communities of practice
Knowledge application and reuse	Expert systems, workflow systems	Knowledge applied across time and space; faster application of new knowledge	Knowledge management systems

Sources: Butler et al. 2003; Alavi and Leidner 2001.

however, that no single technology constitutes a knowledge management system (Alavi and Leidner 2001). Rather, three technology tools are found in most successful implementations. The first is a system for coding and sharing of best practices in public and private organizations. The second is the creation and religious maintenance of an organizational knowledge directory. The third is the creation of formal and informal knowledge networks. In order to learn from others, knowledge workers must have free and open access to communication with others with similar interest and focus in the practice.

Integrating Technology Architecture

The preceding chapters discussed how knowledge management systems have evolved from governments' attempts that began more than fifty years ago to integrate their information technology applications. The federal enterprise architecture initiative of the early years of the twenty-first century is one of the government's latest efforts to bring structure, rationality, and commonality to the many different information and communications technologies in use today—and to do so while meeting mandates to improve their performance and their accountability.

IT, and more recently information and communications technology (ICT), has a long history of failures to atone for. Better integration and planning, such as that taking place under the federal enterprise architecture initiative, is bringing order to the disorder that once reigned.

One of the reasons for this disorder in IT and ICT applications has long been the inability of organizations to collect and share information across agency boundaries. Employing enterprise architecture is the first step in designing a KM system that results in a true knowledge-sharing environment in which the system is adapted to support real enterprise processes and the operational needs of the organization. In the past, components of a knowledge management system were often added piecemeal, as knowledge needs became apparent and as technology became available. Thus, adding such increasingly rich and powerful technology as Web sites and Web services, Internet open access, intranets, taxonomies, portals, data warehouses, search engines, collaboration schemes, links to external information providers, and many other agency-specific software systems often led to what Malafsky (2005) has described as KM programs' becoming "mired in [technological] complexity." This chapter is an attempt to bring some meaningful sense of order to the complexity that characterizes much of KM.

When applied appropriately, ICT enables transformations and innovation in such features of public programs as policy formation, administration, and the delivery of program services. More importantly, ICT gives government administrators the power to pick up the pace of innovation in their agencies. The ability that ICTs give managers to improve agency efficiency and effectiveness has long been a justifying principle upon which ICT programs were implemented. For example, there is no question that without ICTs e-government would not be possible.

To help agencies avoid the pitfalls and disorder that often accompanied earlier applications of ICTs, the Australian Public Service Commission proposed a list of twelve fundamental principles to guide information architecture planning and acquisitions in government agencies (APSC 2002). A selected list of those guiding principles is included here:

- Reduce integration complexity and enable integration and interoperability.
- Take a holistic approach, ensuring that government information can be accessed and applied to improve decision making within and across agencies.
- Design the system to be business event-driven (i.e., to accomplish specific tasks).

- All information must have defined sources who will act as stewards of the information. Authorized information must be accessible and available for reuse.
- ICT systems must comply with government security, confidentiality, and privacy laws and policies. This protection must include avoiding improper denial of service, intentional and accidental modification of the data, and unauthorized access.
- Priority on ICT purchases should be given to products adhering to proven industry standards and open architecture.
- To the maximum extent possible, ICT architecture should enable and support the accessibility of government information and services to citizens, businesses, and other federal government agencies and state and local governments.
- The *total cost of ownership* (TCO) principle should shape ICT planning. TCO includes considering costs and benefits across government for hardware and software technologies; planning must balance development, support, and disaster recovery and system retirement costs against the costs of flexibility, scalability, ease of use, and support over the life cycle of the technology or application.

Finally, the suggestions for developing a strategy for implementing knowledge management systems by Australian KM consultant James Robertson (2004) add further emphasis to the recommendations of the Australian government agency. Robertson asserted that to be successful, a KM strategy must begin by identifying the key needs and issues within the organization. It must also provide a framework for dealing with these needs and issues. However, even with a detailed strategy, a high-level champion, and the appropriate building blocks of ICT technology in place, there is still a high probability that a newly installed KMS will fail. One study reported failure rates for private-sector KMS programs that exceed 80 percent (Butler et al. 2003). Most likely, a key reason for these high failure rates was the lack of commitment by senior-level management to stay the course. Failure rates are nearly as high in the public sector, where KM implementations enjoy knowing that they have the support of executive-branch operational transformation mandates behind their KM efforts.

Where Is KM Technology Headed?

The industry journal *CIO Decisions* reported the results of a 2005 survey of the opinions of 300 senior IT decision makers on what role they envisioned for IT in the future. The answers to that question are a reflection of the first directional trend that KM technology is experiencing: IT appears to be playing a smaller role in government KM systems.

The chief information officer (CIO) sample was divided roughly fifty-fifty in its answers to the question of where they believed KM technology is headed. Half believed that IT's role is diminishing, with the other half responding more optimistically. Half of the optimistic portion strongly believed that IT is definitely not going to be given a smaller role. Rather, they predicted that the resources committed to IT will increase. They were also convinced that IT professionals (such as the CIOs surveyed) will continue to have a voice in shaping the future of their organizations. Most of the remaining optimistic respondents (approximately 20 percent of the total) were convinced that the resources directed to IT would continue to grow, but at a slower pace than in the recent past (May 2005).

The sample was also evenly split demographically, with 150 respondents working in small companies and 150 in large companies. All of the roughly 25 percent of the total who believed that IT will continue to dominate the future were employed in high-performing, large companies. However, only 35 percent of the large-company half were optimistic about IT's future role. On the other hand, fully 65 percent of the small-company respondents were optimistic about the future of IT.

Other studies also indicate that IT and ICT will be taking a much smaller role in knowledge management than it did during the early development years of KM's evolution. As noted, throughout most of the 1990s, nearly all government KM initiatives were driven by outside technology vendors or consultants. Since 2002, however, the enterprise architecture and management transformation initiatives may have influenced an unplanned cooperative approach to IT and KM in the federal government. This symbiotic relationship between IT and KM was described by Bryan Gladstone (2000, 1):

> After two decades working with electronic information and communications technologies, managers are recognizing that success is not about getting people to work with IT, but about helping people to work with other people. Knowledge management is explicitly about how people learn and share together in organizations. As such, it is the only way to ensure that all our expensive investments in information handling and communications actually prove worthwhile.

The second major trend in KM technology is the growing demand for collaboration capability in KM communications hardware and software. These are, in fact, some of the most far-reaching developments in technologies affecting knowledge management. They fall into two broad categories: software that supports collaboration and cross-agency information identification, collection, and sharing; and communications tools and systems that support users' needs for information as they are on the move. In many ways, these trends come together to support tools that facilitate information finding in a variety of ways.

In 2005, public-sector knowledge management system designers could choose from more than thirty separate software products dealing with one or more aspects of collaboration. These included programs for document management, workflow systems, information portals, Web conferencing, and more (Harney 2005). Few of the available systems are all-inclusive in what they can do for the user; most provide only one or a few of the different capabilities incorporated under the umbrella application of collaborative business knowledge (CBK). One of the few systems with an application designed specifically for KM is constructed on three separate modules: collaboration, business process management, and KM. The KM module does search and automatic categorization across all modules and features, and tells users accessing certain documents what similar documents they might like to examine.

Collaborative business (enterprise) knowledge system designers follow three cardinal rules in developing these solutions (Spira 2005): First, all applications must take place in one environment—the "one environment rule." Second, there must be friction-free knowledge sharing—that is, people sharing knowledge and information without having to think about how they do the sharing. And, third, workers are able to communicate and collaborate contextually (i.e, sharing documents and whiteboarding).

Marcelline Saunders, product manager for search and KM for the Canadian systems integrator Hummingbird Ltd., identified collaboration suites as one of the three chief trends in information and communications technology in 2005 (Saunders 2005). The other trends included mobility (m-government) and instant messaging. Collaborations refer to the process and procedures that make it possible for people to easily communicate with other workers both within and without their own organizations—that is, to be able to cross artificial information boundaries as needed. Government workers need to share information within their own agency, across agencies, across national boundaries, and with such organizations as businesses and nongovernmental organizations (NGOs). Saunders identified a solution to the need for collaboration as one consisting of a single component that fits into existing and planned information architecture, is part of a managed desktop tool set, has community support, guarantees privacy, and involves local formal (teams) and informal (communities of practice) groups.

Dr. Bob Lewis of Lockheed Martin, a speaker at the 2005 Washington, DC, KM conference, also identified collaboration systems as one of the important product directions that information-finding technology is taking (Lewis 2005). One of the evolving collaboration technologies identified by Lewis includes a new and more powerful and directed search engine that can build a search based on the user's previous searches and what other organization members searching the same topic have found. Lewis also touched on the ultimate collaboration tool, the collaborative "system of systems," which is an innovative product that facilitates interfacing between systems, thereby allowing communications between separate communities of practice, for example.

Collaboration is the chief ingredient for enabling vertical and horizontal cross-boundary data integration among government agencies. According to a National Association of State Chief Information Officers' 2005 research brief, state and federal agencies must find better ways to break down existing information silos and facilitate greater data integration. This is particularly important in areas of public safety, disaster relief, and homeland security (NASCIO 2005).

Data integration is a third trend shaping government's implementation of KM and the information architecture that facilitates knowledge collection and sharing. Integration is the tools and processes necessary to provide for electronic sharing of information between two or more databases or systems (NASCIO 2005). The electronic sharing utilizes a standard message format, such as extensible markup language (XML). XML has become the standard in the federal, state, and local levels of government for data sharing and information exchange. The movement of information occurs in several different ways. First, it occurs by extracting relevant data from each source and storing it centrally. A second model operates by retrieving data from each source (in the de facto net) on an as-needed basis. Actual data sharing occurs in one of two ways: for information or intelligence gathering, it is usually accessed by a query. Or, it is exchanged between sources for use in a specific application. Finally, integration is the process of sharing data across organizations and domains, within an established enterprise, and based on standard formats.

Advances in Mobile Technology

Mobile technology is a fourth trend affecting KM and IT. Many federal workers are highly mobile and widely dispersed across the country. Law enforcement, emergency services agencies, inspection agencies (such as those in food system, customs, case workers, transportation, labor, and health), remote workers (such as parks, environmental protection, and resource management), and the staffs of elected officials are all candidates for greater use of mobile technology. These thousands of workers must have access to the most current policies and procedures, manuals, forms, and regulations. They need to be connected to home-agency and outside databases, have access to department intranets and portals, and have the ability to communicate and collaborate in real time. Field workers often have an even greater need to be kept informed than do home office support personnel.

In 2005, instant messaging (IM) was well on the way to becoming a fifth trend in information and communications technology, although it was still evolving as an application in government technology. If IM is adopted in government to the extent that it has been in the private sector, it is expected to ultimately take some of the pressure off the large and growing use of e-mail. E-mail is deeply engrained as the medium of choice for internal communications. As such, many agency managers report serious overloading of their e-mail message boxes. Some workers spend up to three or more hours each workday reading and responding to e-mails, many of which need not have been sent in the first place. Instant messaging will have to be integrated into existing e-mail systems, or it, too, may contribute to information overload.

From E-Government to M-Government

After the wholesale movement toward Web-based communications systems, the adoption of wireless communications technology may be the most significant of the current trends in emerging technology for KM. In the public sector, this trend toward mobile communications is called *m-government.* M-government is defined as programs and activities designed to provide information and communication services to public employees through wireless communication networks and the use of portable communications devices. The services provided to public employees also improve the ability of other stakeholders—citizens, businesses, nonprofit organizations, other governments, and legislative bodies—to access government services. M-government is facilitated by two directions in technology. The first is *wireless technology*; the second is *mobile technology.* Although the terms are similar and often used synonymously, there are subtle differences.

Wireless technology is broader in scope than mobile technology. Most wireless devices are mobile. However, mobile devices are not all wireless. A desktop PC is not a mobile device, but it can be connected wirelessly to a local area network (LAN) for Internet access. Mobile technology, on the other hand, consists of the portable devices that government workers can carry and use for communication. They include mobile (cell) phones, laptop computers, personal digital assistants (PDAs), pocket computers, pagers, wearable computers, and related equipment and supporting systems (Moon 2004).

Although the adoption of mobile technologies in areas of government services other than public safety has been relatively slow until now, many believe that once certain concerns over security are resolved, growth in their adoption will be dramatic. Most governments believe that mobile technologies can greatly improve the efficiency, effectiveness, responsiveness, and accountability in the management of such reaction and prevention programs as natural disasters, fire suppression, law enforcement, and homeland security.

Among the barriers limiting far greater m-government implementation are issues relating to security and privacy, accessibility, and impacts of other public services. For greater adoption by governments, mobile technologies must not only guarantee the security of communications, they must also be able to operate across many different platforms or architectures—in what is known as "interoperability." Two types of interoperability have been identified: operational and technical. Operational interoperability refers to the different agency networks that collect, organize, and disseminate information. Technical interoperability refers to hardware and software compatibility. For mobile technologies to work in government they must:

- Be part of a comprehensive infrastructure that supports effective information sharing,
- Be secure and guarantee privacy,
- Overcome barriers of ambiguity about statutory authority,
- Be open to public scrutiny and trust,
- Overcome problems of lack of experience among users,
- Be hardware and software compatible,
- Be guided by agreed-upon data-sharing standards and limitations,
- Be introduced within a culture that values and rewards information sharing,
- Finally, an infrastructure for knowledge management must be in place (Moon 2004, 11)

In 2003, three best-practices examples of m-government applications at the state level included California, Virginia, and New York. Each of these programs was described in a 2004 research report sponsored by the IBM Center for the Business of Government, and carried out by Professor M. Jae Moon of Texas A&M and a group of A&M graduate students. The examples are summarized in the following paragraphs.

California, long a pioneer in both e-government and m-government, retains the practice of keeping funding for new wireless technology within each department or agency, without any central departmental control. Virginia and New York have each taken the route of centralized ICT management, which has allowed them to introduce what Moon (19) described as "innovative, strategic, specific m-government plans in a more proactive and effective way."

In one of the nation's earliest applications of mobile technology, California introduced a wireless program known as "My California on the Go" in 2001. It was introduced as a way for citizens to receive instant wireless updates on energy warnings, traffic jams, state lottery results, press releases, and emergency information from the governor's office. Anyone with a PDA, pager, or cell phone could access the information.

Virginia has the reputation for having been the first state to introduce such services as online, real-time customer service assistance and online driver's license renewals, among others. Continuing its tradition of leadership in e-government, Virginia launched a wireless state portal, "My Mobile Virginia." This was the first program in the nation to make government services available via wireless and mobile devices. Most of the services are for citizens, although some are for state employees. Downloadable information services include emergency weather information, terrorism threats, legislative information, lobbyist information, election information, tax information, and information for tourists. What may have been the most important governmental reform related to technology planning in the state was the establishment in 2003 of the Virginia Information Technology Agency (VITA). This agency oversees ICT planning for the entire state government.

The State of New York had moved much earlier to coordinate ICT at the state level, when the Office for Technology (OFT) was established in 1996. New York introduced the Statewide Wireless Network (SWN) in 2000. The primary objective of the SWN is to increase and improve inter- and intrastate agency communications. However, it is also enabling a better working relationship between state agencies and local government offices. New York has also adopted additional mobile technologies. For example, the New York Division of Parole adopted a wireless program to facilitate better communication among the more than 1,200 parole officers and 45,000 parolees. Parole officers were issued handheld computers—"WorkPads"—linked to a mainframe at agency headquarters. While in the field, officers were able to immediately request more help and attain additional information. Their knowledge level was thereby greatly enhanced.

Performance Measurment and KM

Like organizations in the private sector, governments must measure their performance progress in a variety of activity categories. Government agencies are today subject to performance analysis that is as rigorous as anything in business or industry. Moreover, government managers must establish specific goals and objectives and report the organization's progress toward accomplishing the objectives. Broadly speaking, there are three main reasons for managers to measure their performance and value their assets (Bahra 2001).

The first reason is because measuring performance provides benchmarks against which to measure future positive or negative change. Second, measurement serves as a motivator for management by stimulating management focus on what is important. Third, measurement is a rationale for having made the investment, which in time will have an impact on justifying future investments. Both the public and the private sector are today employing return-on-investment (ROI) metrics.

Benefits and Pitfalls

A recent study on the use of performance measurements in state governments found that the evidence clearly supports the belief that performance measurement can have an important and influential effect on the management of public programs (Melkers and Willoughby 2004). The benefits occurred more in the area of managing state agency programs than for the program budgeting process. Although not specifically mentioning the items, two of the study findings pertained closely to ICT and knowledge management. First, the use of performance measurement in the states has improved both the substance and the quality of communication between and among executive agencies, agencies, the state budge office, and legislators and their staffs. Second, the effects of this improved communication extend beyond state government. Communication with the public about government performance has improved, and many former problems in reporting to external stakeholders have been resolved.

The chief difficulty in measuring knowledge management investments is that they are often intangible or provide results at some unknown future date. Also, appropriately attributing cost data is often difficult. If measurements are accepted as necessary, a way must be found to surmount these problems; one such method for measuring knowledge management investments has been developed by researchers at the UK Cranfield School of Management. Researchers Karin Breu, David Grimshaw, and Andrew Myers (2000) asked industry leaders across the UK to identify the knowledge-based benefits they had received from IT and KM. Factors and their components are presented in Table 3.3.

The items are grouped into five composite benefit factors: innovation and

Table 3.3

Benefit Factors and Their Constituent Components

Factor	Representative Constituent Components
Innovation and growth	• New products/services • Research and development • New [program] opportunities • Developing new constituencies • Capability to innovate • Organizational responsiveness • Organizational integration • Organizational flexibility • Sharing of ideas and knowledge • Organizational learning • Speed of decision making
Customer focus	• Customer/client retention • Customer service provided • Meeting customer/client needs • Product/service quality
Supplier network	• Supply chain efficiency • Integration of logistics • Supplier relationships • Sustaining existing markets • Time to market of new products/services
Internal quality	• Process innovation • Capability for change • Operational efficiency • Project management • Product/services management • Staff morale • Quality of decision making

Source: Cranfield School of Management (UK). Modified from Bahra 2001, p. 97.

growth, organizational responsiveness, customer (or client) focus, supplier network, and an internal quality factor. Each factor includes five or more identifiable and measurable characteristics (Bahra 2001); each is described below in more detail.

Innovation and Growth: This component describes the benefits to the organization that arise from a culture and philosophy that encourage new products and services, including approaches to the delivery of those services. It also values higher output from research and development efforts, seeking out and exploiting new business opportunities, and enhancing the creative and innovative capability of the organization.

Organizational Responsiveness: This component includes success at reducing or eliminating geographic barriers and achieving organizational integration and flexibility. In this way, agencies seek ways to become what is often referred to as “lean and mean,” “quick on the feet,” and welcoming of change. The organizational culture is one in which the sharing of ideas and organizational learning is honored. A key metric often employed is improving the speed of decision making.

Customer Focus: Until recently, losing customers was not a concern of public agencies. However, with outsourcing and privatization, it has become of some concern to agencies. Therefore, achieving continuous improvements in such externally focused activities as customer retention, meeting customer needs, and maintaining product and service quality are important components of a system of performance measurements.

Supplier Network: These are the benefits an organization gains through common standards achieved through closer collaboration with other value-chain organizations and agencies. It may also mean establishing programs for involving suppliers in product and service design. In state and local governments, for example, this is increasingly being accomplished by greater use of design-build-operate public works contracts. Integrating logistics and improving supplier relationships are also included in this factor.

Internal Quality: These are the measurable benefits that occur as a result of process innovation, being open to change, enhancing organizational efficiency, and better management of projects. In addition, it includes the human resources benefits of better employee morale, improved retention, and higher-quality decision making.

Results of the UK survey quantified progress by using planning period percentage objectives for each factor. Respondents were also to state their actual results. By comparing achieved versus targeted results, agency administrators are then able to identify areas where additional performance efforts are needed.

Conclusion

Designing an effective and far-reaching public sector knowledge management system requires the best combination of people, information, processes, and technology. Public-sector knowledge management systems must be designed so that the agency personnel are able to (1) identify relevant information that is needed for completion of the agency’s mission, (2) strengthen interagency collaborations, and (3) store, organize, and catalog everyday and invaluable knowledge so that it can be used in the near and distant future.

A survey of Canadian public-sector managers found that, with only minor variation, the majority of the respondents gave similar importance rankings to items found in five different KM models. Nine components may be considered to be fundamental components in all KM and KM systems applications: technology, leadership, culture, measurement, process, organization, infrastructure, learning, and content.

Implementing the information and communications technology architecture component of a KMS begins with aligning the system with the agency's knowledge needs. Design ing the information technology architecture entails organizing the agency's knowledge and information technology resources to carry out the mission of the organization. There are two key parts to designing information technology systems architecture: information system architecture and technology system architecture.

Three trends are evident in the changing role of IT in supporting knowledge management: a diminishing role for ICT, a growing need for integration and collaboration, and acceleration in the use of wireless and mobile technology by government agencies.

The use of performance measurements in the fifty state governments supports the belief that performance measurement can have an important and influential effect on the management of public programs.