PEARSON Education

Knowledge Management

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KNOWLEDGE MANAGEMENT

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Preface

We live in a world that changes by the minute. Change often moves organizations and advances people's intellect. For change to be effective, organizations as well as people must change. However, even the most intelligent individuals can become handicapped in ineffective organizations. People, being creatures of habit, are so busy working the job that they fail to see change around them. They get carried away with behavior that did well in the past, not realizing that it no longer produces effective results in a fast-changing business.

The key to change and growth is awareness, sharing ideas, and coming up with new and innovative ways of staying ahead of the competition. It involves learning, innovating, and adopting behavior designed to improve quality and performance. As McLuhan said, "Everybody experiences far more than he understands. Yet, it is experience, rather than understanding, that influences behavior."

So, smart people need smart organizations. The name of the game is integration and cooperation for competitive advantage. For companies to make use of human experience and intelligence, they must provide a sharing environment, empower people with tools, and create a climate for learning and testing new ways of doing business. As Philip Kotler, professor of marketing, Northwestern University, wrote, "Every company should work hard to obsolete its own line . . . before its competitors do."

Why This Book?

Knowledge management is growing rapidly. More and more companies have built knowledge repositories, supporting such knowledge varieties as customer knowledge, product development knowledge, customer service knowledge, human resource management knowledge, and the like. Even new job titles have appeared—from knowledge developer, to knowledge facilitator, to corporate knowledge officer. Other signs of the growing knowledge management emphasis are in the many newspapers, magazines, journals, conferences, and seminars that appear daily worldwide. Even vendors on the Internet and in established locations tout specialized knowledge management applications of all kinds and aimed at all levels of the organization. By all accounts, knowledge management is becoming a necessary feature of today's business culture.

In our opinion, people change the world; books pave the way. This text is about knowledge, how to capture it, how to transfer it, how to share it, and how to manage it. In this volume, we introduce the many facets of knowledge management—from concepts, to people, to tools, to procedures. In terms of tools, we cover the use of the computer for capturing and sharing tacit knowledge and the network that transfers tacit

and explicit knowledge. Consider the following questions regarding one aspect of knowledge and computers:

- Do you know a more effective way to preserve the knowledge of an expert who might be retiring soon than by preserving it through a computer?
- How could today's corporations afford brain drain and loss of knowledge and expertise without a way to capture it so that less-experienced employees could use it to advantage?
- If knowledge is today's best corporate asset, would it not make sense to find a way to preserve, nurture, share, and protect such capital?

The actual carrier of the knowledge, whether it is e-mail, groupware, or peer-to-peer meetings, will involve people with an attitude of sharing common knowledge in the interest of the project or the organization. Technology is only a tool employed to expedite processes.

Another reason for writing this book is dissatisfaction with existing books for the academic sector. There are many good books on the market where each book gives a specialized picture of knowledge rather than a comprehensive view of what knowledge is and how it is embedded in today's organization. For example, one book focuses on common knowledge based on studying a number of established enterprises. Another book brings up the concept of learning in action as a guide to putting the learning organization to work. Another known book discusses how organizations manage what they know. Other books are either extremely behavioral focused or lean heavily toward knowledge automation. This text is neither. It is process oriented. It strikes a balance between the behavioral aspects of knowledge and knowledge management and refers to technology as a medium for knowledge transfer, especially in the e-world.

How the Text Is Organized

This text is about knowledge management—what it is and how to use it for competitive advantage. Figure 1 is a graphic layout of how the text is organized. Part I presents the basics of *knowledge management* and focuses on the concept of *knowledge* and *knowledge management system life cycle.* Chapter 1 introduces the meaning of knowledge, how knowledge came about, the myths, and a summary of the knowledge management life cycle. Chapter 2 addresses cognition and knowledge management, types of knowledge, expert knowledge, and human thinking and learning. Chapter 3 elaborates on the challenges in building knowledge management systems and the knowledge management system life cycle.

Part II addresses the important area of *knowledge creation* and *knowledge capture.* The focus is on the various knowledge tools to capture tacit knowledge as a step to storing it for knowledge sharing. Chapter 4 brings up Nonaka's model of knowledge creation and transformation and knowledge architecture centered on people and technical cores. Chapter 5 lays out in detail the tacit knowledge capture process using the interview as a tool. It also covers how to evaluate and develop a relationship with the expert. Chapter 6 discusses other tacit knowledge capture tools such as brainstorming, protocol analysis, Delphi method, and concept mapping.

Part III examines *how tacit knowledge is codified* and how the resulting knowledge base is implemented. In Chapter 7, we deal with knowledge codification tools such as knowledge maps, decision tables, decision trees, and production rules. Chapter 8 elabo-

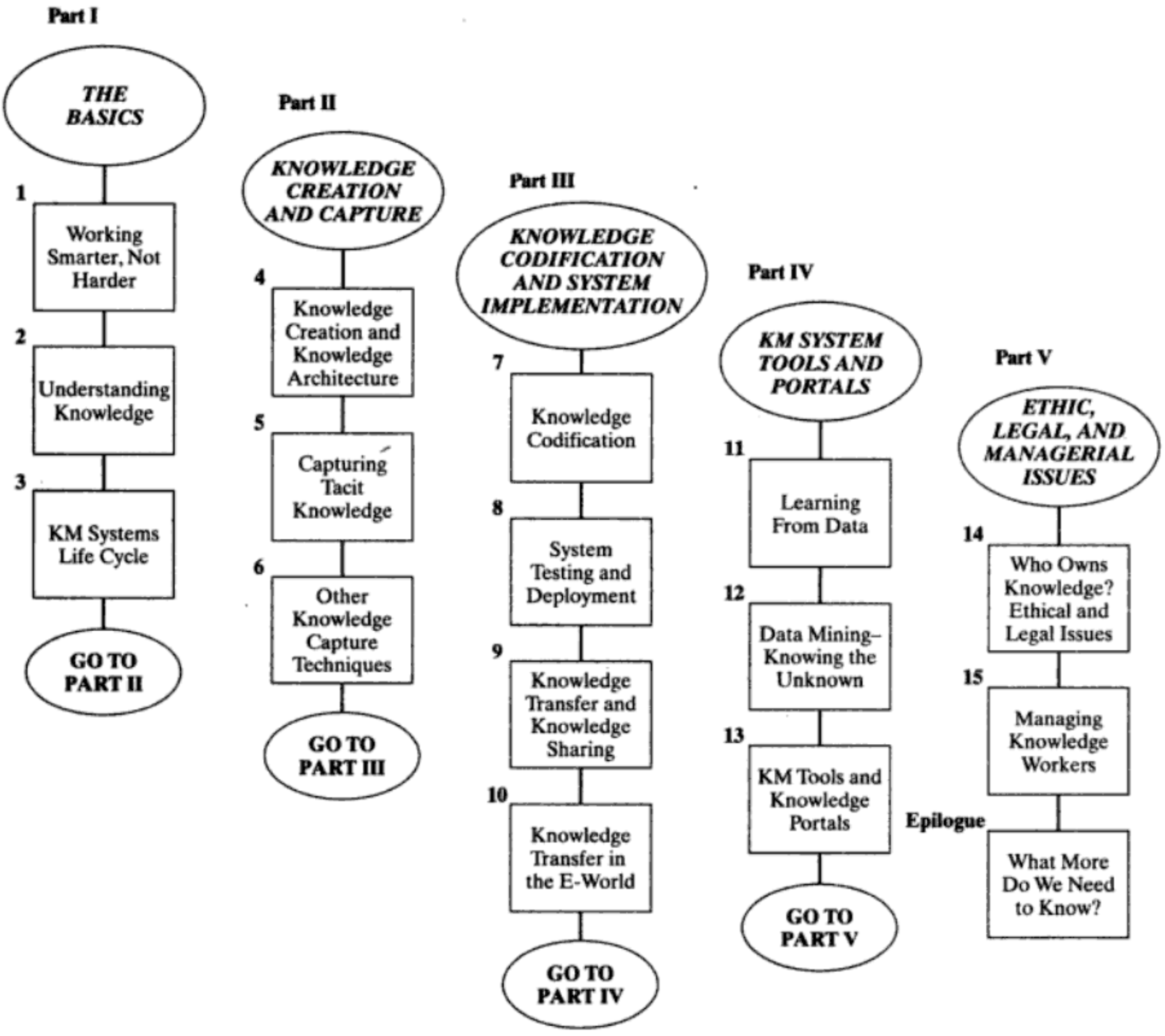

FIGURE 1: Organization of the Text

rates on various approaches to logical and user-acceptance testing, how to manage the testing phase, and issues related to deployment. Chapter 9 expounds on knowledge transfer and knowledge sharing. Specifically, we focus on the prerequisites for knowledge transfer, knowledge transfer methods, and the role of the Internet in knowledge transfer. Finally, Chapter 10 focuses on the e-world in terms of knowledge transfer within a company's intranet, extranet, groupware, and groupware applications. E-business is discussed in terms of knowledge transfer between businesses, supply-chain management, and customer relationship management.

Part IV addresses the more *technical aspects of knowledge management.* The focus is on data mining and knowledge management tools and portals. In Chapter 11, the focus is on learning from data through neural nets, association rules, and classification trees. Chapter 12 deals with data-mining concepts, tasks, processes, and practice. Chapter 13 addresses portals, knowledge portal technologies, and key managerial issues.

Part V brings up the *ethical, legal, and managerial issues* in knowledge management. The question is who owns knowledge—the knowledge worker or the firm? In Chapter 14, we discuss the liability of the knowledge developer, the expert, and the user. We also highlight the meaning of copyrights, trademarks, and trade names. Major threats to ethics in knowledge sharing are also covered. Chapter 15 concludes the text with a focus on the knowledge worker and how to manage knowledge work. Specifically, we elaborate on the skills set of the knowledge worker and how technology can be a critical tool for advancing knowledge work. The Epilogue is a futuristic view of knowledge management and the likely direction it will take to help the learning organization succeed in an increasingly competitive global environment.

Key Features

This text incorporates several key features for easy learning:

- *Learning by example* is evident throughout the text. Concepts, principles, or procedures that are either technical or new are followed by examples or illustrations for easy learning.
- *Boxed vignettes* throughout each chapter are brought in from the field through journals or Web sites.
- *Illustrations* are incorporated where necessary for clearer understanding of the material. Each graph, figure, or table has been carefully sketched to ensure that the key concept being represented stands out clearly. When actual adaptation is used, references are provided so the student can locate the knowledge source.
- *Implications for knowledge management* relates chapter material to knowledge management or management decision making.
- *Knowledge exercises* available at the end of each chapter offer a variety of both straightforward and more thought-provoking applications. The solutions are available in the instructor's manual on the Web site: www.prenhall.com/awad.
- *A summary* at the end of each chapter brings into focus the essence of the chapter. Good summaries can be a useful guide for chapter coverage. Depending on learning preference, reading the summary before reading the chapter can be an effective learning approach.
- *Terms to Know* are selected key terms from each chapter. A glossary of these terms is available on the Web site: www.prenhall.com/awad.

Supplements

COMPANION WEBSITE (www.prenhall.com/awad)

The text's Companion Website includes the Instructor's Manual, Test Item File, and Microsoft PowerPoint slides.

Access to the instructor's section of the site, where the Instructor's Manual and Test Item File are housed, requires a valid user ID and password to enter. You simply need to register yourself as the instructor of the course by going to the Web site and completing the initial instructor registration process. Upon completion of the process, your registration request will be forwarded to your sales representative for validation.

If you have any problem with your authorization, please contact your Prentice Hall sales representative.

INSTRUCTOR'S MANUAL

A specially prepared manual is available for the instructor. The manual provides the following support material:

- A *syllabus* based on a quarter or a semester plan as a guide to teaching the course
- *Lecture assistance,* including the objectives of each chapter, teaching notes, and chapter summary
- *Solutions to knowledge exercises* at the end of each chapter

TEST ITEM FILE

The Test Item File contains multiple choice, true-false, and essay questions. The questions are rated by the level of difficulty and answers are referenced by page number.

POWERPOINT PRESENTATIONS

The slides illuminate and build upon key concepts in the text. They are available for both students and instructors for download from www.prenhall.com/awad.

Acknowledgments

In a nutshell, every effort has been made to make *Knowledge Management* truly understandable, high on lucidity, and practicable. In preparing the manuscript, we kept in mind people, not computers, as the final decision makers. Although the underlying technology in automating knowledge work ensures the availability of tacit knowledge in knowledge bases and other repositories, humans have the final say in the way organizations and society must perform.

Before the manuscript found its way to the publisher, various versions were tested in the classroom over a 2-year period in the United States and abroad. There were successive revisions and updates resulting from student feedback and feedback from professional reviewers and attendees to our many seminars on the subject. We would specifically like to thank the following people:

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Because no knowledge management book is ever complete, future revisions are inevitable. After having gone through this material, you are invited to share your experience, ideas, or thoughts. Feel free to e-mail the authors at ema3z@virginia.edu or ghaziri@aub.edu.lb, respectively.

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CHAPTER 1

Working Smarter, Not Harder

Contents

Knowing ignorance is strength
Ignoring knowledge is sickness
—LAO TSU

In a Nutshell

Welcome to the twenty-first century and the knowledge society. The business landscape is changing rapidly. The competitive environment is no longer linear or predictable. Survival and success depend entirely on the organization's ability to adjust to the dynamics of the business environment. Changes in information technology (IT) have generated gaps in access and control of information and knowledge. Even when these gaps are bridged, several fundamental challenges remain. How do we apply knowledge for

value-added and competitive advantage? How do we convert information into knowledge? How do we use technology to convert challenges into opportunities? Knowledge management is the solution for realigning the firm's technical capabilities to create the knowledge that drives the firm forward.

There is obvious room for change in the way we work and communicate and in relationships and processes among people within and across organizations. To be empowered to face these challenges means not only accessing technology, but also developing the ability to manage knowledge. In the final analysis, the key questions an organization must consider are "Does your company know what you know?" "Do you know what you know?" "How do you make best use of the knowledge you have?" It also means thinking "out-of-the-box," where "the box" is what represents all the tried-and-true procedures that have worked in the past. There is less room for "packaged solutions" to solve most of a firm's problems. Knowledge management means thinking outside the boundaries of current practices, products, services, and organizations. The new and unpredictable business environment puts a premium on innovation and creativity much more so than it has in the past. This explains our chapter title—working smarter, not harder. It is "obsoleting what you know before others obsolete it and profit by creating the challenges and opportunities others haven't even thought about" (Malhotra 2000).

We have progressed from the data processing age of the 1960s to the information age of the 1980s to the knowledge age of the 1990s. The latest transformation represents the most fundamental change since the introduction of the digital computer 4 decades ago. Knowledge and intellectual capital (viewed here as accrued knowledge) represent our corporate and national wealth. Knowledge workers are found in every organization, and they are the backbone of every successful business. Knowledge workers use technology to reason through problems and reach successful solutions. Computer-aided software gives them an edge over workers using conventional methods. In this chapter, we discuss knowledge management, the general concepts and myths surrounding knowledge management, the relationship between knowledge management and management information systems, and how an innovative organization looks at knowledge.

In the past decade, there has been much discussion about the importance of knowledge and knowledge management. Roy Vagelos, the chief executive officer of Merck & Co., told *Fortune* magazine that devoting time and resources to the proper management of knowledge is slowly, but surely, gaining support in many organizations. For a company to manage knowledge, it must first inventory its people, systems, and decisions. Professional knowledge workers within the company must be identified, and their functions must be defined. Knowledge technologies must be incorporated to reengineer the entire business process. Major decisions should be reviewed, and a knowledge system for making each decision should be developed. The company's information system should also be examined to determine how to benefit from emerging knowledge technologies. This self-assessment makes a company more cognizant of its strengths and weaknesses. It should also lead to changes that are more in tune with the competitive nature of the business environment.

What Is Knowledge Management?

Knowledge management (KM) is a newly emerging, interdisciplinary business model that has knowledge within the framework of an organization as its focus. It is rooted in many disciplines, including business, economics, psychology, and information management. It is the ultimate competitive advantage for today's firm. Knowledge management involves people, technology, and processes in overlapping parts (see Figure 1.1).

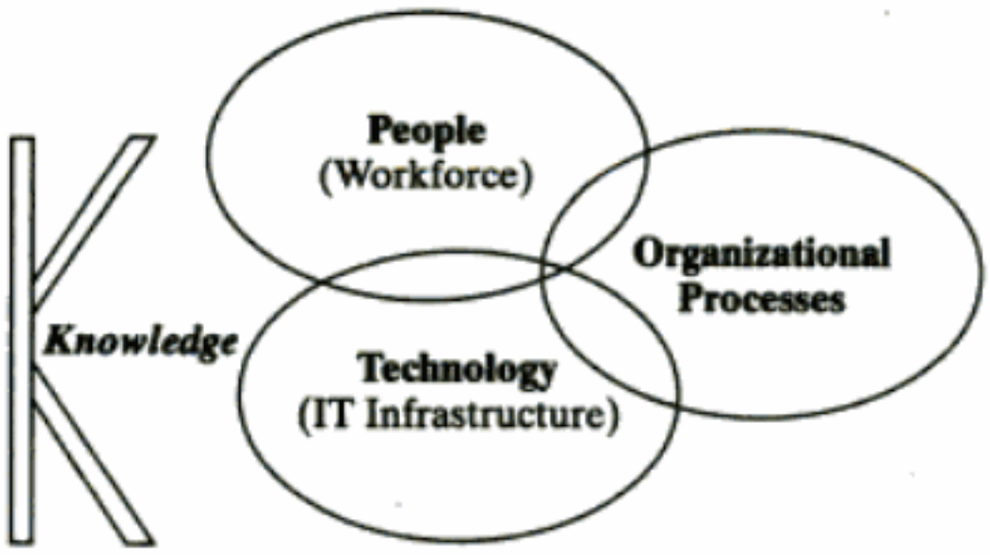


FIGURE 1.1: Overlapping Human, Organizational, and Technological Factors of KM

As can be deduced from the select definitions in Table 1.1, researchers as well as practitioners have yet to agree on a definition. However, each definition of KM contains several integral parts:

- Using accessible knowledge from outside sources
- Embedding and storing knowledge in business processes, products, and services
- Representing knowledge in databases and documents
- Promoting knowledge growth through the organization's culture and incentives
- Transferring and sharing knowledge throughout the organization
- Assessing the value of knowledge assets and impact on a regular basis

In some ways, KM is about survival in a new business world—a world of competition that increases in complexity and uncertainly each day (see Box 1.1). It is a world that challenges the traditional ways of doing things. The focus is not only on finding the right answers, but also on asking the right questions. What worked yesterday may or may not work tomorrow. The focus is on "doing the right thing" rather than "doing things right" so that core competencies do not become core rigidities in the future (Malhotra 2000).

KM is the process of capturing and making use of a firm's collective expertise anywhere in the business—on paper, in documents, in databases (called *explicit knowledge*), or in people's heads (called *tacit knowledge*). Figure 1.2 implies that up to 95 percent of information is preserved as tacit knowledge. It is the fuel or raw material for innovation—the only competitive advantage that can sustain a company in an unpredictable business environment. It is not intended to favor expert systems of the early 1990s, when computers were programmed to emulate human experts' thought processes. The goal is to present a balanced view of how computer technology captures, distributes, and shares knowledge in the organization by linking human experts and documented knowledge in an integrated KM system.

The goal is for an organization to view all its processes as knowledge processes. This includes knowledge creation, dissemination, upgrade, and application toward organizational survival. Today's knowledge organization has a renewed responsibility to hire knowledgeable employees and specialists to manage knowledge as an intangible asset in the same way that one calls on an investor to manage a financial portfolio. A firm seeks to add value by identifying, applying, and integrating knowledge in unprecedented ways, much like an investor adds value by unique combinations of stocks and bonds. The process is part science, part art, and part luck.

THE KNOWLEDGE ORGANIZATION

A conceptual structure of the knowledge organization is shown in Figure 1.3. The middle layer addresses the KM life cycle—knowledge creation, knowledge collection or capture, knowledge organization, knowledge refinement, and knowledge dissemination.

TABLE 1.1 Alternative Definitions of Knowledge Management

- Knowledge management is the process of gathering a firm's collective expertise wherever it resides—in databases, on paper, or in people's heads—and distributing it to where it can help produce the biggest payoff (Hibbard 1997).
- KM is a newly emerging, interdisciplinary business model dealing with all aspects of knowledge within the context of the firm, including knowledge creation, codification, sharing, and how these activities promote learning and innovation (encompassing technology tools and organizational routines in overlapping parts) (Berkeley 2001).
- KM caters to the critical issues of organizational adaptation, survival, and competence in the face of increasingly discontinuous environmental change. Essentially, it embodies organizational processes that seek synergistic combinations of data and information processing capacity of information technology, and the creative and innovative capacity of human beings (Malhotra 1999).
- Knowledge management is the art of creating value from an organization's intangible assets (Sveiby 2000).
- Knowledge management is the classification, dissemination, and categorization of information and people throughout an organization (Taft 2000).
- Knowledge management is the discipline of capturing knowledge-based competencies and then storing and diffusing that knowledge into business. It is also the systematic and organized attempt to use knowledge within an organization to improve performance (KPMG 2000).
- KM is really about recognizing that regardless of what business you are in, you are competing based on the knowledge of your employees (Johnson 2001).
- KM is a conscious strategy of getting the right knowledge to the right people at the right time; it is also helping people share and put information into action in ways that strive to improve organizational performance (O'Dell et al. 2000).
- Knowledge management is a framework, a management mind-set, that includes building on past experiences (libraries, data banks, smart people) and creating new vehicles for exchanging knowledge (knowledge-enabled intranet sites, communities of practice, networks) (O'Dell et al. 2000).
- KM is accumulating knowledge assets and using them effectively to gain a competitive advantage (Brooking 1996).
- KM is a framework within which the organization views all its processes as knowledge processing, where all business processes involve creation, dissemination, renewal, and application of knowledge toward organizational sustenance and survival (Malhotra 2000).
- Knowledge management includes a combination of software products and business practices that help organizations capture, analyze, and distill information (Craig 2000).
- KM is not about technology; it is about mapping processes and exploiting the knowledge database. It is applying technology to people's minds (Deveau 2000).
- Knowledge management is the sharing of information throughout a company or even between business partners. It creates an environment in which the company leverages all its knowledge assets (Trepper 2000).
- KM can automate the classification of documents while using machine logic that comes as close as possible to human logic (Hersey 2000).
- Knowledge management is a discipline of identifying, capturing, retrieving, sharing, and evaluating an enterprise's information assets (Bair 2001).

BOX 1.1

AN EXAMPLE OF KNOWLEDGE MANAGEMENT.

The predawn silence at the U.S. embassy in Indonesia is shattered by automatic weapons fire, and a small force of U.S. Marines barely prevents the attackers from entering the compound. Within the next few hours, the embassy sends information about the attack to the Combat Development Command in Quantico, Virginia. There, a team analyzes the data and sees that it matches a pattern of activity of a fundamentalist rebel group operating in the region.

Another team in Quantico taps into a Community of Practice knowledge database to review new tactical maneuvers being developed in a modeling game room. Experts from across the U.S. Marine Corps join an online discussion, aided by the latest intelligence information and satellite photographs merged into an electronic work space. Within a few hours, a new urban tactic is developed, tested in the modeling game room, and sent to the Marine command in Indonesia.

The commander coordinates plans with the USS *Winston Churchill*, a guided-missile destroyer some 500 kilometers to the east. Later that day, he calls for fire and, 90 seconds later, the ship launches a dual salvo of Tomahawk missiles at a key rebel communications center 10 kilometers from the embassy.

"It's just a story," says Alex Bennet, the U.S. Navy's deputy CIO for enterprise integration, but such stories are an important ingredient in what observers describe as the largest knowledge management effort in the world. The military's knowledge management programs are so comprehensive, in fact, that the private sector can learn much from them, from more effective ways to apply information technology to new ways of teaching.

Army Knowledge Online will become mission-critical, literally, says program manager Maj. Charles Wells. "Yesterday, we had a very straightforward threat: We knew who the enemy was, and we had a lot of detailed plans to stop an attack," says Wells. "Today, we are faced with a variety of challenges—regional instabilities, economic dangers, and the proliferation of weapons of mass destruction. How are we going to accomplish all these missions with a much smaller force? The senior Army leadership sees knowledge management as the key."

As advice to other knowledge managers, Lt. Cmdr. Judith Godwin, Pacific Fleet knowledge manager, says, "Don't build something and expect people to come. They won't." Instead, she says, "Find communities that are trying to get a task done. Enable them with a specific tool so they can see the value it can bring to what they are doing right now. Then it will grow from there."

SOURCE: Excerpted from Anthes, Gary H. "Charting a Knowledge Management Course," *Computerworld*, August 21, 2000, p. 38ff.

The final step is the maintenance phase, which ensures that the knowledge disseminated is accurate, reliable, and based on company standards set in advance. The outer layer is the immediate environment of the organization—technology, culture, supplier and customer intelligence, competition, and leadership. Such an environment has a lot to do with how well an organization goes about developing and implementing its KM life cycle—also called the KM process.

The ideal knowledge organization is one where people exchange knowledge across the functional areas of the business by using technology and established processes. As depicted in Figure 1.4, people exchange ideas and knowledge for policy formulation and strategy. Knowledge is also internalized and adopted within the culture

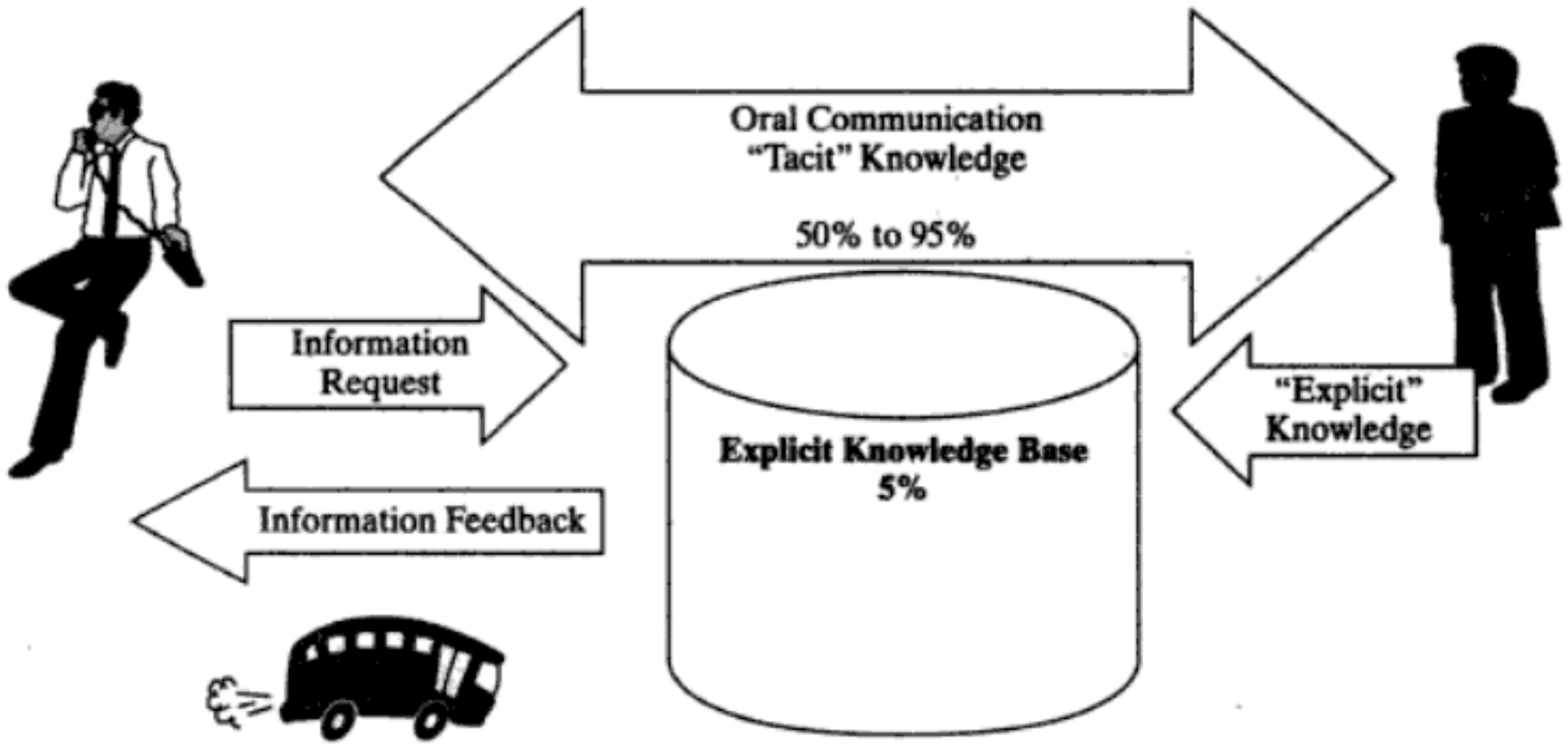


FIGURE 1.2: Uncaptured Tacit Knowledge

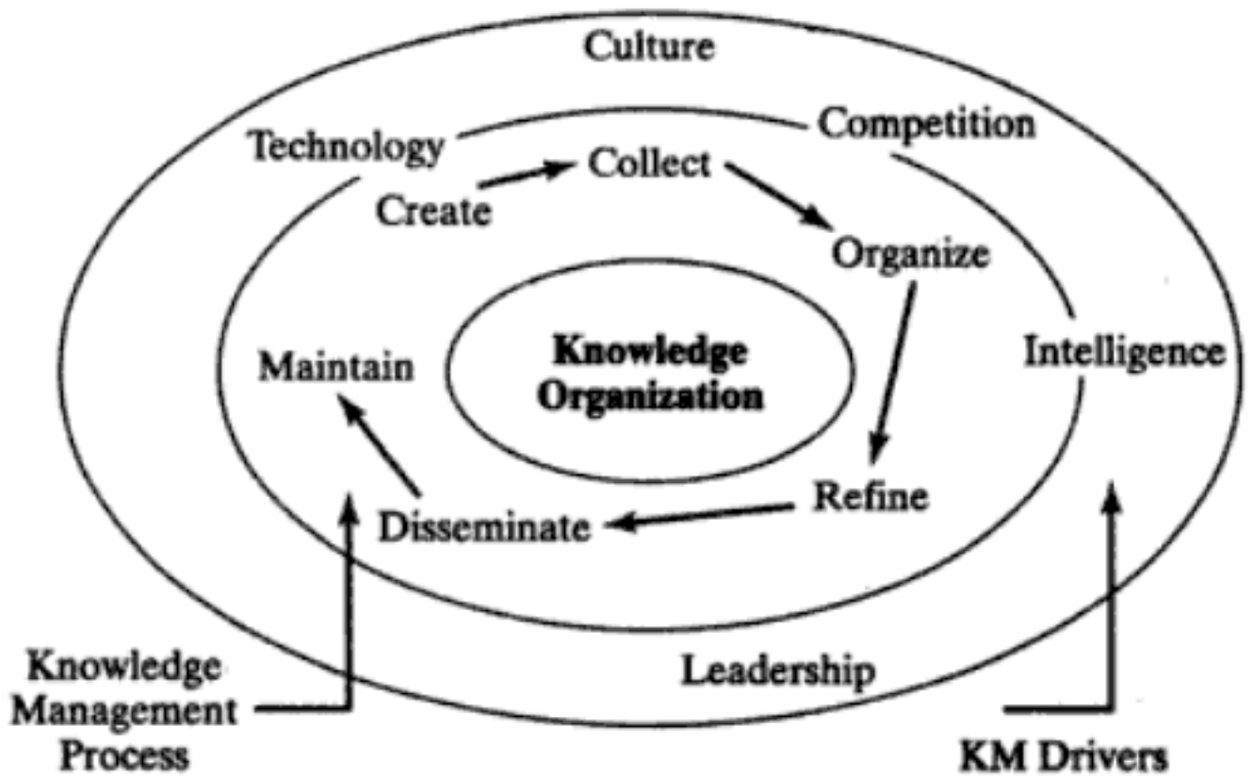
SOURCE: Bair, Jim "Knowledge Management Technology: Beyond Document Management." www.strategy-partners.com/spweb/pages.nsf/all+pages/White%20Page%20%20%20Knowledge%20Management%20Technology:%20Beyond%20Document%20Management?opendocument September 19, 2001, pp. 1–6. Date accessed August 2002.

of the organization. All knowledge workers (people) are in an environment where they can freely exchange and produce knowledge assets by using various technologies. This process influences the company as a whole in a positive way.

A knowledge organization derives knowledge from several sources:

- Customer knowledge—their needs, who to contact, customer buying power, etc.
- Product knowledge—the products in the market place, who is buying them, what prices they are selling at, and how much money is spent on such products
- Financial knowledge—capital resources, where to acquire capital and at what cost, and the integrating in financial practices
- Personnel practices knowledge—the expertise available, the quality service they provide, and how to go about finding experts, especially in customer service

FIGURE 1.3: The Knowledge Organization



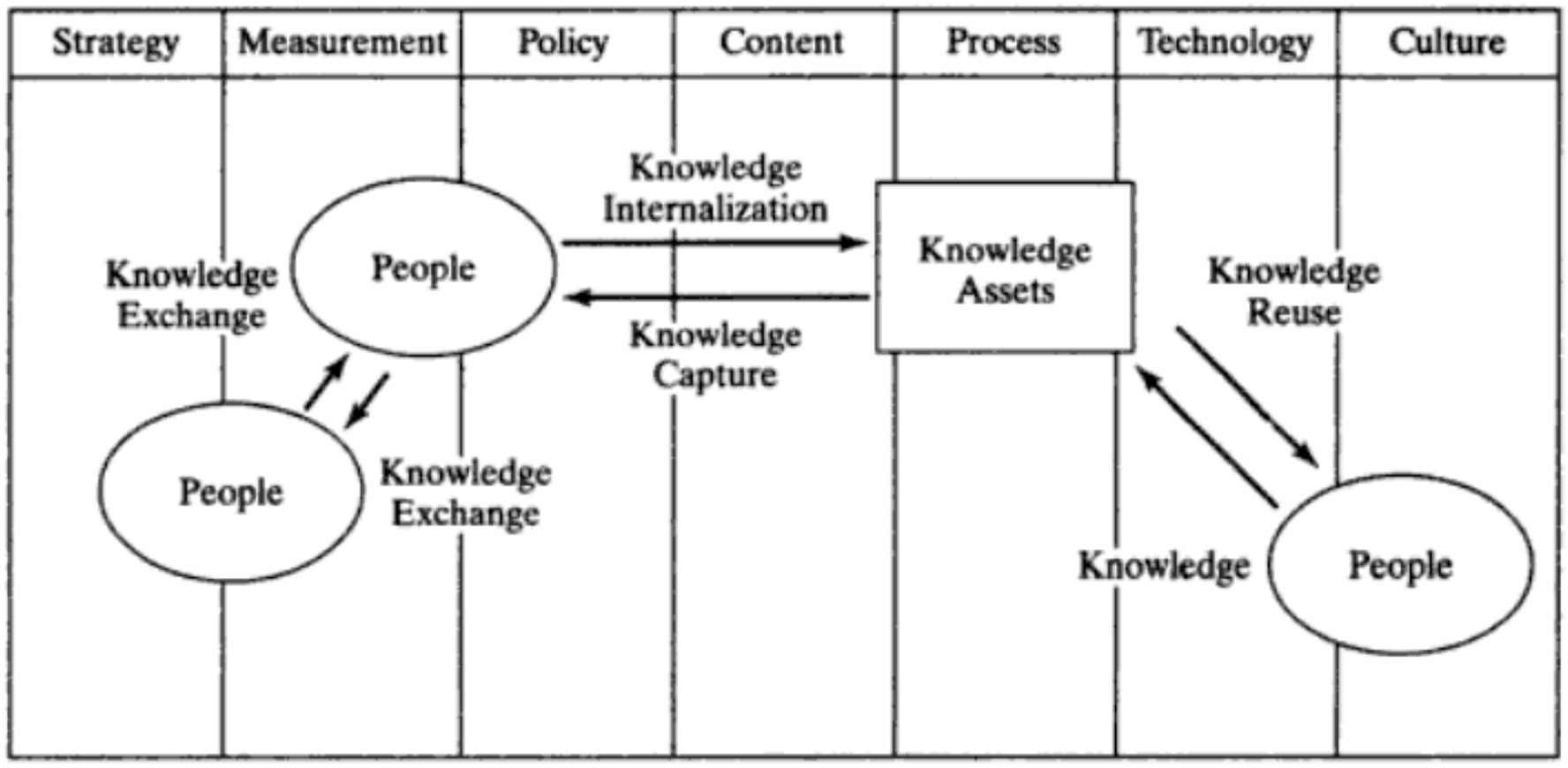


FIGURE 1.4: Ideal Knowledge Management

SOURCE: Gravallese, Julie. "Knowledge Management," *The MITRE Advanced Technology Newsletter*, April 2000, vol. 4, no. 1. www.mitre.org/pubs/edge/april_00/4, Date accessed August 2002.

The idea of "managing" knowledge is abstract. Knowledge is not something we typically think of as being managed, but rather something that is individually controlled, personal, and autonomous. To be able to manage knowledge, one must first be able to elicit an individual's knowledge from that individual. The human aspect of both knowledge and managing are integral. There is also the issue of measuring knowledge: If you cannot measure it, you cannot manage it.

One unique indicator of KM in action is seeing people think actively, not passively—thinking ahead, not behind. It is an environment where customer service is improved through better problem-solving, where new products are available to the market more quickly, and where the organizational processes that deliver the new products continue to improve through innovation and creativity of the people behind the product and the production process. This is where technology, networking, and data communication infrastructure play an important role. Technology has made knowledge sharing and innovation more feasible (see Figure 1.5).

What KM Is Not About

- *Knowledge management is not reengineering.* Reengineering implies one-shot, drastic "electrical shock" change in organizational processes to improve efficiency. It is a mechanical shift from one stage of operation to a more efficient stage, and it usually involves radical changes of business processes and the people involved. In contrast, KM implies continuous change and addresses future threats and unique opportunities. There is continuous learning, unlearning, and relearning to ensure smooth change from top to bottom. The focus is on change that will generate gradual but solid gains in the competitive environment. Knowledge management is engrained in the day-to-day operations of the business and directed by people who are directly connected with the changing world of their company's business.
- *Knowledge management is not a discipline.* It is another way of improving quality, profitability, and growth.
- *Knowledge management is not a philosophic calling.* KM goes to the core of an organization's intangible asset (knowledge), revisits the knowledge, and taps into it.

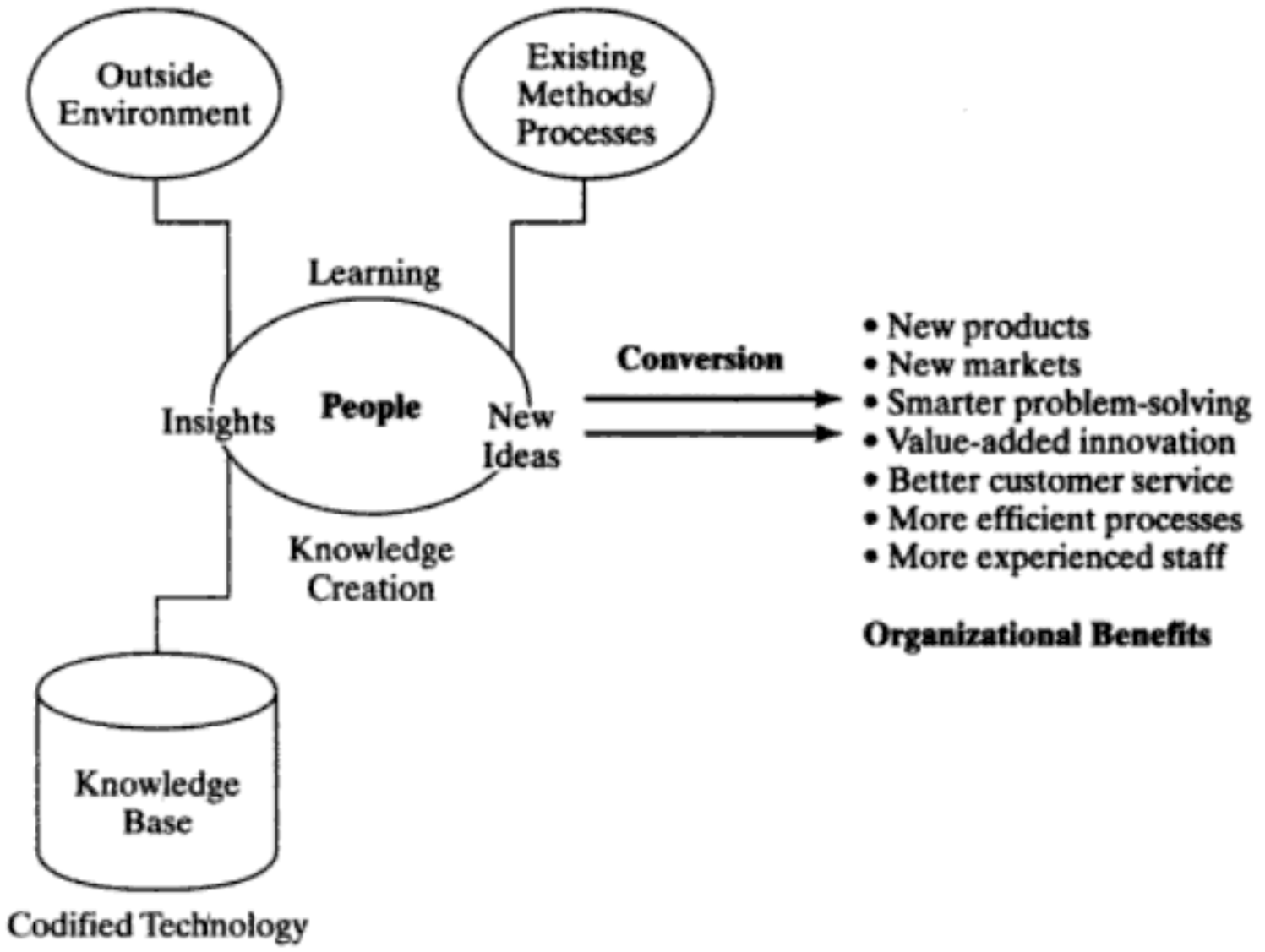


FIGURE 1.5: Knowledge Management and Innovation

- *Knowledge management is not intellectual capital, per se.* Intellectual capital (IC) represents the value of a company's trademarks, patents, or brand names. Intellectual capital is a company's collective brainpower, or a composite of experience, knowledge, information, and intellectual property—all the property of the organization. Although treated in the literature the same as knowledge, knowledge, per se, is the consequence of actions and interactions of people with information and knowledge exchange based on experience over time (see Box 1.2).
- *Knowledge management is not based on information.* Information can become knowledge after people use it in ways that create value. Knowledge has been viewed as information in action. As we shall explain in Chapter 2, information is context-sensitive; knowledge is consensus-oriented.
- *Knowledge management is not about data.* Data (facts without context) or information (interpretation or patterns of data) is not knowledge. As we shall find in Chapter 2, data by itself is not actionable knowledge (O'Dell et al. 1998, 17).
- *Knowledge value chain is not information value chain.* In information value chains, the key component is a technological system guiding the company's business processes, viewing humans as passive processors. In contrast, knowledge value chains view humans as the key components assessing and reassessing information stored in a technological system. Best practices into organizational business processes are carried out after active human inquiry, and such processes are continuously updated in line with the changing external environment.
- *Knowledge management is not limited to gathering information from the company's domain experts or retiring employees and creating databases accessible by intranets.* KM is a collective concept of the organization's entire core knowledge.
- *Knowledge management is not digital networks.* KM is about improving business processes with people and technology in mind. Effective technology is the enabler of KM, and people must be in the equation from the start to use technology effectively.

BOX 1.2

INTELLECTUAL CAPITAL

Tracking a company's physical assets is straightforward enough, as long as you're counting computers, adding salaries, and estimating heating bills. But managing intellectual capital is a different ball game, and one in which few companies consistently hit home runs.

Intellectual capital involves a company's employee expertise, unique organizational systems, and intellectual property. For example, if a company's book value is $10 per share and its stock is selling for $40 per share, the difference is often attributed to intellectual capital. "When you subtract book value from market value, the remaining is all the intellectual and knowledge and market capital. It includes all the patents they might have and all other intangibles," says Vish Krishna, associate professor of management at the McCombs School of Business at the University of Texas at Austin.

Once a company identifies its intellectual capital, the next step is to maintain it. One of the techniques that Dollar Bank uses to manage intellectual capital is to keep employees involved in decision making and planning, says Abraham Nader, senior vice president and chief operating officer at the Pittsburgh-based bank.

Ron Griffin, CIO at The Home Depot, Inc., says that Atlanta-based home improvement retailer has tried-and-true structures in place for measuring, maintaining, and growing intellectual capital. The company uses a nine-box grid system to measure each employee's performance and potential, and it offers developmental courses to bring employees up to speed on certain issues. The categories measured include leadership ability, how an employee fits into the Home Depot culture, financial acumen, and project management capabilities

For its part, Home Depot posts a bulletin on its intranet with quick references on topics such as how to repair a leaky toilet or build a deck. That way, knowledge is available for employees to remain up to speed and to pass such information along to customers. "It's not just about selling product in our business; it's a lot of the knowledge, and we train on that extensively," Griffin says.

SOURCE: Exeerpted from Taylor, Christie. "Intellectual Capital," *Computerworld*, March 12, 2001, p. 51.

- *Knowledge management is not about "knowledge capture," per se.* Knowledge cannot be captured in its entirety. Problems involving collaboration, cooperation, and organizational culture must be addressed before one can be sure of reliable knowledge capture.

Regardless of the business, a company competes based on the knowledge of its employees. A company also has a management mind-set that relies on past experience (such as smart people, documents, or databases) and creates a new way for exchanging knowledge by using intranets, the Internet, local area networks, and the like. Consider the case of a British supermarket chain that used a customer data-mining application to assess buying behavior. After running correlation analyses among several variables, it quickly discovered a clear association between the purchases of diapers and beer by male customers on Friday afternoons. Armed with this knowledge, the store began to stack diapers and beer together.

It should be clear by now that people are the determinants of KM success. The best software is insufficient if you do not have people willing and ready to cooperate and

collaborate. Sharing knowledge based on mutual trust is the critical component in the entire KM process. To illustrate, Lotus describes its Raven as resembling the "collaborative capabilities of Notes" but going further by "defining the relationships between people and content." Raven is a key element of Lotus' overall knowledge management strategy, which includes services, methodologies, and solutions from Lotus and IBM, all captured under the unifying theme of "people, places, and things." The company can create an employee profile detailing the employee's specialty and his or her projects, and then store the profile in a database that can be edited and accessed by users and coworkers via e-mail, instant messaging, and conferencing setups. The requirement with Raven is for employees to update their respective profiles (databases) consistently and regularly to maintain the "knowledge portal." If knowledge is not reinvested in this manner, it cannot be reliably created at a later time. Software update alone is not the answer.

Raven provides a single portal that will allow end users and communities to find and discover useful information and applications on a given subject, make the user aware of other knowledgeable people in the company, and organize all related tasks, teams, and projects. With its unique architecture, it is capable of generating a content map, creating expertise profiles, creating and hosting communities, clustering documents, mining skills, locating experts, and searching and browsing in a user-friendly manner. Such a KM tool can satisfy many of the user's needs that might not be fulfilled currently in the firm. One can plan to use such a product for the KM implementation. However, to fit a firm's needs perfectly, an information technology consultant should be contacted for proper fit.

Why Knowledge Management?

A new word for the consumer in today's market, "prosumer," refers to the consumer who is no longer in the passive market where goods are offered at the exact face value. Prosumers are more educated consumers, and they demand more. They provide feedback to manufacturers regarding the design of products and services from a consumer perspective (Bexar 2000). This has initiated new and radical changes in the business world. Even with recent technology developments such as networking, e-mail, and the Web, business has yet to fully respond to the societal, cultural, and technical challenges. However, a positive response to knowledge sharing and knowledge management among growth-oriented firms is beginning to appear.

KM has already demonstrated a number of benefits and has offered justification for further implementation. The Internet facilitated its development and growth via fast and timely sharing of knowledge. By sharing knowledge, an organization creates exponential benefits from the knowledge as people learn from it. This makes business processes faster and more effective and empowers employees in a unique way. For example, Microsoft's Hotmail service advanced the wide use of e-mail that allowed users to exchange information through any Web browser. Today's Web-based interface is the norm for most Internet service providers.

Based on a number of published studies, KM has had a positive impact on business processes. The goal is to capture the tacit knowledge required by a business process and encourage knowledge workers to share and communicate knowledge with peers. With such knowledge, it is easier to determine which processes are more effective or less effective than others. The main constraint in KM, however, is initially capturing it. However, if an organization can succeed in capturing and dispersing knowledge, the

benefits are endless. A company can leverage and more fully utilize intellectual assets. It can also position itself in responding quickly to customers, creating new markets, rapidly developing new products, and dominating emergent technologies.

Another benefit of KM is the intangible return on knowledge sharing rather than knowledge hoarding. Too often, employees in one part of a business start from "scratch" on a project because the knowledge needed is somewhere else but not known to them. To illustrate one documented case, a department of AT&T spent close to $80,000 for information that was available in a technical information document from its associate company, Bell Research Corporation, for $13 (Skyrme 1999, 2).

As a result of KM, systems have been developed to gather, organize, refine, and distribute knowledge throughout the business. In his study of Smart Business, Botkin (1999) suggests six top attributes of knowledge products and services:

- *Learn.* The more you use them, the smarter they get and the smarter you get, too.
- *Improve with use.* These products and services are enhanced rather than depleted when used, and they grow up instead of being used up.
- *Anticipate.* Knowing what you want, they recommend what you might want next.
- *Interactive.* There is two-way communication between you and them.
- *Remember.* They record and recall past actions to develop a profile.
- *Customize.* They offer unique configuration to your individual specifications in real time at no additional cost.

During the 1960s and 1970s, technology was focused on automating high-volume static processes such as claims processing, mortgage loan updating, airline reservation systems, and the like. The emergence of e-commerce in the late 1980s and 1990s showed how information technology could implement a new way of doing business effectively. Ever-increasing processing power, high bandwidth data transmission, and networking made it possible to reenvision how business gets done. It has also changed the business environment and introduced new competitive imperatives. Among them are:

- *Reacting instantly to new business opportunities, which led to decentralized decision making (and competency) at the front lines, where the action is.* With that came the desire to build mutual trust between knowledge workers and management and to cooperate in handling time-sensitive tasks.
- *Building better sensitivity to "brain drain."* It has been said that "expertise gravitates toward the highest bidder" (Applehans et al. 1999, 17). More and more companies realize the importance of managing and preserving expertise turnover. For the human resources department, the key question is "How does the firm replace expertise when it retires, resigns, or simply leaves?"
- *Ensuring successful partnering and core competencies with suppliers, vendors, customers, and other constituents.* Today's technology has enabled companies to reengineer the ways to do business. Getting partners up to your speed requires more than fast technology. Knowledge workers and others within the company should ensure that cooperation and coordination of work are practiced for the good of the firm.

With the expected depletion of highly knowledgeable workers due to the retirement of baby boomers, KM will be important in the upcoming years. It is essential that organizations capture and preserve the knowledge of senior colleagues so that younger employees can make immediate use of it and improve upon it to make the business run even more smoothly and more efficiently. Merrill Lynch has worked to incorporate KM to shorten the learning curve of its 18,000 brokers worldwide. The newly developed

knowledge-based system facilitates sharing of knowledge and quickly enables less-trained brokers to achieve performance levels ordinarily associated with much more experienced professionals. The system captures and disperses knowledge about transactions, trading rules, yields, securities features, availability, tax considerations, and new offerings. Sharing of this knowledge allows brokers to serve millions of clients worldwide with sophisticated investment advice and detailed, up-to-date information and data. It acts as an instant training vehicle.

Andersen Consulting (now Accenture) provides another example of a well-developed knowledge-sharing system, called *ANet.* This electronic system connects employees and encourages the sharing of knowledge. ANet allows an employee to use the total knowledge of Accenture (formerly Arthur Andersen) to solve a customer problem anywhere in the world through electronic bulletin boards and to follow up with visual and data contacts. In theory, ANet expands the capabilities and knowledge available to any customer to that of the entire organization. It further enhances employee problem-solving capacity by providing access to compiled subject, customer-reference, and resource files available either directly through the system or from CD-ROMs available to all offices. Based on experience, Accenture reported that technological changes alone could not make ANet successfully used by employees. Major changes within the organization, such as changes in incentives and culture, were needed to create participation. A summary of KM justification is shown in Table 1.2.

Companies that fail to embed a viable KM operation probably suffer from several oversights or pitfalls:

- *Failing to modify the compensation system to reward people working as a team.* The traditional method of compensating people based on the old-fashioned "information-hoarding" practice does not work in a knowledge-sharing environment. Merit increases and bonuses should be based on team contribution and team performance rather than quantity or volume.
- *Building a huge database that is supposed to cater to the entire company.* Generalized systems do not usually work well, because information and knowledge are not stratified to address specialized areas of expertise. Ideally, the

TABLE 1.2 KM Justification

- Creates exponential benefits from the knowledge as people learn from it
- Has a positive impact on business processes
- Enables the organization to position itself for responding quickly to customers, creating new markets, developing new products, and dominating emergent technologies
- Builds mutual trust between knowledge workers and management and facilitates cooperation in handling time-sensitive tasks
- Builds better sensitivity to "brain drain"
- Ensures successful partnering and core competencies with suppliers, vendors, customers, and other constituents
- Shortens the learning curve, facilitates sharing of knowledge, and quickly enables less-trained brokers to achieve higher performance levels
- Enhances employee problem-solving capacity by providing access to compiled subject, customer-reference, and resource files available either directly through the system or from CD-ROMs available to all offices.

human resources department should first determine who works best with whom based on commonality of job type or job experience and then discover the knowledge that can be shared for each employee to be more successful.

- *Viewing KM as a technology or a human resources area.* This oversight relates to the earlier one—where human resources and information technology efforts are poorly coordinated—and defeats the purpose behind embedding KM into the fabric of the organization. The two departments should work jointly at introducing KM as part of the organizational processes.
- *Placing too much emphasis on technology.* Although intranets, knowledge-based tools, data warehouses, and other computer-based software are part of the way today's organization must adopt, technology is only the enabler of knowledge management. The knowledge it makes available must be organized and disseminated to human decision makers to be of any use.
- *Introducing KM into the organization via a simple project to minimize possible losses.* This is the wrong way to start KM. A company should start with a strategy and a champion, with a focus on a worthwhile, high profile project that can set the tone for the rest of the organization. It is a high risk approach, but one that is most likely to pay dividends in the long run.
- *Pursuing KM without being ready.* Spurred by the paradigm shift in our economy, many corporations pursue KM without evaluating whether they are organizationally ready (Stewart et al. 2000, 45). In other words, corporations that have been operating under classical management principles cannot be successful in adopting KM without major changes in culture, management attitudes, and communication skills.
- *Having poor leadership.* Like any high priority project, KM is best implemented with determined champions and top management commitment. For example, General Electric (GE) recognizes an organizational culture open to ideas from all levels of the company. By encouraging best-practice sharing, the company can grasp the knowledge within the employees and innovate the organization's processes. Jack Welch, former CEO, has established a knowledge management university and frequently teaches the classes himself. Only 10 percent of the 96 companies surveyed by the Conference Board sponsored by PricewaterhouseCoopers identified the CEO as a component of a KM initiative. By integrating the CEO of the company into the KM system, KM acquires a level of importance and respect that would otherwise be lacking. GE has incorporated all levels of the business and is well designed to share knowledge. The company is successfully able to use employee input and knowledge to produce a strategic advantage (Jones 1999, 3–18).

The Drivers

With these justifications to consider, several key KM drivers are worth noting. Each driver makes a compelling case for KM.

Technology Drivers. The proliferation of technology, data communications, networking, and wireless transmission has revolutionized the way employees store, communicate, and exchange data at high speed. The World Wide Web has changed KM from a fad to an e-business reality. With a personal computer costing less than $600, anyone can access people and information at any time and from anywhere. Today, the same technological infrastructure makes it possible to store, communicate, and exchange knowledge. This makes technology a core capability leveler, leaving knowledge as a competitive differentiator. It means that although technology can move information or knowledge from Chicago to Bombay at lightening speed, it is people who turn knowledge into timely and creative

decisions. Tomorrow's successful companies are ones that use information technology to leverage their employees' knowledge in ways that make knowledge immediately available and useful. It also implies quality maximization and cost minimization over the long term.

Process Drivers. One of the most critical sets of KM drivers is designed to improve work processes. Implied in this area is the elimination of duplicate mistakes by learning from the past and by transferring the best experiential knowledge from one location or project in the firm to another. Starting from scratch with each project makes no sense in terms of efficiency, productivity, and value-added contribution to the company's bottom line. The value of knowledge sharing is shown in Box 1.3.

Another area where KM can improve process is the way companies react to market changes. "Just in time" is one approach to minimizing investment in inventory and more expeditiously meeting the demands of the consumer. Responsiveness that exceeds the competition becomes the key contributor to differentiation. It requires knowledge of control processes. KM means allowing companies to apply unique knowledge that makes them more responsive to market changes by the hour.

Personnel-Specific Drivers. This area of KM drivers focuses on the need to create cross-functional teams of knowledge workers to serve anywhere in the organization and minimize personnel turnover as a threat to collective knowledge. More and more of what was once viewed as independent firms are now closely coupled. Products and services are jointly handled from diverse disciplinary areas (such as packaging, manufacturing, engineering, and technical skills), where creative cooperation is essential for innovation. Brainstorming, competitive response, and proactive positioning—all require collaboration and coordination of various tasks within and among corporations.

Another personnel-specific driver is minimizing knowledge walkouts. Highly marketable employees with unique knowledge can spell disaster for their employer. Competence drain that goes to the competition is probably the worst that can happen to a company struggling through the new knowledge economy.

Knowledge-Related Drivers. Several KM drivers relate to the very concept of knowledge sharing and knowledge transfer within the firm. They include revisiting overlooked employee knowledge, making critical knowledge available at the time it is needed, and finding a mechanism to expedite available knowledge for immediate use. Companies often know what they know but have difficulty locating it. Take the case of a customer who wanted to return a product that was initially purchased from the same outfit in a different city to a local chain store. A code had to be entered into the computer to debit the initial store by the price of the product and then credit the local store by the same amount. There was only one employee in the local store who knew the code. She happened to be on vacation. The customer service employee could not find critical existing knowledge in time. So, she had to contact the other store for instructions on how to handle the returned item. Counting wait time and learning the procedure took close to 1 hour, while the customer was waiting.

Financial Drivers. As an asset, knowledge defies economic theory, where assets are subject to diminishing returns over the long run. Knowledge assets increase in value as more and more people use them. With this in mind, knowledge follows the law of increasing returns—the more knowledge is used, the more value it provides. KM provides a worthwhile opportunity to integrate knowledge in a way that enriches the quality of decision making throughout the organization.

In the final analysis, the goal of KM is to produce a positive return on investment in people, processes, and technology. It means measurable efficiencies in production,

BOX 1.3

AN EXAMPLE OF THE VALUE OF KNOWLEDGE SHARING

LEARNING FROM MISTAKES

Mistakes happen. Best Buy Co., the Minneapolis-based retailer of consumer electronics, personal computers, and home appliances, does speaker installation and similar tasks. For Best Buy, preventing mistakes is a focus for knowledge management. KM is about creating a corporate culture that learns from experience, so if mistakes do happen, they will never be repeated.

To see how quickly the bottom-line benefits of knowledge sharing prove themselves at Best Buy, let's look at the results of one of its original three KM pilots, in the auto service and installation bays. "We have over 400 stores, two car bays per store, 1,400 service technicians, and 400 different audio products," says Allen Meyer, KM program director. "How many different ways can you put a radio in a car? One: the right way. The emphasis on knowledge management and knowledge sharing is to be able to model best practices behavior to avoid cost and improve customer satisfaction."

If, for example, a technician was to set off the Porsche Boxster's airbag, Best Buy would lose revenue and customer confidence. You might say that the retailer that does this the fewest number of times wins. As a matter of fact, no one at Best Buy has made this particular mistake even once. "One of our technicians found the similarity of wires for the airbag and the speakers and disseminated that information," Meyer says. "The hazard was promoted to a top tip and sent to every mobile installer across our enterprise that day." Of course, that glitch is only one of many possible mistakes. Other installations, for example, require drilling close to a car's gas tank.

Today, before an installer ever touches a car, he or she goes to the computer to print out any tips for the specific vehicle and product. If anyone learns something new, a tip is input to be validated by the gatekeeper and disseminated through the system. In these ways, knowledge sharing becomes a process embedded in standard operating procedures. "With a new model where this is always going to be a problem, it may be inevitable that [a mistake] happens once," Meyer admits. "The real tragedy is if it happens even a second time because the information didn't get out. If we avoid that scenario, how much money can we save?"

SOURCE: Excerpted from Barth, Steve. "Learning from Mistakes," *Knowledge Management*, April 2001, pp. 41–47.

sales, and services on a daily basis; improving the quality of decision making at the front lines; bringing your business partners up to speed; improving employee morale to ensure low turnover and effective decision making; and improving customer-employee relations through better trust in knowledge workers' expertise.

How It Came About

Traditionally, there has been a predefined "recipe for success," where companies have been run by company mottos and age-old business practices that were accepted as methods for success. Doing the same stuff harder and harder has demonstrated to many leading firms that they are losing touch with the quickly changing business environment and losing market share. The successes of yesterday no longer translate into successes of tomorrow. In today's business world, the heartbeat of the firm depends on the constant revamping of systems to remain competitive. There is tremendous emphasis on quick response instead of planning. Business can no longer rely on preset rules with

which to operate, because the business environment is constantly evolving at an alarming speed. To be successful, business firms must redefine and question their current knowledge stored in corporate databases, while creating new practices to fit the business environment. As a reaction to the questionable benefits from downsizing, business process reengineering, and other cost-cutting measures in the 1980s and 1990s, knowledge management surfaced as the best next step to addressing the competition in a hard-to-predict environment.

The information revolution has placed emphasis on sharing huge amounts of information that is now accessible on the Internet. In a time of "e-everything," information is accessible from business-to-business, business-to-consumer, and consumer-to-consumer (Malhotra 2000). Corporate America has begun to use this information availability to their advantage. External relationships such as supply chain management have been successfully used to improve productivity and flexibility based on sharing between suppliers and customers. Companies have taken this idea of information sharing through KM to work within the firm. Aided by technology, employees now can share knowledge internally, in an effort to make the corporation a more productive enterprise.

KM is slowly gaining acceptance across industries. Several factors triggered interest in KM:

- *The pace of change has accelerated dramatically during the past decade.* Companies are looking at innovative ways of taking on the competition. Innovation is the one core competency needed by all organizations (Drucker 1969).
- *Globalization and geographic dispersion changed the organization's scope.* More and more organizations are trying to lean on years of experience to manage their global commitment in a timely and profitable fashion.
- *Downsizing and reengineering resulted in staff attrition and knowledge drain.* This prompted organizations to assess their knowledge core and make more effective use of it. Reengineering assumed a one-time fix to a situation. This created a vicious cycle, where solutions became new problems. It failed to recognize rapid changes in today's market.
- *Networking and data communications made it easier and faster to share knowledge.* Knowledge sharing is becoming the best way to distribute expertise across and around the firm via technology. Technology alone is insufficient.
- *The increasing dominance of knowledge as a basis for improving efficiency and effectiveness triggered many companies to find the means for utilizing the knowledge they have gained from previous experience.*

With these factors, it is easy to see how knowledge management works for the survival of the firm. Knowledge is the key. It is the core competence of any business. It is a function that can and should be embedded into every business process—new products and services, new channels of distribution, new marketing strategies, and new industry definitions. Technology is the backbone, and human components are necessary to utilize it.

In a 2000 survey of 243 domestic and international organizations by a leading consulting firm, the goal was to assess the current status of KM in business. Over two-thirds of the respondents claimed they had a KM strategy in place. Among the highlights of the report are the following:

- KM provides real benefits.
- Companies with KM are better than those without it.

- Organizations are failing to tackle KM's challenges. Failure to integrate KM into everyday work, lack of time to learn and share knowledge, lack of training, little personal benefit, and failure to use knowledge effectively continue to be a problem.
- Organizations are struggling with understanding the cultural implications of KM. They are finding that it complicates their job description.
- Companies still see KM as purely a technological solution. The shift in focus is occurring now, but human importance has yet to be realized.
- There is much to be accomplished in adopting and integrating KM, but the future looks bright (KPMG 2000).

Human resources is commonly identified as having a leading role in knowledge management. When PricewaterhouseCoopers sponsored a survey of 90 companies, they found that 32 percent of employees believed that human resources were involved in knowledge management, with a 25 percent response for information technology. Although information technology and technology in general are a large part of knowledge management, people continue to be the driving force behind knowledge management (Newman 1999).

Key Challenges

The biggest challenge that KM vendors face is explaining what KM is and how it can benefit a corporate environment. To get their foot in the door, vendors must integrate KM into the corporate culture—a shift in both organizational and individual philosophy. The culture comes from the top of the organization. Good or bad, it defines the major aspects of employee behavior on a daily basis. If the culture is not one that encourages cooperation and trust among employees, employees will not cooperate. Many experts suggest that the first objective is to make knowledge sharing profitable for the employee and the firm as well. When one tries to change another person's conditioned behavior, it is best to tie a form of compensation to changes in behavior, performance, or cooperation or to offer some kind of reward as a motivator. Cultural difference and their impact on knowledge sharing are shown in Box 1.4.

After the organizational culture is modified, the next challenge is to evaluate the firm's core knowledge, by employee, by department, and by division. One source compares assessing returns from a KM initiative to "calculating a payback from providing employees with telephones, paper and pens, etc." (Glasser 1999, 17). In evaluating these initiatives, one must look at the human as well as the technological investment.

A third challenge is learning how knowledge can be captured, processed, and acted on. KM must allow an organization not only to "stockpile" and access information, but to get at the history of how decisions were reached as well. Turning knowledge into action requires gleaning the information that has meaning and relevance for a particular organization. Because many executives resist the idea of managing knowledge like other assets, a company has to incorporate KM into the cultural fabric—a shift that requires changes in both organizational and personal philosophy.

A fourth challenge in KM is addressing the still neglected area of collaboration. Sound collaboration capabilities mean helping company employees share documents and needed information for all kinds of projects. Beyond efficiency and productivity, the real benefit of collaboration is *innovation*. It is a natural outcome of people working together for a common cause in a group or an organizational setting. Promoting innovation is the essence of KM. Technology can make this possible via online meetings, discussion databases, and other techniques made available through the IT department. To illustrate, imagine you missed your flight on the way to your home office to

BOX 1.4

CULTURAL DIFFERENCES AND THEIR IMPACT ON KNOWLEDGE SHARING

WEAVING TWO INTO ONE

Making a merger work is not easy. When faced with a different corporate culture, it is not uncommon for the acquiring entity to try to impose its own systems, values, and strategies on the acquired. This approach can produce a defection of talent and a decline in stock price. One example is the unification of Daimler-Benz AG and Chrysler Corp. Touted beforehand as a "merger of equals," in reality it was an acquisition. Daimler-Benz, the dominant partner, has gradually been imposing its will. Observers say that the cultural conflicts between these companies have been particularly damaging when it comes to sharing knowledge. "German engineers are leery of having their 'superior' technology incorporated into 'lowbred' American cars," says Kay Hammer, an entrepreneur and president of Evolutionary Technologies International, Inc. "Similarly, German marketers are having trouble figuring out what the U.S. consumer wants. If they are too arrogant to listen to their American counterparts, there's going to be even more trouble ahead."

Cultural issues and other intangibles can make or break a merger. The decision about buying or selling a company should include analysis of the cultures in the form of a knowledge audit. Knowledge management techniques and principles are vital to a smooth transition. KM naturally was at the forefront when Sopheon PLC, a London-based developer of KM tools, merged with the Minneapolis-based KM consultancy Teltech Resource Network Corp. In this case, management had to harmonize several core differences that could have undermined the deal. Both sides had to learn the finer points of transatlantic culture differences. "Europeans like to get to know you a little first and then do business, whereas in America it is often the other way round," says Paul Corney, a business and strategic advisor to Sopheon in England, who acted as a facilitator for the merger.

These examples suggest that a smooth merger transition depends on speed of execution and effective communication to resolve cultural barriers. "If the cultures are not meshed quickly, knowledge will exit before it can be harvested," says Barry Calogero, executive vice president at Robbins Gioia, Inc., a management consultancy in Alexandria, Virginia. Following management efforts to assure employees of the wisdom and express the strategic advantages of the mergers, assessing and sharing knowledge management help to cement the deal.

SOURCE: Excerpted from Robb, Drew. "Weaving Two into One," *Knowledge Management*, April 2001, pp. 33–38.

participate in an important meeting regarding the launching of a new product. Instead of missing the debates and participation in strategic discussions, a KM system with collaborative features can allow you to log on from your hotel room and jump into an online debate about the product in question. You could participate in the meeting as it is taking place. You could even vote on the final decision as if you were there in person.

A fifth challenge is to continue researching KM to improve and expand its current capabilities. The research should discover ways of gathering, storing, processing, and distributing knowledge customized to the unique structure and operation of the firm. Meantime, it should be recognized that the wicked environment of discontinuous change is not temporary. The KM process means cooperation and commitment to change. Organizations must act on what they learn and continually adapt to the dynamic environment to reap the benefits of KM initiatives. Once initiated, there is no

looking back at the classical ways of doing business. A summary of the key challenges is shown in Table 1.3.

A final challenge is how to deal with tacit knowledge. As we shall discuss in Chapter 2, organizational learning helps us deal with tacit knowledge. Unfortunately, most of the time is spent dealing with explicit knowledge. Tacit knowledge is difficult to express and, therefore, difficult to codify, transfer, or share.

Like any other initiative, with challenges come KM tools or methods that take various forms. The most common tools include the Internet and intranets, data warehousing, document repositories, best-practice repositories, database mining tools, work-flow tools, work-flow applications, and online application-processing tools (Taft 2000, 14). These tools connect people to people and people to information on a global basis. Briefly, two key technologies are of special importance:

- *Installing an* intranet *is the first KM tool that allows company employees to access a wealth of information from anywhere at anytime to conduct business.* Active knowledge management assures accuracy, currency, reliability, and integrity of stored knowledge round the clock.
- *Developing a* videoconferencing system *makes it practicable for remote knowledge workers to initiate a face-to-face discussion over a telecommunication network.* Such a setup is ideal for sales staff in the field or workers encountering problems on an offshore oil rig. Later in the text, we discuss the kind of technology required to make this interface possible.

An important question that is often asked is "How would one know that KM initiatives are taking place?" Several indicators are worth watching in a business:

- Employees throughout the organization sharing the best practices—through databases as well as through personal interactions
- A knowledge center that promotes knowledge skills and facilitates knowledge flow for all employees to use in knowledge sharing
- A fine-tuned intranet and groupware facilities to expedite information and knowledge flow at all times, regardless of time, distance, or location.
- Working knowledge teams from all departments or divisions, whose focus is identifying, developing, and promoting ways to apply KM throughout the organization

Related to KM initiatives are KM user issues worth considering. With the user in mind, we need to question the processes required for KM success, organizationally and technologically, and how a KM system is measured to transform individual and team know-how into what the firm should "know." One solution is to develop taxonomies of

TABLE 1.3 Key Challenges in KM

Key Challenges in KM
• Explaining what KM is and how it can benefit a corporate environment
• Evaluating the firm's core knowledge by department and by division
• Learning how knowledge can be captured, processed, and acted upon
• Addressing the neglected area of collaboration
• Continuing research into KM to improve and expand its current capabilities
• Learning to deal with tacit knowledge

organizational knowledge for easy knowledge transfer and distribution. Success can be assured with a proven implementation plan based on experience.

Historical Overview

Knowledge has been the staple source of competitive advantage for many companies for hundreds of years. For example, the idea of passing knowledge to an apprentice from a master was used extensively during medieval times. Passing the "family recipe" that makes a certain product unique from one generation to another also attests to the notion of knowledge transfer and knowledge sharing. Although such transfer was extremely slow, it opened the door to modern methods of knowledge management that can exploit faster media of knowledge exchange, such as the Internet.

The recorded history of knowledge dates back to Plato and Aristotle, but its modern-day understanding is credited to scholars like Daniel Bell (1973), Michael Polanyi (1958, 1974), Alvin Toffler (1980), and the Japanese guru, Ikujiro Nonaka (1995). Other writers like Sveiby (1997) and Stewart (2000) promoted the concept knowledge as the core asset of an organization. As we shall find in Chapter 2, Polyani and Nonaka identify two kinds of knowledge: *Tacit* knowledge is highly experiential and is found in the heads of employees, customers, and vendors; *explicit* knowledge can be found in books, documents, data banks, corporate policy manuals, and the like. The learning process involves the intersection of both kinds of knowledge and the resulting knowledge transformation process.

In the 1960s, Drucker coined the terms "knowledge work" and "knowledge worker" when he was discussing the role of knowledge in organizations. He was the first to suggest that the U.S. economy has shifted from an economy of production to a knowledge economy, where the basic resource is knowledge, not capital. This means a shift to market-driven as opposed to product-driven orientation (Drucker 1969).

In the early 1970s, researchers at MIT and Stanford were analyzing ways in which companies produced, used, and diffused knowledge. This was the first essential step in the evolution of knowledge management, as we know it today. The idea of knowledge being a corporate asset had not yet caught on, and it was not until the 1980s that companies truly began to value knowledge. They also began to find ways to manage knowledge through such technologies as artificial intelligence and expert systems. Expert systems had their heyday in the 1980s and early 1990s, when developers focused on trying to develop "thinking machines" to emulate human experts rather than using machines to improve human thinking—the essence of KM.

During the 1990s, the onset of the Internet, the information superhighway, allowed KM to take off. The Internet facilitated access to publications about the concept of KM and how to implement it. With the help of the Internet, KM became a feasible concept for many companies. It provided more opportunities for knowledge sharing and knowledge transfer than there had been in the past. In terms of methodology, KM was briefly presented in total quality management (TQM) and teamwork. Business process reengineering (BPR), downsizing, and outsourcing were also attempts to improve the performance of the firm, although they had limited success. They resolved the productivity factor, but drained knowledge from the organization.

These attempts were more like round one, where companies managed their knowledge assets in the same way they managed physical assets. Physical goods were stored in the warehouse, but for the intellectual equivalent, it was in the knowledge repository. When databases and "warehouses" were full (too many physical assets), they began thinking about supply chain management (SCM), trying to match the supply of goods with demand and reduce inventories to what was actually ordered for produc-

tion. It was more like rewarding the efficiency-driven prediction of the future based on past trends—doing things right. In contrast, in round two of KM, companies began to realize that to fit the supply of knowledge to the demand for it in products and services, they needed to toy with how knowledge workers did their jobs. To be effective, KM has to be "baked into" the job and be part of the fabric of the work to bring in knowledge when needed and export it anywhere in the organization when it is acquired (Davenport 1999, 2). This is where we began to see a shift from "doing things right" to "doing the right thing"—working smarter, not harder.

Given the progress made in automating procedures in the 1970s and communications and networking (mostly through e-mail) in the 1980s, the focus of technology in the 1990s was on cognitive computing to augment the knowledge work of humans. Of these, the Internet and intranets have had the most profound impact on spreading the know-how. From a knowledge perspective, the Internet and accompanying technologies have demonstrated several characteristics in knowledge management:

- *The Internet is an incredible information source.* Internet access is available worldwide. It means a company's knowledge workers can access information and share knowledge anywhere, anyplace, anytime, without delay
- *With the World Wide Web, every user can share and update information at will.* This is especially attractive with the decreasing cost of communications.
- *The Internet uses a universal communication standard protocol.* This protocol, TCP/IP, makes information access and exchange accessible from anywhere there is a computer and an Internet service provider.
- *The Internet provides quicker interaction and communication with fellow knowledge workers.* This interaction can be one-on-one or as a group.

KM Myths

In contrast to what KM is, we have tried to clarify what KM is not. KM is not a separate area or function in a business, represented by a KM department or a KM process. KM is interwoven into all of an organization's processes. Although effective utilization of technology is essential, KM is not constrained by collecting knowledge from domain experts and building networked databases or databases supported by the company's intranet. Finally, KM is not defined in terms of the specific knowledge needs of every employee, the relevant knowledge needed, or the knowledge to be shared.

There are several myths as well:

Myth 1: Knowledge management is a fad. As mentioned earlier, there are many pessimists in industry who doubt the "good fit" potential of KM. Being at a crossroads, vendors push older software products under the KM label. BPR and artificial intelligence had their positive turn, although they suffered from raised expectations. Unlike earlier trends, however, true KM becomes embedded in the way people work in business. So, knowing what you know or what you need to know cannot be a fad.

Myth 2: Knowledge management and data warehousing are essentially the same. The term *data warehousing* implies a repository of data, not knowledge. Knowledge, per se, is how you take information and transform it into action. Data warehousing is critical for KM. It is where data, critical documents, e-mail, and other forms of information are available for eliciting knowledge at the time when it is needed. For example, Sears, Roebuck & Co. has a customer data warehouse with demographic information on over 100 million households to help the sales force improve marketing and sales quality. For

example, a repairperson working on a customer's refrigerator notices through the KM system that such a customer is a likely prospect for a new freezer. Data mining serves a similar purpose, in that patterns within a mass of data allow management to better understand trends and directions in a product or consumer preference—a necessary dimension of KM.

Myth 3: Knowledge management is a new concept. As a concept, KM has been practiced by successful firms as far back as the early 1980s. Companies like Ford and General Motors Corporation have been exchanging design information and collaborating on design projects worldwide using technology all along. Today's version of KM goes under customer profiling, where a supermarket clerk scans a store-generated customer card to determine patterns of purchases and consumer preferences by date, by product, and by location. The idea is the same as it has been for the past 2 decades, except that in today's KM, technology has taken on a special role in the way knowledge is shared and disseminated.

Myth 4: Knowledge management is mere technology. This is a serious misconception. KM is really about people, relationships, and a new way of working together as an entity in an organizational setting. It is a unique way of thinking about work and about working. Imagine a knowledge community of employees with common interests sharing information on best practices that help everyone do a more efficient job. KM will work only if there is trust and confidence among coworkers. Over 80 percent of all technology-centered KM efforts have been known to fail because of a lack of attention to people (Whiting 1999, 44).

Myth 5: Technology can store and distribute human intelligence. Data may be stored in a centralized database for employee access, but that does not ensure that employees will use the information. In a turbulent competitive environment, one cannot assume that companies can predict the right information for the right employee. So, it is hardly the case that technology distributes human intelligence. It is impossible to build a KM system that predicts who the right person is and at what time he or she needs specific information for decision making. Tacit knowledge exists within a person's brain; information or "knowledge" stored within the database can be viewed as a valuable exchange between people to make sense of a situation but should not be interpreted as human intelligence. In other words, knowledge repositories stored in computers do not allow for renewal of existing knowledge and creation of new knowledge. KM should be considered as a system to be used with concentration on the human aspect aided by technology for decision making.

Myth 6: Knowledge management is another form of reengineering. Reengineering is efficiency-driven—a one-time attempt at introducing radical change in organizational processes to improve efficiency. The emphasis is on cost reduction and making better use of existing operations. Jump-starting such a business, however, often results in failure. KM is an ongoing renewal of organizational processes to learn in advance about the company's future opportunities and contingencies. The concentration is on value-added activities that demand innovation and creativity. This is ingrained in the day-to-day processes of the business. Technology plays a critical role in the way information becomes available at electronic speed.

Myth 7: Company employees have difficulty sharing knowledge. The answer is yes and no, depending on a number of factors: attitude of the knower, who the requester is, company culture, sensitivity of the knowledge requested, availability of attractive motivators, and trust level among company personnel. Under the traditional business model, employees with unique knowledge accumulated over years of experience tended to protect "turf"

by not sharing such knowledge. In a KM environment, where knowledge sharing means great potential for everyone including the organization, knowledge workers need to be sold on how knowledge sharing will bring them mutual benefits. The term *sharing* means "willingly giving away a part" and "holding in common." It is a "give to get" attitude, and because "knowing" is personal, asking someone to share is to ask him or her to give something of themselves. Mature or secure people in a stable work environment tend to share knowledge more than others whose experience is to the contrary. Also, knowledge sharing can improve bonds between people, provided the act of sharing is reciprocal.

Myth 8: Knowledge management works only within an organization. On the surface, this may be true, but some of the most valuable knowledge comes from the outside—suppliers, brokers, government agencies, and customers. The problem with extending KM initiatives to outside sources is incompatible technology, security issues, and complexity of the design.

Myth 9: Technology is a better alternative than face-to-face. We have seen over the years that when it comes to real-life experience and use of human knowledge, technology does not hold all the answers. The emerging mind-set within today's forward-looking, creative organizations is that KM must entail cultural and organizational change as well as technology-based innovations. Data warehousing and data mining are all contributors to extracting and sharing knowledge, but the best knowledge resides in human minds. This makes a face-to-face approach to knowledge acquisition and knowledge sharing a better alternative.

Myth 10: It is a "no brainer" to share what you know. In general, secure and mature people are less reluctant to share what they know with others. Unfortunately, in traditional business, people with years of experience tended to hoard knowledge rather than share it, because it gave them leverage, control, and assurance of a job. Furthermore, "knowing" is personal. To ask people to share knowledge is tantamount to expecting them to give something of themselves. Sharing knowledge often depends on who the requester is, how sensitive is the knowledge requested, the attitude of the "knower," and the motivational forces at play. To share knowledge, the business has to undergo special employee training, instill trust within the business, and give employees and management a chance to cement relationships based on trust. A summary of the KM myths is shown in Table 1.4.

TABLE 1.4 Myths About Knowledge Management

The Myths of Knowledge Management
1. Knowledge management is a fad.
2. Knowledge management and data warehousing are essentially the same.
3. Knowledge management is a new concept.
4. Knowledge management is mere technology.
5. Technology distributes human intelligence.
6. Knowledge management is another form of reeingineering.
7. Company employees have difficulty sharing knowledge.
8. Knowledge management works only within an organization.
9. Technology is a better alternative than face-to-face.
10. It is "no brainer" to share what you know.

KM Life Cycle

KM goes through a series of steps, making up an ongoing life cycle. The four-step process, summarized in Table 1.5, includes gathering, organizing, refining, and disseminating. These and alternative approaches to the KM life cycle are explained in detail in Chapter 3.

The capturing phase deals with knowledge capture and includes e-mail, audio files, digital files, and the like. In this phase, it is important to go to all the sources available and never judge the usefulness of the captured knowledge until after it is subjected to exhaustive testing. In this phase, KM systems are an ideal approach to eliciting and representing knowledge into a form that can be available to many users—a key KM process. This process is discussed in detail in later chapters.

After the capturing phase, captured data or information should be organized in a way that can be retrieved and used to generate useful knowledge. One can use indexing, clustering, cataloging, filtering, codifying, and other methods to do the organizing. Speed, user-friendliness, efficiency of access, and accuracy are important elements to consider throughout the organizing phase.

After organizing the information, it should be refined. Data mining can be applied in this phase. Data mining takes explicit knowledge found in databases and transforms it into tacit knowledge. Data-mining software is used to find patterns in data, predict behavior, and warn against future problems based on the data supplied in data warehouses. For example, the sales records for a particular brand of tennis racket might, if sufficiently analyzed and related to other market data, reveal a seasonal correlation with the purchase by the same parties of golf equipment.

TABLE 1.5 Four-Process View of Knowledge Management

Four-Process View of KM	
• **Capturing**	—Data entry —Scanning —Voice input —Interviewing —Brainstorming
• **Organizing**	—Cataloging —Indexing —Filtering —Linking —Codifying
• **Refining**	—Contexualizing —Collaborating —Compacting —Projecting —Mining
• **Transfer**	—Flow —Sharing —Alert —Push

After the refining phase, knowledge should be disseminated or transferred. This includes making knowledge available to employees via tutorials or guidelines for effective use. Predictive models can be designed to alert users to consequences of certain projects or human resource activities. The key point is not to let stored or available knowledge sit idle in a repository like a database. It should be available to authorized users to contribute to the corporate competitive advantage.

Figure 1.6 shows the relationship between the KM life cycle and four key areas in the organization. Taken together, one can understand a viable set of relationships between KM and management decision making, organizational culture, organizational personnel, and information technology. As we shall see in Chapter 3, each area could have an impact on the way KM is installed and maintained in the organization.

Role of Trust in the KM Life Cycle

Knowledge-based organizations are learning human systems. One of the requirements that encourage the flow of knowledge is establishing an environment where employees feel free to share insights, experiences, and know-how. This boils down to the issue of *trust.* Trust supports the KM process by giving employees clear impressions that reciprocity, free exchange, and proposing innovations will be recognized and fairly compensated. In contrast, lack of trust encourages employees at all levels to hoard knowledge and build suspicion in people and organizational processes.

Trust means integrity, consistent communication, and proven willingness of the organization to integrate employees into the decision-making process. For trust to be effective, an organization must make an overt effort to embed trust in the culture of the business. This means tackling the environment of trust from several angles: human resources, management initiatives, top management support, and demonstrating to knowledge employees that they belong. It becomes the cement that glues an organization together in its effort to address an unpredictable competitive environment. The bottom line is that one cannot have an open, candid dialogue with someone he or she does not trust. If one trusts his or her peers, then there should be no concerns about where they stand.

With trust in mind, the key question is how does a company develop trust? First, trust should be built at all levels of the organization. A summary view is to break down

FIGURE 1.6: The KM Cycle and the Organization

the barriers created by traditional organizational structures. Rather than managing by controlling and closely supervising employees, the alternative is to empower them and open lines of communication between managers and workers. During the annual performance evaluation session, each employee should be given a chance to explain what he or she did to build a sense of community in their department, division, or the company as a whole. Some of the suggestions offered include:

- Decentralizing or flattening the organization structure to allow decision making by teamwork
- Reducing control-based management and encouraging management by results so that employees and teams can get their rightful credit for contribution to the company's profitability
- Revisiting the company's mission statement and ethics policy to demonstrate the company's new views about organizational values and opening lines of communications through periodic employee satisfaction surveys, brainstorming sessions, and the like
- Assessing and improving employee responsibilities and accountability on a company-wide basis; eliminating unnecessary directives or barriers
- Recognizing employees through bonus programs, knowledge employee of the month, on the employee bulletin board, or in the newspaper
- Installing an employee training program, especially geared for improving employee commitment to knowledge sharing

It can be concluded, then, that trust is critical to a successful KM program. Despite its value, it continues to be a most difficult intangible to create and maintain, especially in large corporations like Ford, General Motors, IBM, and others. The potential is in its lasting effect once it is properly embedded into the organization and maintained within the corporate policies that make sense for KM.

Implications for Knowledge Management

Any discussion on knowledge management is bound to produce both optimists and doubters. However, we know now that the source of organizational wealth is something specifically human—knowledge. Applying knowledge to what we already do contributes to productivity. In contrast, applying knowledge to what is new is innovation. Knowledge is the key to both goals. This will be the focus of Chapter 2.

The rapid advancement of knowledge exchange tools (such as the Internet, intranets, and groupware) is setting the stage for knowledge management. The great potential of this emerging concept lies in how well we share the "know-how" to augment the decision-making quality and capacity of the organization. For those whose product is knowledge, knowledge workers are distinguished from information handlers by their ability to solve unique problems with renewed effectiveness and add value in an unpredictable competitive environment. The emphasis is on augmenting the abilities of the human user—working smarter, not harder. They use their knowledge rather than data or information.

In most corporations, the management of knowledge is still uncharted territory. Few executives understand how to make the most effective use of their company's knowledge. They may know about tangible assets like the physical plant or existing inventory, but they have trouble putting a price tag on the value of the talent or expertise in the sales force.

To promote a knowledge management environment, companies must consider cultural, social, and organizational changes as well as technological support. They must also add systems and applications in their IT infrastructure in the interest of integration and knowledge sharing. For this reason, more and more companies are beginning to recognize the importance of knowledge management systems. This area is covered later in the text.

One area that a company must address is how to manage its intellectual capital—the sum of knowledge of the human resources of the organization. As we shall find in Chapter 2, the knowledge found in policy manuals, case histories, training materials, and employees' heads is the most valuable asset of the company in terms of replacement costs. To develop and maintain this knowledge is extremely costly. Unless a company reviews its core knowledge and takes steps to manage it, it is subject to potential disaster resulting from resignations, turnover, loss of its competitive edge, and the like.

Finally, in the grand scheme of things, the trend toward knowledge sharing is good for coworkers, for the company, and for society as a whole. The key converter from hoarding knowledge to sharing knowledge is trust. To gain a competitive advantage in an unpredictable environment, we must learn to master the art of knowledge sharing and knowledge management. Efforts can be realized only if there is follow-through. Corporate culture must change first. Knowledge is not a technology, but an activity enabled by information technology and produced by people. Companies must commit to changing their corporate structure by assigning knowledge workers, whose responsibilities include motivating and organizing the corporate, to adapt to a new way of business that transcends the entire landscape.

SUMMARY

- Today's knowledge age brings with it an increasingly complex business environment worldwide. Companies need to address knowledge sharing, knowledge collaboration, and knowledge dissemination to be able to compete in an unpredictable marketplace.
- KM is the process of gathering and making use of a firm's collective expertise anywhere in the business. A firm seeks to add value by creatively identifying, applying, and integrating knowledge in unprecedented ways.
- KM is not about reengineering, discipline, or one based on information only. It is not a fad or a way of appeasing employees around an employee-oriented concept. It is about change, and tomorrow's business is the name of the game. People are the determinants of KM success.
- There is plenty of justification for KM. Knowledge sharing means faster processing, no duplication of effort, and reacting more responsively to new business opportunities. It also means ensuring successful partnering and core competencies with suppliers, vendors, customers, and other constituents.
- Companies that fail to install a KM environment could be guilty of using the old reward system, having a database that lacks focus, having poor coordination of the IT or human resources effort, choosing the wrong project, and having poor leadership.
- There are several drivers that provide a compelling case for adopting KM: technology, process, personnel-specific, knowledge-related, and financial drivers. In the final analysis, the goal of KM is to produce a positive return on investment in people, processes, and technology.

- Several factors triggered interest in KM: need for innovation, globalization, easier navigation with telecommunications, and the increasing dominance of knowledge as a way of improving efficiency and effectiveness of the firm.
- KM dates back to Plato and Aristotle, although its modern-day understanding began in the 1960s. During the 1990s, the onset of the Internet, the information superhighway, allowed KM to take off. Quicker interaction and communications with fellow knowledge workers, whether one-on-one or as a group, made it all possible.
- Several KM myths have been cited in an effort to clarify what KM is not. Once the concept becomes widely accepted and the KM process becomes standardized, most of these myths should disappear.
- The KM cycle essentially begins with knowledge gathering, followed by knowledge organization, knowledge refinement, and knowledge transfer. The role of trust is critical throughout the entire life cycle. In Chapter 3, the KM life cycle, including knowledge maintenance and update, will be discussed in detail.

TERMS TO KNOW

Downsizing: Reducing the physical, personnel, and functional processes of an organization in an effort to improve its efficiency through reduced costs and improved performance.

Financial driver: A driver or a motivator that views knowledge assets as something increasing in value as more and more people make use of it.

Intellectual capital: The value of a company's trademarks, patents, brand names, and the like; a company's collective brainpower or a composite of experience, knowledge, information, and intellectual property.

Internet: A system of interconnected data communication or computer networks on a global basis.

Knowledge management: The process of gathering and making use of a firm's collective expertise wherever it resides—on paper, in databases, or in people's heads.

Knowledge-related driver: A driver or a motivator that relates to the concept of knowledge sharing and knowledge transfer within the firm.

Knowledge-sharing: A process of transferring human knowledge about a process or a procedure to others in the organization; ability and willingness of people to exchange specialized experience with others for the common good of the organization.

Personnel-specific driver: A driver or a motivator that focuses on the need to create cross-functional teams of knowledge workers to serve anywhere in the organization and minimize personnel turnover as a threat to collective knowledge.

Process driver: A driver or a motivator designed to improve work processes through KM.

Reengineering: One-shot drastic "electrical shock" change in organizational processes to improve efficiency; a mechanical shift from one stage of operation to a more efficient stage.

Supply chain management: The integration of all activities associated with the flow and transformation of goods from the raw materials to the customer as well as the related information flows.

Technology driver: A driver or a motivator designed to use technology for storing and transferring knowledge throughout the organization.

Trust: A feeling of confidence in another person; having confidence or faith in another person or in a relationship.

Videoconferencing: A computer-based system designed to simulate face-to-face meetings with two-way full-motion video along with two-way audio. Participants can view one another during long-distance conferences or meetings.

TEST YOUR UNDERSTANDING

1. Select one definition of KM in Figure 1.2 and explain the reason(s) for your choice.
2. KM involves people, technology, and processes in overlapping parts. Explain the KM concept.
3. One unique indicator of KM in action is seeing people think ahead, not behind. Do you agree with this statement? Explain why you agree or disagree.

4. In what way is KM *not* about:
   a. reengineering
   b. a discipline
   c. data
   d. knowledge capture
5. Distinguish between:
   a. KM and intellectual capital
   b. a champion and a manager
   c. the Internet and an intranet
   d. trust and knowledge sharing
6. What factors justify the adoption of KM into an organization?
7. What oversights or pitfalls impede the introduction of KM into an organization?
8. Briefly explain the factors that triggered interest in KM.
9. The chapter explains several challenges in KM. Select three challenges and elaborate on each.
10. How would one know that KM initiatives are taking place?
11. Summarize in your own words the history leading to today's KM.
12. How does the Internet contribute to the use of KM in organizations?
13. Explain five KM myths and the reasons for viewing them as myths.
14. List and briefly explain the key steps in the KM life cycle.
15. How does a company develop trust? Be specific.

KNOWLEDGE EXERCISES

1. Suppose you were asked to do a 15-minute presentation before the managers of a small retailer about the pros and cons of knowledge management. What would you say? Outline the content of your talk.
2. How easy do you think it is to understand knowledge management? Why?
3. Search the Internet and current journals for surveys that show how well companies are adopting (or struggling with) KM. Report your findings in class.
4. How should a company assess its knowledge core? Detail a procedure that can be sold to top management.
5. What do you think distinguishes today's knowledge age from that of the information age of the 1980s and 1990s?
6. Search the literature, including the Internet, and prepare a three-page report on some of the problems in developing and implementing a knowledge management system.
7. In your own words, describe the implications that a knowledge management system has on an industry of your choice.
8. Working with a classmate, conduct an interview or a telephone survey regarding a local business's
   a. familiarity with KM
   b. level of literacy in KM
9. A business manager, a programmer, and a psychologist all want to become KM designers. Which do you feel will have the least difficulty? Why?
10. A car dealer who has just learned about knowledge management thinks it could be ideal for separating "tire-kickers" from serious buyers. Would this be a typical KM application? Why?
11. Visit a small business (such as a hardware store or a bakery) and stay long enough to get a feel for the information exchanged, customer questions, and the way the business is run. Write a short report about the core knowledge of the business. Are there knowledge workers there or just clerks?

12. Find cases or current information on trends in KM by searching the Internet. Locate a company that is reported to have succeeded (or failed) in going the KM route. Write a three-page report summarizing your findings.
13. Visit a local bank (not a branch) and identify knowledge workers. What is unique about knowledge workers? How do you distinguish them from regular employees?

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CHAPTER

Understanding Knowledge

Contents

I think, therefore I am.
—RENE DESCARTES

In a Nutshell

The most critical word in the KM area is *knowledge.* Unfortunately, there is a continuing myth that knowledge resides only in books, reports, or documents. This cannot be true, any more than viewing musical notes on a page constitutes music. What we have here are representations of information and music, respectively. What do we mean when we talk about knowledge? Two key issues are distinguishing between knowledge and information and determining how they are interrelated. Knowledge is neither data nor information, although it is related to both. The terms are not interchangeable, and knowing what is needed often determines organizational success or failure.

This chapter examines the concept of knowledge as the heart of an organization's productivity and growth and discusses the classifications of knowledge. Intelligent behavior implies the ability to understand and use language and to store and access relevant experience at will. Humans acquire expertise—that is, they learn via experience. Expertise incorporates the ability to reason and to make deductions; it also includes the concept of common sense. This makes human intelligence and the knowledge that humans amass over time the primary organizational asset. An organization's technology or telecommunications network is only a vehicle for knowledge transfer and knowledge exchange; it cannot replace human knowledge.

An essential criterion of knowledge and learning is memory. Learning by discovery is less understood than learning by experience or by example. Several approaches to learning are covered later in the chapter. A knowledge base is a critical component of knowledge management. Knowledge developers need to understand the theory and meaning of knowledge early in the knowledge capture phase and become familiar with the unique kinds of knowledge available in the corporation under study. It should be pointed out that an expert's knowledge is not limited to information or complex procedures. Knowledge embraces a wider sphere than information. Likewise, a knowledge base is not the same as a database. A database has a predetermined structure; a knowledge base is a set of facts and inference rules for determining new information and "smarter" knowledge for decision making.

Knowledge as know-how may be either shallow or deep knowledge. It may also be procedural, declarative, semantic, or episodic knowledge. More recently, knowledge has been classified as explicit or tacit knowledge. All these classifications are covered in the chapter.

Another goal of this chapter is to show that human knowledge and logical processes can be captured and represented in a valid way to solve certain kinds of problems. (The words *valid* and *validity* as used in the text do not have the same meaning as *truth.* A conclusion, for example, follows logically from facts and rules using inference procedures; it can be a false, or not correct, conclusion, even though it may still be a valid one.)

Definitions

Before discussing knowledge and its many ramifications, *knowledge* needs to be defined in relation to *intelligence, experience,* and *common sense.*

KNOWLEDGE

We define *knowledge* as "understanding gained through experience or study." It is "know-how" or a familiarity with how to do something that enables a person to perform a specialized task. It may also be an accumulation of facts, procedural rules, or heuristics. These elements are defined as follows:

- A **fact** is a statement of some element of truth about a subject matter or a domain. For example, milk is white and the sun rises in the east and sets in the west are facts.
- A **procedural rule** is a rule that describes a sequence of relations relative to the main. For example, always check the traffic when entering a freeway; if the gas gauge indicates less than a quarter of a tank of gas, look for a gasoline station.
- A **heuristic** is a rule of thumb based on years of experience. For example, if a person drives no more than 5 miles above the speed limit, then that person is not likely to be stopped for speeding.

A beneficial aspect of knowledge is that it can compensate for some search time. A human expert who knows a set of solutions can get a job done without much searching for information. Conversely, a human novice in a video game searches a vast number of alternative moves at each juncture because he lacks experiential knowledge. Unfortunately, without the aid of knowledge that allows the novice to immediately eliminate inappropriate approaches, this method encompasses too many approaches to evaluate.

Another aspect of knowledge is specificity; it cannot be transferred from one problem domain to another. Therefore, one must have the surgeon's know-how to repair a heart valve, the auto transmission specialist's know-how to replace a reverse gear, and the painter's know-how to create an accomplished portrait. These kinds of extensive knowledge are referred to as *tacit knowledge* and often take many years to acquire.

Finally, values, beliefs, and integrity are related to knowledge. This has a lot to do with what the knower perceives, accepts, and concludes from the environment. People generally organize and synthesize their knowledge by their values. Nonaka and Takeuchi suggest that "knowledge, unlike information, is about beliefs and commitment" (Nonaka and Takeuchi 1995). More recently, we began to attach integrity to the whole process of knowledge capture, knowledge sharing, and knowledge maintenance. Integrity means reliability, trustworthiness, privacy, and confidentiality. Integrity cuts across the discipline, regardless of company size or resources.

INTELLIGENCE

Intelligence refers to the capacity to acquire and apply knowledge. It is the ability to build or improve upon knowledge, to transform as much of one's knowledge as possible into knowledge that can be used to make good decisions. An intelligent person is one who has the ability to think and reason. This distinction separates the novice from the master in a game like chess. Knowledge conversion is directly responsible for much of the expert's efficiency in applying knowledge and for the difficulty of making it explicit.

Consider this example: Recent research into the true meaning of intelligence illustrates very well the difficulty of defining the term. The organization doing this research decided to get to the bottom of the question once and for all and, given its importance,

assigned its most senior scientist to it. The esteemed scholar spent several months conducting this research. At the end of that period, the scientist gathered a number of colleagues together, held up in front of them the artificially intelligent artifact chosen as the subject of the research, and said, "Ladies and gentlemen, this is a thermos bottle. It keeps hot stuff hot, and it keeps cold stuff cold. My question is, how does it know?"

Ability to understand and use language is another attribute of intelligence. Language understanding is not easy to acquire, especially for the existing technology. For example, consider the statement, *The city of Fairmount is under 6 feet of water.* Does this mean that the city is completely underwater, with the tallest building below the water level? Another example is the statement, *The sun broke through the clouds.* How literally should one interpret this statement? Of course, both the meaning of the words and the context of the statements determine how a reader should understand the messages. Prior knowledge and common sense also enter the picture.

Memory, or the ability to store and retrieve relevant experience at will, is part of intelligence. How the brain stores and retrieves information or knowledge is still unclear. Later, the text includes a discussion of knowledge organization and how it is exploited in the KM building life cycle.

Learning is knowledge or skill that is acquired by instruction or study. It is the inevitable consequence of intelligent problem-solving. Intelligent people learn quickly and make effective use of what they learn. Inasmuch as problem-solving and knowledge organization have been successfully demonstrated in the business enterprise, the same success has yet to be shown in technology or computer programs. People learn from experience; to date, computers have not.

EXPERIENCE

Experience relates to what we have done and what has historically happened in a specific area of work. In Latin, the word *experience* means "to put to the test." People with deep knowledge in a given subject have been tested by experience. Experience also leads to expertise. Think of Sherlock Holmes investigating a murder. The goal is to find the murderer. Holmes's reasoning and deductions rely on all evidence collected; he works backward from the goal until the suspect is caught. Expertise is also intuition and the ability to access one's knowledge rapidly to achieve an efficient and successful outcome.

Experience is closely related to knowledge. Knowledge develops over time through successful experience, and experience leads to expertise. An **expert** is someone who knows what he or she does not know and is the first one to tell you so. Firms hire experts to benefit from their experience and proven knowledge in solving complex problems. People use experience to change facts into knowledge, which separates novices from experts. Exceptions do occur, however. Bach, for example, was expert musician at 5 years of age. In general, without experience, one would hardly be considered an expert. Experience in using knowledge allows people to refine their reasoning processes in a knowledge management environment.

COMMON SENSE

Common sense refers to the unreflective opinions of ordinary humans, which comes naturally to a child as young as 3 or 4 years old. For example, most youngsters know that if they touch a hot stove, they will get burned. In contrast, a computer could be told all kinds of things about hot stoves and the effect of heat on the human skin, and it still would not perceive what would happen if it "touched" a hot stove: Machines lack common sense. Common sense is not easily learned or acquired

TABLE 2.1 Basic Knowledge-Related Definitions

Artificial	Emulating or imitating something natural or real
Common sense	Innate ability to sense, judge, or perceive situations; grows stronger over time
Fact	A statement that relates a certain element of truth about a subject matter or a domain
Heuristic	A rule of thumb based on years of experience
Intelligence	The capacity to acquire and apply knowledge; ability to understand and use language; ability to store and retrieve relevant experience at will; learning from experience
Knowledge	Understanding gained through experience; familiarity with the way to do something to perform a task; an accumulation of facts, procedural rules, or heuristics
Procedural rule	A rule that describes a sequence of relations relative to the domain

Lack of common sense makes technology "brittle"; that is, computers rarely go beyond the scope of their data warehouse or knowledge base. Many important projects assumed by humans in business today require common sense, which is only partially understood by today's computer. Table 2.1 summarizes these concepts.

Cognition and Knowledge Management

Cognitive psychology provides an essential background for understanding knowledge and expertise. The goal of cognitive psychology is to identify the cognitive structures and processes that relate to skilled performance within an area of operation. Cognitive science in general is the interdisciplinary study of human intelligence. Its two main components are experimental psychology, which studies the cognitive processes that constitute human intelligence, and artificial intelligence, which studies the cognition of computer-based intelligent systems. Our focus in this text is on the first component—how cognition contributes to the performance of intelligent workers.

With these relationships in mind, one can see cognitive psychology's contribution to KM. Understanding the limitations and biases provided by cognitive psychology helps in understanding expertise. Human limitations—such as memory capacity and the physical limits imposed by human sensory and motor systems—must be considered when attempting to understand how the human expert carries out a task.

The process of eliciting and representing expert knowledge typically involves a knowledge developer and one or more human experts. To capture human knowledge, the developer interviews the expert(s) and asks for information regarding a specific area of expertise that the expert is adept at solving. The expert may be asked to "think aloud," to verbalize his or her thought processes, while solving the problem. People cannot always give complete, accurate reports of their mental processes. Experts may have greater difficulty in conveying some kinds of knowledge, such as procedural knowledge (explained later in the chapter). Psychologists have long been aware of problems related to verbal reports, and through research, they have developed methods for circumventing them.

Cognitive psychology research contributes to a better understanding of what constitutes knowledge, how knowledge is elicited, and how it should be represented in a corporate knowledge base for others to tap. Because knowledge developers should

take knowledge elicitation (also called *knowledge capture*) seriously, they should have a strong educational and practical background in cognitive psychology and cognitive processes. Knowledge capture techniques are covered in Chapter 4.

Data, Information, and Knowledge

The main benefit of discussing knowledge this early in the text will become obvious later, when the analysis turns to knowledge workers and how knowledge developers capture and codify knowledge from human experts. Knowledgeable experts tend to be adept at explaining how they arrive at decisions or solutions because they have years of experience. They have become experts by adding and refining knowledge, not just by capturing and storing information. Likewise, knowledge developers, whose job is to acquire and represent experts' knowledge, need to understand the many ramifications of knowledge early in order to decide whether a particular expert has the requisite knowledge for building or updating a reliable knowledge base.

DATA

Data are unorganized and unprocessed facts. They are static; they just sit there. For example, *John is 6 feet tall.* This is data; it does not necessarily lead one anywhere. However, the meaning one brings to the evaluation of this data could be important. Such an evaluation may indicate that John's height would make him an asset to the basketball team. This becomes information.

Data is a set of discrete facts about events—structured records of transactions. When a customer goes to the store and buys merchandise, the number of socks and the price he or she paid are all data. The data tells nothing about the motivation behind the purchase, the quality of the socks, or the reputation of the store. Quantitatively, stores evaluate patterns of purchases, number of customers purchasing specific items, and other items those customers purchased. Evaluations such as these can be used to derive information about customer behavior, the price-sensitivity of certain merchandise, and the like. This means that data is a prerequisite to information.

All organizations need data, and some companies depend more heavily on data than others. For example, insurance companies, banks, the internal revenue service, and the social security administration are heavy number crunchers. Millions of transactions are processed daily. The problem with too much data is that it offers no judgment and no basis for action. This means that an organization must decide on the nature and volume of data needed to create information.

INFORMATION

The word *information* is derived from the word *inform,* which means "to give shape to"; information means shaping the data to arrive at a meaning in the eyes of the perceiver. **Information** is an aggregation of data that makes decision making easier. It is also facts and figures based on reformatted or processed data. For example, a profit and loss statement provides information. It is an assembling of facts into a form that shows an organization's state of health over a specific time period. Here is another example of information:

> *Five farmers of northern Beirut, who had switched crops from watermelon to sugarcane with the high hope of a quick profit, could not bear the anguish of crop failures for two consecutive seasons. They committed suicide after having to sell the farm to pay the bank loan.*

Unlike data, information is understanding relations. It has meaning, purpose, and relevance. It has a shape, because it is organized for a purpose. The data may have been reorganized, statistically analyzed, or have had errors removed—all performed to add meaning to a message, a report, or a document. The medium is not the message, although it could affect the message. An analogy: Having a telephone does not ensure worthwhile conversation, although certain telephones make the message clear and more easily understood. Today, having more information technology is not a guarantee for improving the state of information.

Information is accessible to employees and managers through the company's local area networks, intranet, e-mail, Internet, satellite infrastructure, snail mail, or hand delivery. Unlike data that emphasizes quantity and efficiency of processing, the focus of information is qualitative: Does the report tell me something I don't know? Is there new meaning in the semiannual report? The implication is that data becomes information when meaning or value is added to improve the quality of decision making.

KNOWLEDGE

Knowledge has always been an essential component of all human progress. Our ancestors must have employed an enormous amount of knowledge to form an axe-like object. From know-how to use seeds for planting to the invention of machinery, to travel to the moon—all required an accumulation of special knowledge to achieve the task. When it comes to basics, people use their intelligence and creativity to come up with the value-added products and services that take on the competition. Knowledge capital is essentially a reflection of how well an organization leverages the knowledge of its workforce, the needs of its customers, and the knowledge of the suppliers to ensure value-added outcome. Knowledge capital is the way an organization derives wealth from its information resources on a regular basis.

Knowledge is the most cherished remedy for complexity and uncertainty. It is a higher level of abstraction that resides in people's minds. It is broader, richer, and much harder to capture than data or information. People seek knowledge, because it helps them succeed in their work. Tiwana views knowledge as actionable (relevant) information available in the right format, at the right time, and at the right place for decision making (Tiwana 2000).

Knowledge has different meanings, depending on the discipline where it is used. In this text, *knowledge* is "human understanding of a specialized field of interest that has been acquired through study and experience." It is based on learning, thinking, and familiarity with the problem area in a department, a division, or in the company as a whole. The focus is on *sustainable competitive advantage.* Knowledge is not information, and information is not data. Davenport and Prusak (2000) define 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." See Figure 2.1 for alternative definitions of knowledge, data, and information. Other characteristics of knowledge are summarized in Box 2.1.

Knowledge is derived from information in the same way information is derived from data. It may be viewed as an *understanding* of information based on its perceived importance or relevance to a problem area. It can also be thought of as a person's range of information. Embracing a wider sphere than information, knowledge includes perception, skills, training, common sense, and experience. It is the sum total of our perceptive processes that helps us to draw meaningful conclusions. For example, an investor requires knowledge to evaluate two companies' profit and loss statements in order to determine which one is the healthier company.

Data	*Information*	*Knowledge*
Statements about reality (Acharya 2001)	Organized, systematized data (Acharya 2001)	Human interaction with reality (Acharya 2001)
Unsorted bits of fact (Dixon 2000)	Data that has been sorted, analyzed, and displayed (Dixon 2000)	Meaningful links people make in their minds between information and its application in action in a specific setting (Dixon 2000)
A representation of a fact, number, word, image, picture, or sound	Data that has been assigned a meaning (Liebowitz and Wilcox 1999)	The whole set of insights, experiences, and procedures that are considered correct and true and that, therefore, guide the thoughts, behavior, and communication of people (Liebowitz and Wilcox 1999)
Measurements (Applehans et al. 1999)	Data that is meaningful or useful to someone (Dickerson 1998)	An ideational (i.e., conceptual rather than physical) construct generated via the agency of the human mind (Housel and Bell 1999)
A discrete, objective fact about events (Davenport and Prusak 2000)	Potential for action; resides in the user (Malhotra 1998)	Ability to turn information and data into effective action (Applehans et al. 1999)
	A statement of fact about measurements (Applehans et al. 1999)	An organizational resource consisting of the sum of what is known (Holseapple 1996)
	Descriptive knowledge (characterizing the state of some past, present, future, or hypothetical solution) (Holsapple and Whinston 1996)	A fluid mix of framed experience, values, contextual information, and expert insight that provides a framework for evaluating and incorporating new experiences and information (Davenport and Prusak 2000)
	Data that makes a difference (Davenport and Prusak 2000)	Systematizing and structuring information for a specific purpose (Johannessen et al. 1994)
		Information whose validity has been established through tests of proof (Libeskind 1996)

FIGURE 2.1: Alternative Definitions of Data, Information, and Knowledge

In addition to evaluation, information becomes knowledge with questions like "What implications does this information have for my final decision?" "How does this information relate to other information I received yesterday?" "What value can I derive from this information that adds value to the finished product?" Regardless of the process that organizes knowledge in the individual, it promotes the sought-after expertise for value-added decision making in the business. See Table 2.2 for a summary definition of each of the three terms.

As can be seen, information is all around, but only a fraction of it is useful in problem-solving. Knowledge has to be built and requires regular interaction with others in the know in the organization. It is social, time critical, interactive, evolving, and created for a

BOX 2.1

SELECT CHARACTERISTICS OF KNOWLEDGE

- Knowledge involves a *human* interaction with reality (or with information about reality, or information about other knowledge or information), where the human is the subject and acts as the active, creative element, and modifies the latter by way of reconstructing it. Knowledge involves attribution of *meaning and significance* by the knower as a person. In fact, every reconstruction is a reinterpretation as well.
- When I know something, it is relative to me. There can be no knowledge without me. It is always in relation to my existence and my knowing it. With my death dies my world, and with it my knowledge. In knowing something, I individualize, subjectify, and appropriate it and make it my own. What I know, in the process, becomes *my own.*
- Knowledge is essentially social in nature. We need *universal categories* for generation, expression, representation, storage, retrieval, and reappropriation of knowledge. The categories are universal in the sense that (a) they are capable of holding the same meanings for all humans belonging to the same community and (b) the categories can be socialized in terms of being shared, reconstructed, and applied by other humans belonging to the concerned universe of discourse.
- In knowing something, I *believe* it to be *true.* Without this belief, it could just be some information, without that stamp of individualized identity marked on it. This belief is a part of a system of beliefs, values, and rationality, and hence constitutes a *responsibility* and potential *commitment.*
- Knowing takes place in relation to *existing knowledge*—it is placing things in context, in relation to existing constructions of reality, content, and concepts.
- Knowledge involves a *judgment,* a subsumption of the particular under the universal. It involves a certain amount of synthesis and integration of discreet information under a category, a construction, or an attribution of a causality or justifiability, relative to the knower's frame of reference.
- Knowledge has a moment of *categorical imperative* and can induce a cognitive dissonance between belief and practice, between the past and the present, between the present and the future, between what is and what ought to be, and so on, and therefore, can form a springboard for potential action. In other words, *knowledge by definition is driven into practice.*
- Knowledge is always a part of a *dynamic* system. Knowledge has the tendency to go for more of itself, to bypass itself, and to constantly develop itself. It is only limited by mental and environmental constraints.
- Knowledge is *gregarious* by nature and has a tendency to socialize itself. Socialization is the means by which individual knowledge gets reinforced, challenged, modified, improved, and validated.
- Knowledge processes are always a part of an *open* system. It is like a game where the goalpost keeps shifting itself. *The meanings, the dictionaries, and even the rules of the language are always in flux*—as volatile as the turns in modern life. Knowledge creation, by definition, is a process of innovation.

SOURCE: Excerpted from Acharya, Jagabandhu. "What Is Knowledge?" kmx.totalkm.com/whatisk.html, April 27, 2001, pp. 2–5, Date accessed August 2002.

purpose but drawing on experience from other times and domains. Cooperation and productivity are expected as people work to achieve, not to control. Teamwork is a prerequisite for people to talk, compare, and exchange thoughts, leading to a culture that makes it clear that "What is my job?" is less important than "What is the purpose of what I am doing?"

Knowledge, not information, can lead to a competitive advantage in business. Information is thus closer to the decision-making process than is data. For example,

TABLE 2.2 Progression from Data to Information to Knowledge

Data	Unprocessed or raw facts; a static set of transactional elements, such as 211102345.
Information	Processed data; an aggregation of data that have meaning. For example, a financial analysis report that begins with account number 211-10-2345.
Knowledge	A person's range of information, embracing a wider sphere than information. It includes perception, skills, training, common sense, and experience. For example, a financial analyst might say, "All indicators tell me that I'd better pull out of XYZ stock before year end."

inventory tracking involves storing, retrieving, and reporting information in a structured format. Decision-making tools that structure information are called **decision support systems (DSS)** (spreadsheets, financial planning, resource allocation, and production scheduling) in which the decision approach is advisory and the problems addressed are semi-structured. These systems are used in situations in which the end user makes decisions.

DSS performs the kind of information processing necessary to speed the decision-making process and thereby saves the user from sifting through the information unassisted. The user might query a sales-forecasting software (or DSS) package, "What if I lowered the price of product X by 8 percent?" The software would evaluate the impact of the price cut and might respond, "Your sales should increase by 32 percent." The user would then decide what to do with this information.

Figure 2.2 approaches data, information, and knowledge in support of the definitions in Table 2.2. Data is the raw material for the so-called "number crunching" or data processing. The emphasis is on quantitative capture of facts—the backbone of accounting and payroll applications. For example, an alphabetic list of company employees, the hours worked, and the hourly rates are all data. When we organize data in a format that adds meaning, it becomes information. In this respect, information is more qualitative than quantitative (or algorithmic) than data. Using the same example, when the employee list shows employee earnings by department and titles, it becomes useful information. Information has been defined as data "in formation" (Dixon 2000). It is data that is classified, sorted, displayed, communicated verbally or graphically, or in the form of tables.

In contrast to information, knowledge is viewed as a body of information, processes, and experience that centers on a particular subject. It is actionable information. Knowledge is links that people make between information and how it is applied in action in a specific domain. For example, the employee list (by department and title) may be evaluated by an experienced personnel director for inequity in pay. Inequity in pay is a specific domain of concern to every organization.

Wisdom is the highest level of abstraction, with vision, foresight, and the ability to see beyond the horizon. It is the summation of one's career experience in a specialized area of work. The power of vision is illustrated in Box 2.2.

One can see that knowledge-rich organizations have a reason for adopting knowledge management into their infrastructure. Knowledge management moves a firm to a new level of quality, creativity, and sustainable competitive advantage. Unlike technology, which disappears as a medium of competitive advantage (everyone has it), knowledge advantage is sustainable because over the long haul it generates continuing advantages. To ensure continuity, a corporation with a knowledge management environment must maintain and enhance its knowledge base and knowledge activities on a regular basis.

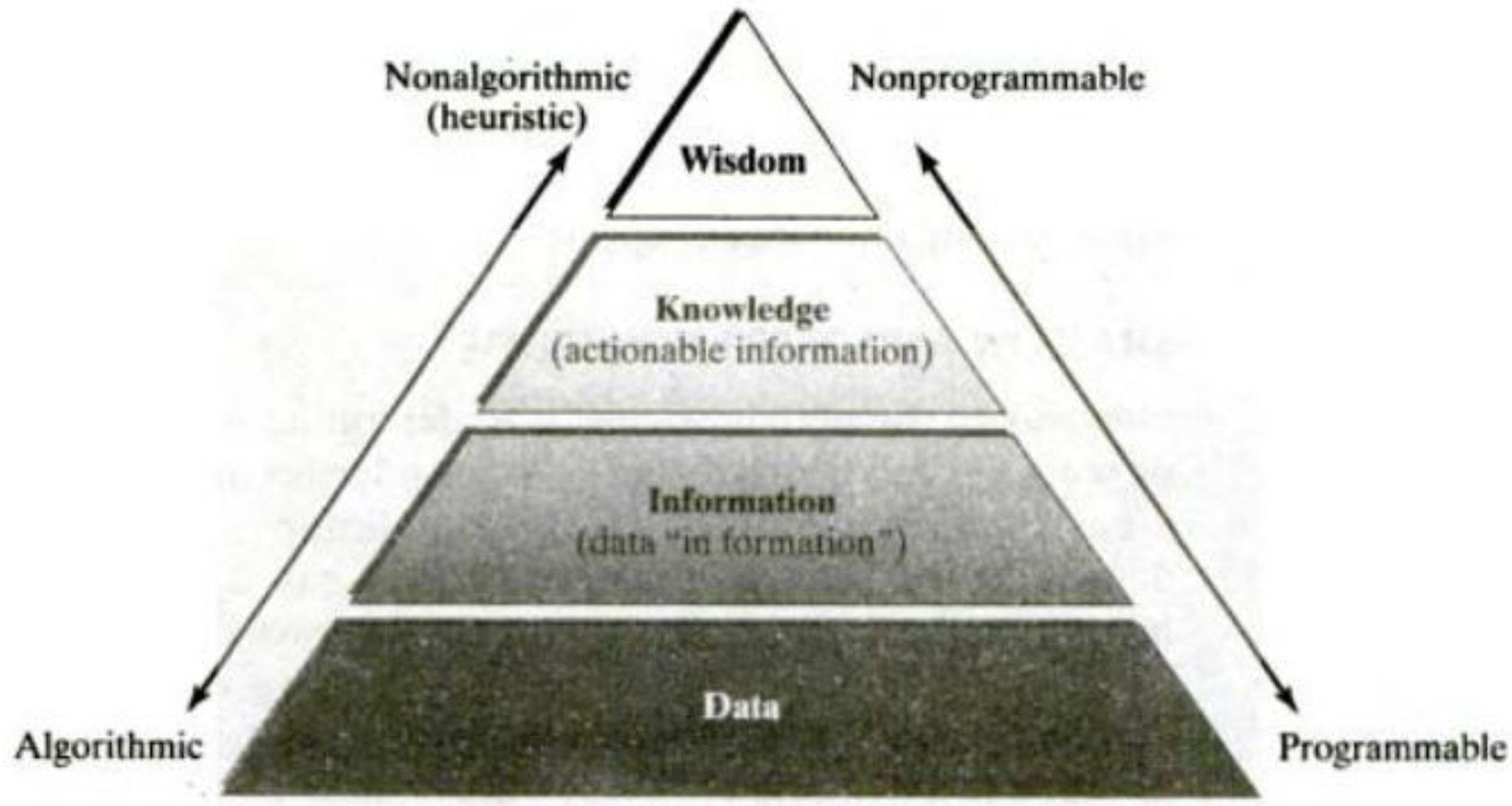


FIGURE 2.2: Data, Information, and Knowledge

BOX 2.2

THE YOUNG MAN AND THE STARFISH—AN EXAMPLE OF VISION

A wise man was taking a sunrise walk along the beach. In the distance, he caught sight of a young man who seemed to be dancing along the waves. As he got closer, he saw that the young man was picking up starfish from the sand and tossing them gently back into the ocean.

"What are you doing?" the wise man asked.

"The sun is coming up, and the tide is going out; if I don't throw them in, they'll die."

"But young man, there are miles and miles of beach with starfish all along it—you can't possibly make a difference."

The young man bent down, picked up another starfish, and threw it lovingly back into the ocean, past the breaking waves. "It made a difference for that one," he replied.

That young man's actions represent something special in each of us. We are all gifted with the ability to make a difference. Each of us can shape our own future. Each of us has the power to help our organizations reach their goals.

Vision without action is merely a dream.
Action without vision just passes the time.
Vision with action can change the world.

—*Joel Arthur Barker*

SOURCE: Anonymous.

Types of Knowledge

Knowledge is classified into a variety of types. When considering knowledge management, the knowledge developer should be familiar with each type and know how to tap into it during knowledge capture.

SHALLOW AND DEEP KNOWLEDGE

One way to classify knowledge is to determine whether it is shallow or deep. **Shallow**, or readily recalled *surface*, **knowledge** indicates minimal understanding of the problem area. For example, approval of loan applications for secured loans of less than $1,000 depending on assets and salary would be based essentially on a few basic rules that hardly require human consultation. In contrast, a loan approval scheme that employs 14 variables (including customer's credit rating, net worth, pattern of paying on time, and college education) would be more complex and more risky. **Deep knowledge** acquired through years of experience would be required to decide on such a loan.

KNOWLEDGE AS KNOW-HOW

Knowledge based on reading and training is much different from knowledge based on practical experience that spans many years. Knowledge based on know-how, or accumulated lessons of practical experience, is what is needed for building expert systems. The problem with practical experience is that it is rarely documented. Capturing such experience requires special tools. Knowledge capture procedures and tools are covered in Chapter 4.

Know-how distinguishes an expert from a novice. If you were told you needed an operation to save your eyesight, you probably would not want an intern to do it. Instead, you would want an expert eye surgeon's seasoned experience based on hundreds of similar operations.

Experts represent their know-how in terms of heuristics, rules of thumb based on their experience—empirical knowledge. In building a knowledge base, heuristics generally operate in the form of if/then statements: "*If* such and such conditions exist, *then* such and such actions result." Lenat has defined *heuristics* as "compiled hindsight" (Lenat 1982). Know-how is not book knowledge; it is practical experience. It can be expressed as rules of thumb or heuristics if one were to build a knowledge base for knowledge sharing within the organization.

REASONING AND HEURISTICS

Humans reason in a variety of ways:

1. Reasoning by analogy: relating one concept to another. For example, a battery is analogous to a reservoir. Both are used to store and provide energy for power.
2. Formal reasoning: using deductive or inductive methods. Deductive reasoning (also called *exact reasoning* because it deals with exact facts and exact conclusions) takes known principles and applies them to instances to infer some sort of a conclusion. For example:

   IF Fred is taller than Nancy **AND** Nancy is taller than Sarah,
   THEN Fred is taller than Sarah.

   Another example:
   IF mothers are women **AND** Sarah is a mother,
   THEN Sarah is a woman.

Deduction makes use of major and minor premises. Almost any argument can be formed using this type of reasoning process. Here are two examples:

a. *Major premise:* Each titanium coil leaving the mill must be 100 percent quality tested.
Minor premise: One part of the coil has not passed the test.
Conclusion: The entire coil should be rejected.

b. *Major premise:* In Turkey, all citizens get a pension from age 60 on.
Minor premise: Kamal Elberlik, age 60, is a citizen of Turkey.
Conclusion: Elberlik is receiving a pension.

As is evident from the examples, the idea behind deductive reasoning is to generate new knowledge from previously specified knowledge. If the original rule is true, then the deduction will be valid. If a knowledge base, for example, uses only deductive inference and the information assimilated is true, then one can depend on all the inferred conclusions to be valid. Unfortunately, much of common-sense reasoning (explained later) is nondeductive by nature.

In terms of inductive reasoning, it works the other way around. Inductive reasoning is reasoning from a set of facts or individual cases to a general conclusion—from specific examples to general rules. **Inductive reasoning** is the basis of scientific discovery. Consider the following examples:

a. *Premise:* Chronic unemployment causes social problems.
Premise: Illiteracy causes social problems.
Premise: Recession causes social problems.
Premise: Drug trafficking causes social problems.
Conclusion: Chronic unemployment, illiteracy, recession, and drug trafficking cause social problems.

b. *Premise:* He is an avid fisherman.
Premise: He is an avid hunter.
Premise: He is an avid mountain climber.
Conclusion: He likes outdoor sports

c. *Premise:* Admission depends on status.
Premise: Admission depends on race.
Premise: Admission depends on appearance.
Premise: Admission depends on financial wealth.
Conclusion: Admission is subjective.

In each example, the inference is an induction: It goes from a finite number of instances to a conclusion about every member of a class.

3. Case-based reasoning (CBR). Suppose a person was diagnosed with a condition that required major surgery. How would that person choose a surgeon? People tend to prefer an older surgeon with years of practical experience over someone fresh out of residency. The younger surgeon might be well versed in book knowledge, but experience is a better predictor of success among surgeons. Their experience is judged based on the number of cases they handled and the success of each case.

The idea of reasoning from relevant past cases is attractive because it is so similar to the process human experts often use to solve problems successfully. The process of choosing a surgeon indicates the perceived importance of case experience in expert problem-solving. Manipulating past problem-solving examples is critical in problem areas such as law, medical diagnosis, prediction, design, and process control. Because

experts tend to forget over time, capturing these cases in a knowledge base means reaping future benefits from past successes (and failures) of experts' work.

For years, knowledge developers have claimed that human experts reason about a problem by recalling similar cases encountered in the past. In fact, they reason by analogy: The expert tries to figure out how one case is similar (or dissimilar) to other cases solved in the past. A **case** is knowledge at an operational level. It is an episodic description of a problem and its associated solution. Box 2.3 illustrates an instance of human CBR, in which the reasoner (the father, who is also an attorney) uses previous cases similar to the current case as precedent to get the judge to dismiss the case.

COMMON SENSE AS KNOWLEDGE

Common sense is another type of knowledge that all human beings possess in varying forms and in varying amounts. It is a collection of personal experiences and facts acquired over time and the type of knowledge that humans tend to take for granted. For example, if someone asked you to look up Shakespeare's phone number, you would know that such a task is impossible. Common sense tells you that Shakespeare is dead and that the telephone was not invented until years after his death.

A human expert uses extensive common sense knowledge. Such reasoning is so common to the expert that it is basically ignored. Unfortunately, a computer does not possess common sense. Although computers can calculate *pi* to a thousand decimal places in seconds, they "know" nothing about some of the simplest things that people learn early in life, such as oranges are to eat, but baseballs are not, and that legs are permanently attached to the body.

FROM PROCEDURAL TO EPISODIC KNOWLEDGE

A fourth way to classify knowledge is according to whether it is procedural, declarative, semantic, or episodic (see Figure 2.3).

Procedural knowledge is an understanding of how to do a task or carry out a procedure. It is knowledge contained in the application of a procedure. Procedural knowledge usually involves psychomotor skills, such as holding onto the handrail while riding an escalator.

Some procedural knowledge is not psychomotor, however. For example, when a person learns a language and speaks it fluently, it becomes a natural part of the person. In the case of an expert, when the same knowledge is used over and over again in a procedure, it comes to be used automatically. Knowledge developers must select appropriate techniques for tapping this type of knowledge. Procedural knowledge is covered more fully in Chapter 4.

Declarative knowledge is information that experts can easily discuss. Unlike procedural knowledge, it is "awareness knowledge," or routine knowledge of which the expert is conscious. It is shallow knowledge that is readily recalled, because it is simple, uncomplicated information. This type often resides in **short-term memory**, the part of the brain that retains information for brief periods of time. It kicks in when you are at an airport and decide to call a friend in the area, for example. You look up the friend's phone number in the phone book and memorize it well enough to dial it. Chances are by the time you have boarded the flight, you will have forgotten the number. You remembered it only long enough to dial it.

Shallow, declarative knowledge is also used in diagnosing the electrical system of a car. The rule of thumb is that dim headlights probably indicate a faulty battery. The simple rule that if the headlights are dim, then the battery is faulty is obvious. It does not explain how the electrical system works; it just states a causal relationship between the headlights and the battery. As we shall find in Chapter 4, knowledge developers

BOX 2.3

REASONING WITH THE JUDGE

An attorney's 17-year-old son was issued a speeding ticket for driving 72 miles per hour in a 65-mph zone. The young man vehemently denied going that fast, but the radar report unmistakably indicated a speeding violation. Father and son were scheduled to appear in juvenile court later that month.

The week before the scheduled court date, the father went to court. He talked to parents waiting outside the courtroom. He sat in on several cases to size up the judge and plot strategy for defending his son's case. Every parent he talked to—case after case—indicated that the judge almost never let the juvenile off the hook. Penalties ranged from a $60 fine to suspension of the driver's license. The judge dismissed only one case out of 40 that day. The father decided to use it as the basis for his son's defense.

On the scheduled court date, father and son appeared before the judge:

Judge: Young man, how do you plead, guilty or not guilty?

Son: No contest, your honor.

Judge: It sounds like you've been coached. Officer, go ahead with your report. (The officer goes through the ritual of showing the radar report.)

Judge: Young man, tell this court your side of the case.

Son: Your honor, it is impossible to go exactly 65 miles per hour while driving. I kept looking at the speedometer. I know I was not driving at 72 miles per hour the way this cop drummed it up.

Judge: (looks at the father) Sir, are you the father?

Father: I am, your honor.

Judge: Do you have anything to say before I give my decision?

Father: Your honor, we have no quarrel with the radar as an electronic system. It is known for measuring speed but not the driver's attitude or experience. I would like to submit as evidence this young man's academic record (all As) and extraordinary accomplishments (Eagle Scout, president of his class, no prior speeding tickets). A number of cases have been brought before this court to mitigate the severity of the charge. For example, in the case of *Jane Maloney v. Commonwealth of Massachusetts* and *Bill Croll v. Commonwealth of Massachusetts.*

Judge: (quickly scans the record as he remembered both cases cited). Bailiff! Hand the driver's license to this boy's father. (To the father) Sir, you are to keep your son's license for 10 days before he's allowed to drive. Next time, bring your checkbook with you. Case dismissed.

find this type of knowledge useful in the early phase of knowledge capture, because it promotes familiarity with the type of expertise of the human expert. The best way to acquire declarative knowledge is with a structured interview.

Semantic knowledge is a deeper kind of knowledge. It is highly organized, "chunked" knowledge that resides in long-term memory. Such knowledge may have been there for years and may have been used so often that the information seems like second nature. Semantic knowledge includes major concepts, vocabulary, facts, and relationships. Returning to the headlight and battery example, semantic knowledge about the system would consist of understandings about the battery, battery cables, lights, the ignition system, and so forth, and their interrelationships. On the basis of this knowledge, one can build rules about causal relationships among those things. In the case of the headlights, one might know that dim headlights can be caused by a loose battery cable, a bad alternator, or a drain on the electrical system. At this point, a real expert (in this case, a certified mechanic) enters the picture (see Figure 2.4).

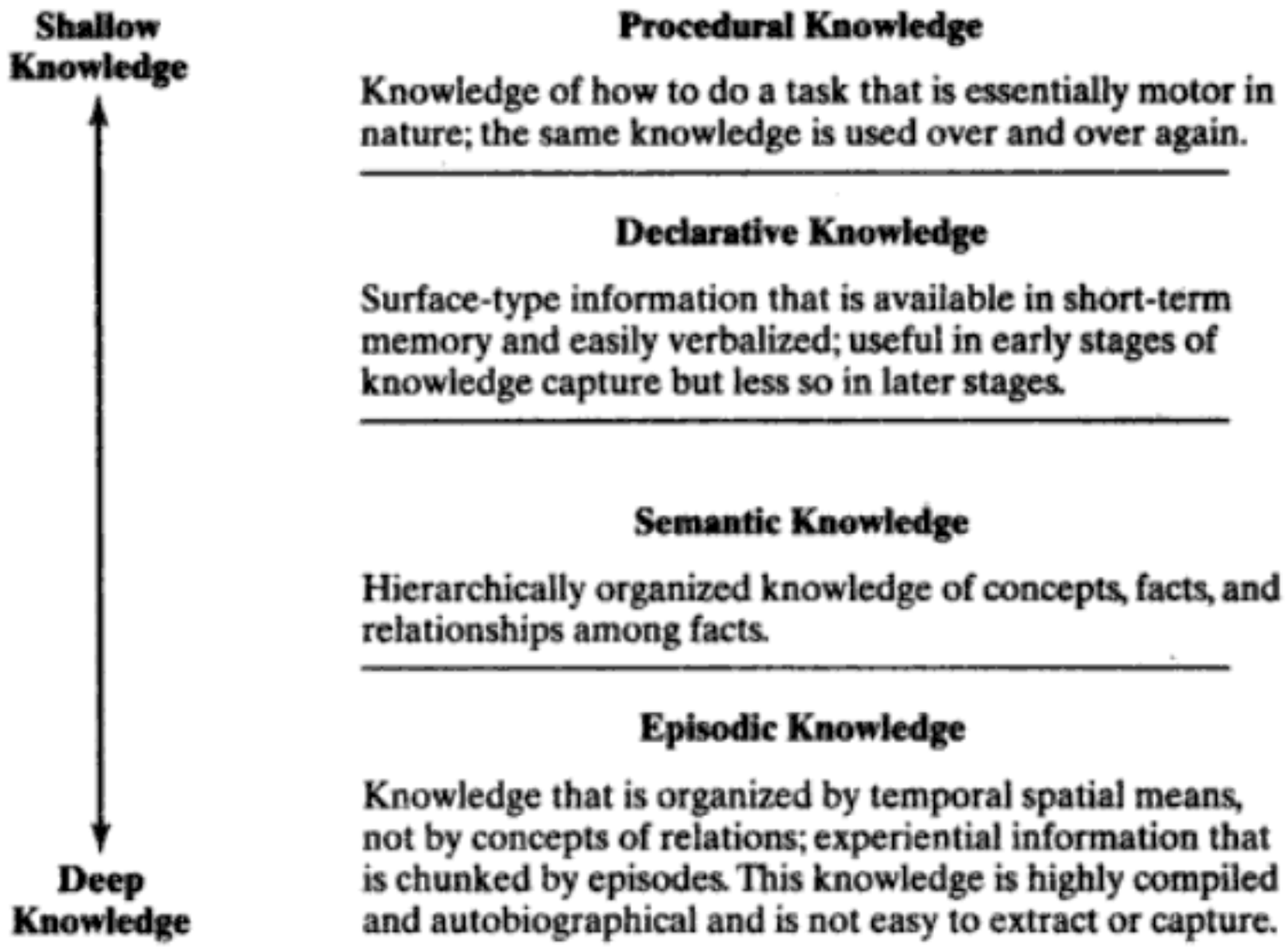
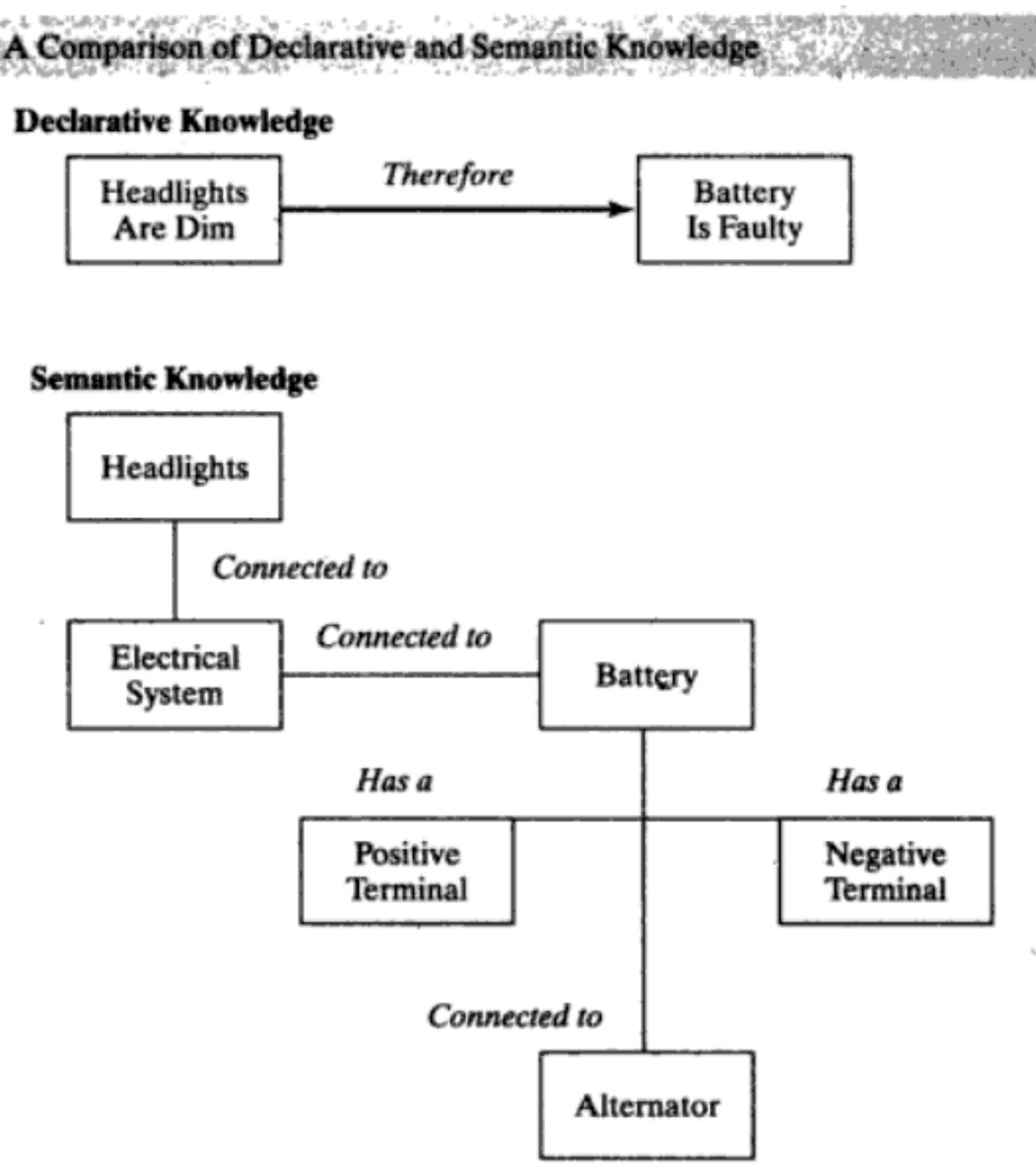


FIGURE 2.3: From Procedural to Episodic Knowledge

FIGURE 2.4: A Comparison of Declarative and Semantic Knowledge



Episodic knowledge is knowledge based on experiential information, or episodes. Each episode is chunked in long-term memory. In general, the longer a human expert takes to explain or verbalize his or her knowledge, the more semantic or episodic it is. In contrast, an expert can recall procedural or declarative knowledge in a relatively short time, because it is readily available in short-term memory.

An interesting aspect about episodic knowledge is that its use is automated. For example, have you ever driven from point A to point B and yet not remembered many details of how you got there? This is a common experience. Driving information is so chunked that most people have trouble remembering and explaining it. In the process of conveying the expert's knowledge, the expert explains by examples, or **scenarios**. Special tools and techniques are required for capturing such knowledge.

EXPLICIT AND TACIT KNOWLEDGE

Another approach to categories of knowledge is whether the knowledge is tacit or explicit (Nonaka and Takeuchi 1995). **Tacit** knowledge is knowledge embedded in the human mind through experience and jobs. Coined by Hungarian medical scientist Michael Polanyi (1891–1976), it includes intuitions, values, and beliefs that stem from years of experience. It is the knowledge used to create explicit knowledge and is best communicated personally through dialogue and scenarios, with use of metaphors. Therefore, knowledge is not private, but social. Socially relayed knowledge becomes part of the real-life experience of the knower.

In contrast, **explicit** knowledge is knowledge codified and digitized in books, documents, reports, white papers, spreadsheets, memos, training courses, and the like. Explicit knowledge can be retrieved and transmitted more easily than tacit knowledge. Because it is knowledge learned directly from experience, tacit knowledge (also referred to as *whispers in the ears*) is difficult to share across space and time. The person with tacit knowledge has no conscious experience of what it is that is causing his or her activity. Chapter 4 elaborates on methods and tools for tapping tacit knowledge.

Tacit and explicit knowledge have been expressed in terms of knowing-how and knowing-that, respectively. They have also been viewed as embodied knowledge and theoretical knowledge, respectively (Sveiby 1997). Knowing-how, or embodied knowledge, is characteristic of the expert who makes judgment or decisions without explicitly going through a set of rules. By contrast, knowing-that, or theoretical knowledge, is when a person learning a skill articulates available knowledge using explicit instruction, rules, principles, or procedures.

On the surface, explicit or documented knowledge is easier to identify, because it is a physical entity that can be measured and distributed. It can be stored as a written procedure or as a process in a computer. With that in mind, it is reusable for decision-making purposes. By contrast, tacit knowledge is personal and hard to formalize and communicate. It is primarily heuristics (rules of thumb), mind-sets, and unconscious values. The downside is that it is occasionally wrong and hard to change. Because the human mind is the storage medium, tacit knowledge is vulnerable to loss. When it is shared, vulnerability is reduced, and it is easier to reuse (Foster 2002).

Understanding what knowledge is makes it easier to understand that knowledge hoarding is basic to human nature. As long as job security is based on the special knowledge that we have, it continues to be a challenge to support knowledge sharing. So, when it comes to building a KM system, the company that assumes "if we build, they will rush" has a surprise coming. A strong incentive and proper change in the culture of the business are part of the planning that must take place before going KM.

Expert Knowledge

Most people realize that knowledge cannot be directly observed. What can be observed is the expertise that relies on knowledge to produce solutions. A person with expert knowledge can solve a complex problem more quickly and more effectively than someone else can. When the expert's advanced skills and years of experience are enhanced by attention to detail, quality results. Not surprisingly, most experts are perfectionists. They want the solution to be exactly what is called for by the problem.

Expert knowledge is not just a head full of facts or a repository of information for the intellect. It is information woven into the mind of the expert for solving complex problems quickly and accurately. Take the case of chess experts. They not merely recognize thousands of chessboard moves, but they consider them in ways relevant to playing the game. These are all finely tuned to the requirements of the game. The patterns experts learn to recognize are also unique, and the possibilities they consider all tend to be good ones. It is obvious that a good problem-solving strategy depends on how much you know.

CHUNKING KNOWLEDGE

Knowledge is stored in an expert's long-range memory as chunks. Knowledge **compilation**, or **chunking**, enables experts to optimize their memory capacity and process information quickly. *Chunks* are groups of ideas or details that are stored and recalled together as a unit. For example, an auto mechanic who had been rebuilding Porsche transmissions for 18 years was able to remember 140 different steps flawlessly. Although the sequences and combinations were difficult for him to describe, he consistently completed each job according to specifications.

Chunking promotes expert performance. The more chunking a person does, the more efficient is his or her recall. The drawback is that chunking makes it difficult for experts to be aware of their own knowledge so that they can describe it to others. For this reason, *decompiling* chunked knowledge and putting it into words is not an easy task.

KNOWLEDGE AS AN ATTRIBUTE OF EXPERTISE

Experts appear to differ from novices by the greater knowledge of their specialties. Our society has always recognized exceptional persons, whose performance is vastly superior to that of the average individual. Speculation about how people acquire extraordinary abilities has been a subject of discussion for many years. Based on current literature, it seems that in virtually all areas of specialization, insight and knowledge accumulate quickly, and the criteria for expert performance undergo continuous change.

To become an expert in a specialized area, one is expected to master the requisite knowledge, surpass the achievements of already recognized eminent people, and make unique contributions to the specialized field. This means that if individuals are innately talented, they cannot easily or quickly achieve an exceptional level of performance without preparation time and years of successful practice. In their classic study of expertise in chess, Simon and Chase (1973) learned that no one had attained the level of international chess master (grandmaster) with less than 10 years of intense preparation with the game. Bobby Fischer and Salo Flohr were only a year shy of the 10-year preparation time (Hayes 1981).

The unique performance of a knowledgeable expert (versus a novice) is clearly noticeable in decision-making quality. This implies that knowledgeable experts

are more selective in the information they acquire, are better able to acquire information in a less-structured situation, and agree more than novices regarding the information they consider important for decision making or problem-solving (Shanteau 1988).

Aside from quantifying soft information, knowledgeable experts tend to categorize problems on the basis of solution procedures (as opposed to surface procedures), embedded over time in the expert's long-range memory and readily available on recall. Because of this strategy, experts tend to use knowledge-based decision strategies, starting with known quantities to deduce unknowns. Should a first-cut solution path fail, the expert can trace back a few steps and then proceed again—a valuable process in deciding on the appropriate action(s).

In contrast, nonexperts use means-end decision strategies to approach the same problem situation. They focus on goals instead of essential features of the task, making the job laborious and unreliable (Sweller, et al., 1983). The net effect is that experts seem to demonstrate better-developed procedural knowledge for problem-solving. If procedural knowledge is appropriate for the problem, experts proceed to encode and finalize a decision more quickly and effectively than nonexperts. As a result, experts reason differently and solve problems more quickly than nonexperts. Experienced cab drivers, for example, will recognize a shorter route while traveling to their destinations and tend to take that route even though the rider misinterprets such a maneuver (Awad 1999).

Taken at face value, experts are the beneficiaries of the information or knowledge that comes inevitably from experience rather than innate talent bestowed upon the select few who eventually become experts in their specialty. Experts work harder, rely less fully on routines, and seem to be engaged in extending their knowledge rather than merely exploiting it. With knowledge as an attribute of expertise, the focus is not only on what it includes but also on how it is acquired and how it works. Within the hidden knowledge of experts are declarative, procedural (skill), and episodic (heuristic) knowledge (Awad 1999). Procedural knowledge manifests itself in performance; episodic knowledge is the invisible knowledge lying in long-range memory. It represents years of proven experience in a domain.

In a nutshell, certain individuals consistently perform at higher levels than others and are labeled experts. They possess attributes that account for their outstanding performance. Whether these attributes are innate talent or whether they are acquired through knowledge, practice, and experience, there is reason to believe that experts succeed primarily because of their proven knowledge and how well they apply and upgrade it on a daily basis. The conceptual model in Figure 2.5 essentially suggests that academic knowledge contributes to conceptual knowledge, which is a prerequisite for practical (in the field) knowledge. Practical knowledge is a contributor to experience that over time leads to expertise. Expertise means minimum or no errors in decision making or problem-solving.

The main conclusion regarding corporate experts is for the company to find ways to retain them by various means, such as recognition, bonuses, and giving an opportunity for mentorship, knowledge sharing, creativity, independence, ability utilization, and the like (see Box 2.4). The key phrase is *knowledge sharing*. Mechanisms must be installed to encourage the sharing of expertise throughout the organization, and there must be strong support from upper management. Without such effort, brain drain could be devastating for a forward-looking organization operating in an uncertain environment.

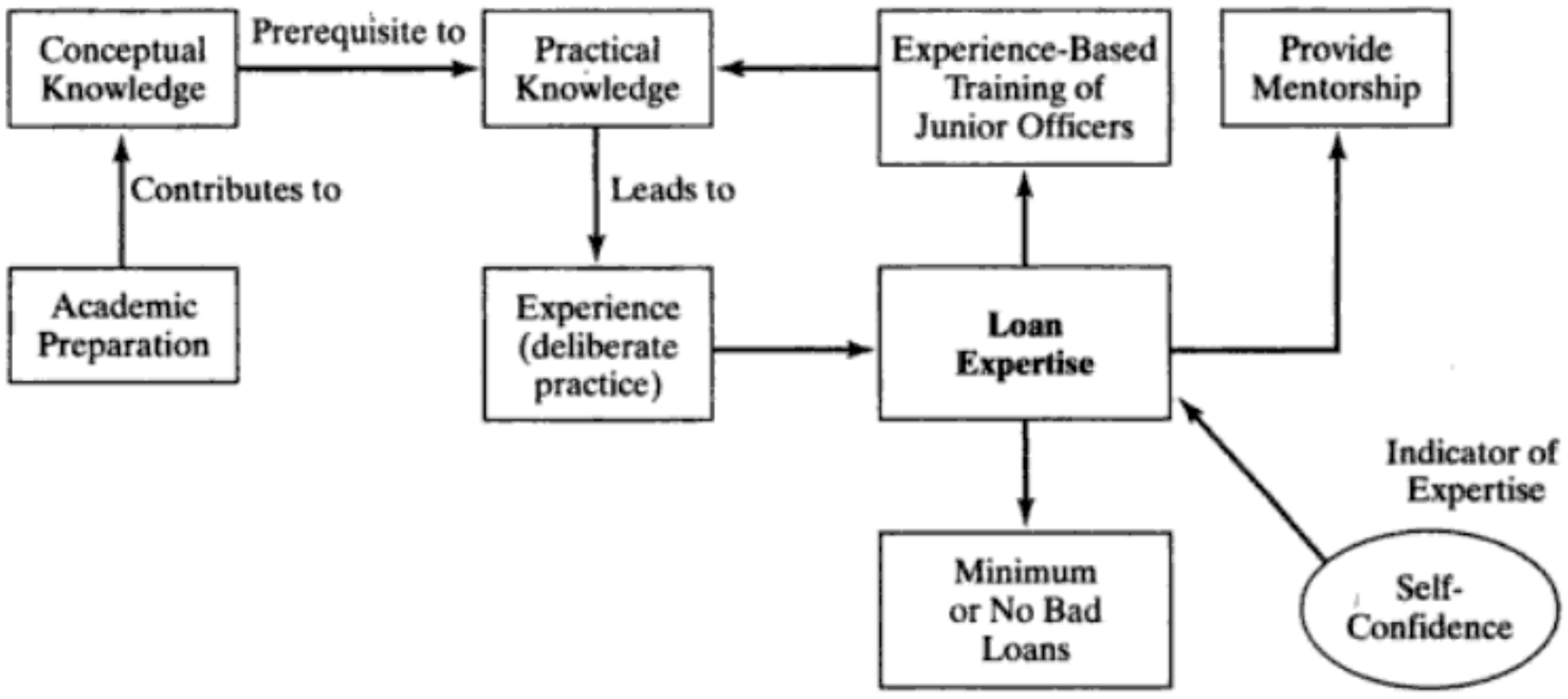


FIGURE 2.5: A Conceptual Model of Expertise

BOX 2.4

THE IMPORTANCE OF EXPERTS

TAKING CARE OF EXPERTS

After the initial pride of being recognized as an expert wears off, being on call to an entire company may not seem very attractive to busy professionals. "Many experts' greatest concern about Yellow Pages and other locator software is that they will be swamped with basic questions," says Richard McDermott, a knowledge management consultant in Boulder, Colorado. "So, they often hide out."

An effective knowledge-sharing system should give experts safe, efficient, and pleasant ways to help their coworkers. Knowledge leaders must show these experts how their participation will help their own colleagues, so they don't see it "as some sort of headquarters deal," says Reid Smith, vice president of knowledge management for Schlumberger Ltd. in Sugar Land, Texas. "Explain why you're doing this and what you're trying to achieve."

Recognizing that experts may want to control their availability, some software applications conceal the expert's identity, leaving it up to the expert to participate or communicate directly with an individual once a query is made.

It makes sense for companies to reinforce appreciation of the value of experts' contributions. Peer recognition is a good way to do this, according to Smith. "We implemented a recognition program where engineers vote for the best of the best practices," he says. More tangible incentives can help, too. Some companies, including Schlumberger, offer prizes for sharing and create point systems for collaborative efforts.

Experts also find that they like sharing what they know. "Occasionally, a worker's job changes so much that providing expertise becomes as significant a part of the job as the tasks in the original job description," says Susan Hanley, director of content and collaboration management at Plural, Inc., in Bethesda, Maryland. Some even change careers so they can do it more.

SOURCE: Excerpted from Cuthbertson, Bruce. "Prospective for Experts," *Knowledge Management*, June 2001, p. 30.

Human Thinking and Learning

Because knowledge is the focus of knowledge management, knowledge developers need to understand how humans think and learn. Scientists have long tried to understand the human brain as part of their process of building computers that may someday duplicate the human expert's thought process in problem-solving. Imagine a child using blocks to build a tower. As soon as the tower is completed, the child takes a whack at the tower, destroying it. Next, the child builds a higher tower and then destroys it as well, and so on. Eventually, the child becomes hungry, and the pattern of BUILD and DESTROY begins to degenerate. The child gives the tower one final swipe, destroying it on the way to the kitchen. These spontaneous activities have proved to be difficult for computers, mainly because no one knows why people do them and, therefore, knows how to instruct the computer to do them.

According to Marvin Minsky (1991), the human mind is a "society of minds" that is hierarchically structured and interconnected so that the BUILD, DESTROY, and HUNGER agents of the child are minds that represent the self, promote intelligence, and provide the basis for acquiring knowledge. The study of artificial intelligence has introduced more structure into human thinking about thinking. So many activities of the computer resemble human cognitive processes that human and machine "thinking" are converging in many applications, despite the differences between the brain's architecture and the computer's. For example, both mind and machine accept data and information, manipulate symbols, store items in memory, and retrieve items on command.

Obviously, humans do not receive and process information in the same way that machines do. For instance, humans receive information via sensing—seeing, smelling, tasting, touching, and hearing. This system of receiving external stimuli promotes a kind of thinking and learning that is unique to humans. On a macro level, computers and humans receive inputs from a variety of sources. Computers receive information from keyboards, speech, touch screens, and other external sensors. On a micro level, both the central processing unit of a computer and the human brain receive all information as electrical impulses. The difference is that computers must be programmed to do specific tasks. Performing one job does not transcend onto other jobs as it does with human.

HUMAN LEARNING

Memory is an essential component of learning, because it accommodates learning. One interesting aspect of healthy human memory is that it never seems to run out of space. Also, as humans acquire more and more knowledge, they generally experience little interference with the recall ability or the quality of the information in memory. In other words, as people learn new facts, they integrate them in some way with what they think is relevant and organize the resulting mix to produce valuable decisions, solutions, or advice. Such learning ability is the basis of accumulating knowledge, experience, and expertise.

For humans, learning occurs in one of three ways: learning by experience, learning by example, and learning by discovery. The next section explores these types in an effort to see how they contribute to human knowledge.

LEARNING BY EXPERIENCE

The ability to learn by experience is a mark of intelligence. When an expert is selected whose knowledge someone wants to acquire, the expert is expected to have years of experience reworking problems and looking into different angles for solving difficult

TABLE 2.3 Three Types of Human Learning

Learning by experience	Trial and error or reworking problems is used to acquire experience in problem-solving. An expert uses experience to explain how a problem is solved.
Learning by example	Specially constructed examples or scenarios are used to develop the concept(s) the student is expected to learn. In knowledge capture, the human expert uses a scenario to explain how a problem is solved.
Learning by discovery	This is an undirected approach, where humans explore a problem area with no advance knowledge of what their object is.

problems. One way of testing potential experts is to observe their recall ability. Experts, who know a lot about a particular problem, have been found to remember facts in that problem area much more easily and more quickly than nonexperts, who presumably have fewer facts to recall. This type of information would be important for the knowledge developer to keep in mind when understanding a human expert's range of knowledge.

LEARNING BY EXAMPLE

Like learning by experience, learning by example is a good contributor to accumulating knowledge over time. In learning by example, specially constructed examples are used instead of a broad range of experience. Much classroom instruction is composed of teaching by example—providing examples, cases, or scenarios that develop the concepts students are expected to learn. Because this method allows students to learn without requiring them to accumulate experience, it is more efficient than learning by experience.

LEARNING BY DISCOVERY

Learning by discovery is less understood than learning by example or by experience. It is an undirected approach in which humans explore a problem area without advance knowledge of the objective. No one understands why humans are so good at this. It is difficult to teach, and it will be years before we can benefit from this approach commercially. Table 2.3 summarizes the three types of learning.

Implications for Knowledge Management

Knowledge awareness benefits entire organizations. With today's emphases on sustainable competitive advantage, added value, and improved productivity, a firm's management needs to create, innovate, monitor, and protect its knowledge inventory. More specifically, a KM environment means a focus on generating new knowledge; transferring existing knowledge; embedding knowledge in products, services, and processes; developing an environment for facilitating knowledge growth; and accessing valuable knowledge from inside and outside the firm. When this happens, it is beyond survival. In fact, it is beyond intranets and databases—the technology that supports KM.

Some sources claim that 20 percent of an organization's knowledgeable personnel can operate 80 percent of the organization's day-to-day business. The human resources manager can play an important role in identifying the knowledge core of the organiza-

tion, recommending ways to preserve this critical core, and building a robust, long-range plan to ensure top-quality operation. Without such preparation, corporate talent could potentially erode through a brain drain that spells disaster for any business. At the same time, professionals with expertise are naturally drawn to organizations that recognize and reward expertise, especially when that expertise directly contributes to the firm's productivity. Such matches explain the stability and growth of many successful "learning" companies.

Based on the discussion in the chapter, several ideas should be considered for how a company should perform in order to create and maintain sustainable competitive advantage. First, there should be more emphasis on tapping, sharing, and preserving tacit knowledge and the total knowledge base of the company. A company's knowledge base includes explicit and tacit knowledge and exists internally in the business as well as within the firm's external connections. Second, companies should focus on innovation and the processes that convert innovation to new products and services. Knowledge sharing and an emphasis on the total knowledge base promote innovation.

Finally, it is important to consider a renewed focus on organizational learning systems and systemic thinking throughout the organization. This is a realistic expectation, because knowledge is closely related to learning, which is the outcome of regular and continuous interactive learning. Systems thinking means understanding how the various parts of the company work. This includes learning behavioral patterns in the system and the culture or system environment in which employees and administrators operate. In other words, systemic thinking is expected to support innovation and continuous improvement processes, social competence, and interactions, as well as the total knowledge base.

What good is knowledge if it cannot be shared? If knowledge is power, sharing it will multiply power across the business. Unfortunately, sharing knowledge is an unnatural thing. One person's knowledge is an added value to that person's career path. Knowledge management is designed to solve the problem of unrecycled knowledge. Systems have been developed to gather, organize, refine, and distribute knowledge throughout the business. Virtually all such systems should have six key attributes: learning capability, improving with use, knowing what you want, two-way communication between the system and you, recalling past actions to develop a profile, and unique configuration to your individual specifications in real time.

In the final analysis, communication and connection make knowledge sharing an ongoing activity. Technology can only do so much to create a formal system. Success with KM exists when the culture is ready to communicate and connect. The end result is "community," built around knowledge and based on vision.

SUMMARY

- Intelligent behavior has several attributes:
  - The ability to understand and use language
  - The ability to store and retrieve relevant experience at will
  - Learning by example, from experience, or by discovery
- Several key terms are worth noting:
  - *Knowledge*—understanding gained through experience
  - *Intelligence*—the capacity to apply knowledge

  - *Heuristics*—rules of thumb based on years of experience
  - *Common sense*—innate ability to sense, judge, or perceive situations that grows stronger over time
  - *Experience*—changing facts into knowledge to refine a reasoning process
- A distinguishing feature of human learning is that as people learn new facts, they integrate them in some way and use the resulting mix to generate value-added decisions, solutions, or advice.
- Humans learn by experience, by example, and by discovery. Learning by discovery is less understood than learning by example and by experience. Learning continues to be a major concern in knowledge management.
- Knowledge developers, whose job is to capture experts' knowledge, need to be well prepared and to have a clear understanding of the distinctions among knowledge, information, and data. They must focus on knowledge as it relates to the problem area.
- The relative importance of data, information, and knowledge is a function of the importance of the problem, the decision approach, the nature of the problem, and the number of persons affected. Whereas data plays a relatively trivial role in problem-solving, knowledge occupies a major role. The decision approach is advisory and relates to a difficult problem affecting many people in the organization.
- Expert knowledge is clustered, or "chunked," in long-range memory. Chunking promotes expert performance, but can also make it difficult for experts to be aware of their own knowledge in a way that allows them to describe it to others.
- Humans have common-sense knowledge, a collection of personal experiences and facts acquired over time. The fact that common-sense reasoning is so strong in experts makes it difficult for knowledge developers to capture their deep knowledge.
- Knowledge can be classified by procedural, declarative, semantic, or episodic means.
  - *Procedural* knowledge is knowledge that is used over and over again.
  - *Declarative* knowledge is knowledge that the expert is aware or conscious of. It is shallow knowledge.
  - *Semantic* knowledge is chunked knowledge that resides in the expert's long-range memory.
  - *Episodic* knowledge is knowledge based on experiential information. Each episode is chunked in long-range memory.
- Common sense is inferences made from knowledge about the world. Reasoning is the process of applying knowledge to arrive at solutions. It works through the interaction of rules and data.
- Deductive reasoning deals with exact facts and conclusions. The idea behind deductive reasoning is to generate new knowledge from previously specified knowledge. In contrast, inductive reasoning is reasoning from a set of facts to general principles. Induction usually produces results without explanation.
- Knowledge has also been classified as tacit and explicit knowledge. Tacit knowledge, or "know-how," is stored in people's minds and is not so easy to capture or share. By contrast, explicit knowledge is codified and digitized in the form of records, reports, or documents and is reusable for decision making.
- Case-based reasoning is reasoning by analogy. Human experts reason about a problem by recalling similar cases encountered in the past.

TERMS TO KNOW

Case: Knowledge at an operational level; episodic description of a problem and its associated solution.

Case-based reasoning: A methodology that records and documents previous cases and then searches the relevant case(s) to determine their usefulness in solving a current problem; problem-solving a case by analogy with old ones.

Chunking: Grouping ideas or details that are stored and recalled together as a unit.

Common sense: Possessing common knowledge about the world and making obvious inferences from this knowledge.

Compilation: The way a human translates instructions into meaning language or response.

Decision support systems (DSS): Computer-based information systems that combine models and data for solving complex problems with extensive user involvement.

Declarative knowledge: Surface information that experts verbalize easily.

Deductive reasoning: Also called *exact reasoning;* takes known principles (exact facts) and applies them to instances to infer an exact conclusion.

Deep knowledge: Knowledge based on the fundamental structure, function, and behavior of objects.

Episodic knowledge: Knowledge based on experiential information chunked as an entity and retrieved from long-term memory on recall.

Experience: The factor that changes unrelated facts into expert knowledge.

Expert: A person whose knowledge and skills are based on years of specialized experience.

Expertise: The skill and knowledge possessed by some humans that result in performance that is far above the norm.

Explicit knowledge: Knowledge codified in documents, books, or other repositories.

Fact: A statement of a certain element of truth about a subject matter or a problem area.

Heuristic: A rule of thumb based on years of experience.

Inductive reasoning: Reasoning from a given set of facts or specific examples to general principles or rules.

Inferencing: Deriving a conclusion based on statements that only imply that conclusion.

Intelligence: The capacity to acquire and apply knowledge through the ability to think and reason.

Knowledge: Understanding, awareness, or familiarity acquired through education or experience.

Learning: Knowledge or skill acquired by instruction or study.

Learning by discovery: Acquiring new ideas by exploring a problem area with no advance knowledge of what is being sought.

Learning by example: Acquiring new ideas based on specially constructed examples or scenarios.

Learning by experience: Acquiring new ideas based on hundreds of previously stored concepts.

Logic: The scientific study of the process of reasoning and the set of rules and procedures used in the reasoning process.

Memory: The ability to store and retrieve relevant experience at will.

Premise: Provides the evidence from which the conclusion must necessarily follow; evaluates the truth or falsehood with some degree of certainty.

Procedural rule: A rule that describes a sequence of relations relative to the problem area.

Reasoning: The process of applying knowledge to arrive at solutions based on the interactions between rules and data.

Scenario: The formal description of how a problem situation operates.

Semantic knowledge: Highly organized, "chunked" knowledge that resides in the expert's long-term memory and represents concepts, facts, and relationships among facts.

Shallow knowledge: Readily recalled knowledge that resides in short-term memory.

Short-term memory: The part of the human brain that retains information for a short period of time.

Tacit knowledge: Knowledge used to create explicit knowledge; the mind-set of individuals that includes intuitions, values, and beliefs that stem from experience.

TEST YOUR UNDERSTANDING

1. If intelligence is the capacity to acquire and apply knowledge, what is knowledge?
2. Briefly explain the key attributes of intelligent behavior.
3. Distinguish between:
   a. fact and rule
   b. knowledge and common sense
   c. experience and heuristics
   d. learning by example and learning by discovery

4. Define episodic knowledge and semantic knowledge. Give an example of each.
5. Illustrate by example the possible relationship between:
   a. knowledge and information
   b. knowledge and data.
6. Why is knowledge compiled? Discuss its relationship to long-range memory.
7. Review the types of knowledge discussed in the chapter. Use an illustration of your own to show how each type differs from the other types.
8. What is the difference between tacit knowledge and explicit knowledge? Give an example of each.
9. If shallow knowledge is declarative knowledge, what is deep knowledge? Be as specific as you can.
10. Illustrate the differences between deductive and inductive reasoning. Under what conditions is one preferred over the other?

KNOWLEDGE EXERCISES

1. "People do not think in the same way as machines, because people are biological." Do you agree?
2. What type of knowledge is used in each of the following activities:
   a. tying a shoelace
   b. debugging a computer program
   c. baking a pie
   d. replacing a car's flat tire
   e. negotiating peace with a hostile country
   f. driving in congested traffic
   Explain each classification.
3. List five heuristics that you employ in everyday life. By what kind of learning have you arrived at these rules of thumb?
4. Determine the type of reasoning in each of the following cases:
   a. Liz did not deposit money in her checking account.
      Liz is a customer of the bank.
      Liz's check bounced (insufficient funds).
      Conclusion: Checks drawn against a negative account balance will bounce.
   b. Drivers who exceed the speed limit get speeding tickets.
      Donna is a licensed driver.
      Donna drove her car 20 miles over speed limit.
      Conclusion: Donna will get a speeding ticket.
      (What is wrong with this reasoning?)
   c. A customer whose account balance drops below $100 during the month is subject to a $5 charge.
      Bob is a bank customer.
      Bob has a checking account.
      Bob's checking account balance dropped to $98.
      Conclusion: Bob's account will be charged $5.

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CHAPTER

Knowledge Management Systems Life Cycle

Contents

There is nothing more difficult to plan, more doubtful of success, nor more dangerous to manage than the creation of a new system. For the initiator has the enmity of all who would profit by the preservation of the old system and merely lukewarm defenders in those who would gain by the new one.

—MACHIAVELLI, 1513

In a Nutshell

The building of knowledge management can be viewed as a life cycle that begins with a master plan and justification and ends with a system structured to meet KM requirements for the entire company. A knowledge team representing the thinking of the firm and a knowledge developer with expertise in knowledge capture, knowledge design, and knowledge implementation ensure a successful system. Lack of planning, structure, and order can invite disaster.

The most critical phase of the KM systems life cycle is identifying the immediate, intermediate, and long-term needs for the prospective system. This means reviewing the knowledge core of existing employees; conducting a cost/benefit analysis to determine the justification for and potential benefits of the candidate system; and determining the tools and the procedures to ensure completeness, accuracy, integrity, and operational success of the installation.

The knowledge management systems life cycle (KMSLC) centers around three questions:

1. What is the *problem* that warrants a solution by the KM system? How important is the problem? What clues indicate that the system should be built? What will the user and the company as a whole gain from the system?
2. What *development strategy* should be considered? Who is going to build the system?
3. What *process* will be used to build the system?

These questions are interrelated, and they lead to other questions when the knowledge developer gets involved in the system development process. In deciding on a KM system, it is important to consider top management support early in the planning phase. Employee support and participation through the knowledge capture phase also make it easier to navigate through the development process. This chapter focuses on the strategic planning and the justification for KM system development and the process of building it.

The concept of "life cycle" is not new. It can be applied to virtually every endeavor, personal and business. Here are some examples:

College:	Admission, education, graduation
Term paper:	Introduction, body, conclusion, references
Air flight:	Boarding, takeoff, cruising, landing, disembarking
Faculty:	Assistant professor, associate professor, professor
Information system development:	Problem definition, analysis, design, implementation

These life cycles have some characteristics in common:

- Discipline, order, or segmentation into manageable activities or phases
- Good documentation for possible changes or modifications of the system in the future
- Coordination of the project to ensure the cycle is completed on time
- Regular management review at each phase of the cycle

Structure and order are to KMSLC what chapters and paragraphs are to a book. Can you imagine trying to read this book if the paragraphs occurred in random order? You would be exposed to the same material, but it would lack order and, therefore,

meaning. In the same way, a well-defined life cycle is essential for successful development and maintenance of knowledge management in a business environment.

Challenges in Building KM Systems

On the surface, KM seems exciting, but several challenges lay ahead that hinder KM system development. Among the key challenges are the following:

- *Culture.* Changing organizational culture is not an overnight exercise. The number one challenge is getting people to share their knowledge rather than hoarding it (see Box 3.1). To do so means changing people's attitudes and behaviors. The company that develops the right combination of incentives for employees to collaborate and share their knowledge will go a long way toward ensuring a successful KM system. There is no question that knowledge is power, and no one wants to give it up. Traditionally, employees hoard knowledge because they understandably worry that they will lose advantage in the organization. KM has to make knowledge sharing attractive enough to be lasting, not just for the company but for the employees as well.
- *Knowledge evaluation.* The company that tackles the evaluation issue will have both a head start on the employee incentive problem and an edge on refining KM processes for maximum profit. Assessing the worth of information is a crucial step if a company wants to refine its methods or create a reward system for employees who have generated the "best" knowledge (see Box 3.2).

BOX 3.1

THE SHARING OF KNOWLEDGE

Both inside and outside a company's gates, great things often begin at those fortunate moments when people with knowledge and vision pool their dreams. A perfect example: WorldCom, Inc., the company that merged with MCI to form MCI WorldCom, Inc., now the fourth-largest telecommunications company in the world, had its origins at a coffee shop in Hattiesburg, Mississippi, when four executives who knew the business got together exactly 1 month after AT&T's long-distance monopoly was broken by antitrust laws. Is it luck or knowledge?

Of course, businesspeople can meet by design at regular times and places, but the spontaneous appearance of a group that can develop a shared vision has historically been the product of a chance meeting on the stairs, on the elevator, by the coffee machine, or at the water cooler. Knowledge management proponents today believe that those chance interactions that mix and reformulate knowledge can and should be systematically encouraged. It can happen in one office, but time and geography are no longer constraints to collaborative work. The creation of a profitable idea—like MCI WorldCom—always takes hard work but is never just dumb luck. Larry Prusak, executive director of IBM's Institute for Knowledge Management in Waltham, Massachusetts, says, "All of life and business is a game of odds. Just as HR policies increase the odds of employee retention, and good customer service increases the odds toward repeat business, knowledge management is about increasing the odds toward knowledge being transferred, utilized, and contributing to innovation."

SOURCE: Excerpted from Glasser, Perry. "The Knowledge Factor," *CIO Magazine*, December 15, 1998–January 1, 1999, pp. 1–9.

BOX 3.2

ESTIMATING THE WORTH OF KNOWLEDGE

Figuring a return for knowledge management initiatives is like trying to calculate payback from providing employees with telephones, paper, and pens. According to international and U.S. chief knowledge officer Michael J. Turillo, Jr., of KPMG Peat Marwick LLP, the consultancy invested $40 million in a knowledge management initiative called *Kworld* during a 5-month period in 1998. The investment included capital outlays for hardware, software, and the development cost of executive and management time consumed by planning and testing the system for the New York City–based firm. Though satisfied with Kworld's early operation, a nagging concern for Turillo remains finding a proper way to evaluate the information in KPMG's knowledge repository, the Global Knowledge Exchange. Assessing the worth of information is a crucial step if a company wants to refine its methods or create a reward system for the employees who have generated the "best" knowledge. A simple hit count on information use reveals little about its worth. Instead, the interest is in quality, who is using the information, and whether they are decision makers.

SOURCE: Excerpted from Glasser, Perry. "Knowledge Factors," *CIO Magazine*, December 15, 1998–January 1, 1999, p. 3.

Unfortunately, estimating the worth of knowledge is complicated. Reliable metrics have yet to be made available.

- *Knowledge processing.* Many companies do not realize the importance of the human element in KM. Effective KM systems must allow organizations not only to store and access information but to document how decisions were reached as well. Specifically, techniques should be identified that will capture, store, process, and distribute the kind of knowledge that cannot be readily tabulated in rows or columns (see Box 3.3).

BOX 3.3

THE PROCESSING OF KNOWLEDGE

The merger of Peat Marwick International and Klynveld Main Goerdeler in 1987 produced a babel of cultures in the American, British, Dutch, and German partnership known today as KPMG Peat Marwick LLP. "KPMG was not so much a global company as it was a collection of geographically identified franchises," says international and U.S. chief knowledge officer Michael J. Turillo, Jr.

Kworld—KPMG's knowledge intranet that started in 1997—is the company's strategic bet to make all its pieces work together. The knowledge base design respects the legacy of KPMG's consulting practice, which remains organized around product, industry, and geography. KPMG users once had to physically locate the work of a specialist senior partner and potentially read through dozens of documents. With Kworld, expert information is available on the desktop. Extracting in-house knowledge about ERP installations for the petroleum industry in Germany, for example, is now only a few mouse clicks away.

(*continued*)

(*continued*)

Keeping the repository current occupies 15 full-time "knowledge editors" in KPMG's New York City office. The editors capture nonquantifiable knowledge from feeds that zap as many as 8,000 published papers, speeches, books, and magazine articles across their screens daily.

SOURCE: Excerpted from Glasser, Perry. "The Knowledge Factor," *CIO Magazine*, December 15, 1998–January 1, 1999, pp. 6–7.

- *Knowledge implementation.* When it comes to KM, an organization must commit to change, learning, and innovating if it is to realize leadership in the marketplace. Technology has already made it possible to implement knowledge collaboration, regardless of time and place. One of the important tasks in KM is extracting meaning from information that will have an impact on special problems or missions. Lessons learned in the way of feedback are stored for others facing the same problem in the future. That is why prisoners of war are debriefed after their release. Their experience is stored in a repository for future behavioral adjustment that could improve the survival and life style of future prisoners of war.

Conventional Versus KM System Life Cycle

Those who have developed conventional information systems in the past and are now involved in building KM systems need to see the relationship between the conventional systems approach and KM system development. This perspective extends to the role of the systems analyst versus that of the knowledge developer. This section examines these important distinctions.

Key Differences

Some striking differences distinguish conventional systems development from KM system development:

1. The systems analyst deals with data and information obtained from the user. The user is highly dependent on the analyst for the solution (a conventional information system). The knowledge developer deals with knowledge captured from people with known knowledge in the firm. The developer is highly dependent on them for the solution.
2. The main interface for the systems analyst is with the novice user, who knows the problem but not the solution. In contrast, the main interface for the knowledge developer is the knowledgeable person who knows the problem and the solution. There is no comparable expert in a conventional information system process.
3. Conventional system development is primarily sequential; that is, particular steps are carried out in a particular order. Design cannot be initiated without analysis, testing cannot be done without a design, and so on. In contrast, KMSLC is incremental and interactive. A KM system is not built in a few large steps; rather, it evolves toward a final form. Rapid prototyping as a knowledge capture tool plays a major role in KM system evolution. The flowcharts in Figure 3.1 illustrate these differences.
4. In the development of conventional information systems, testing occurs toward the end of the cycle after the system has been built. In KMSLC, the knowledge

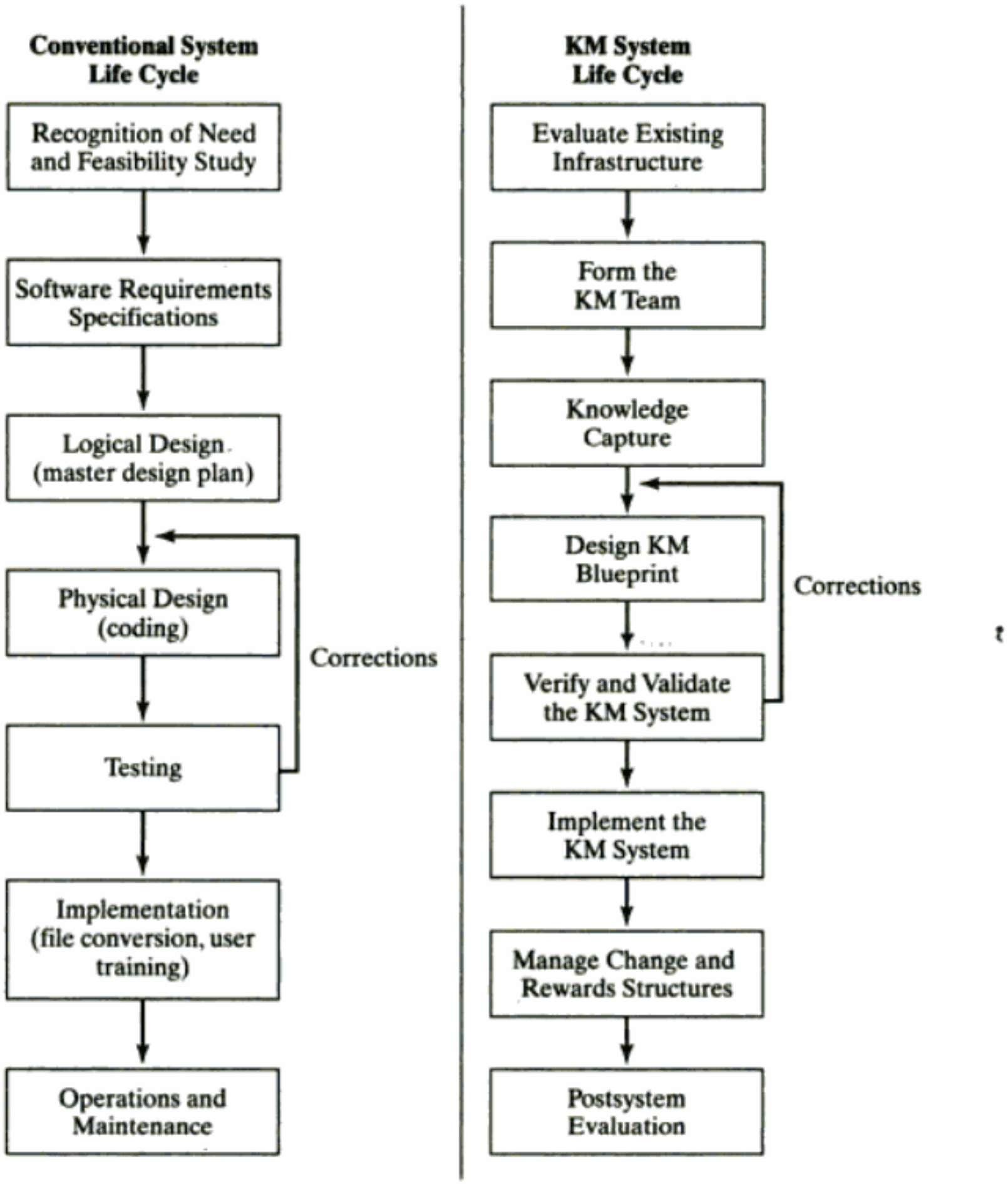


FIGURE 3.1: Comparison of the Development Life Cycles of a Conventional Information System Life Cycle and a KM System Life Cycle

developer tests (verifies and validates) the evolving system from the beginning of the cycle.

5. The discipline of system development and system maintenance is much more extensive for conventional information systems than it is for KMSLC. KM system maintenance is delegated to knowledge editors, whose job is to ensure a reliable system and to upgrade the system to standards.
6. The conventional system life cycle is process-driven and *documentation-oriented*, with emphasis on the flow of the data and the resulting system. It fosters the "specify then build" approach. The KMSLC is *result-oriented*. The emphasis is on a "start slow and grow" incremental process.
7. Conventional system development does not support tools like rapid prototyping because it follows a set sequence of steps. KMSLC utilizes rapid prototyping (to be explain later in the text), incorporating changes on the spot, which augments and refines the KM system until it is ready for use. Thus, the prototype *evolves*

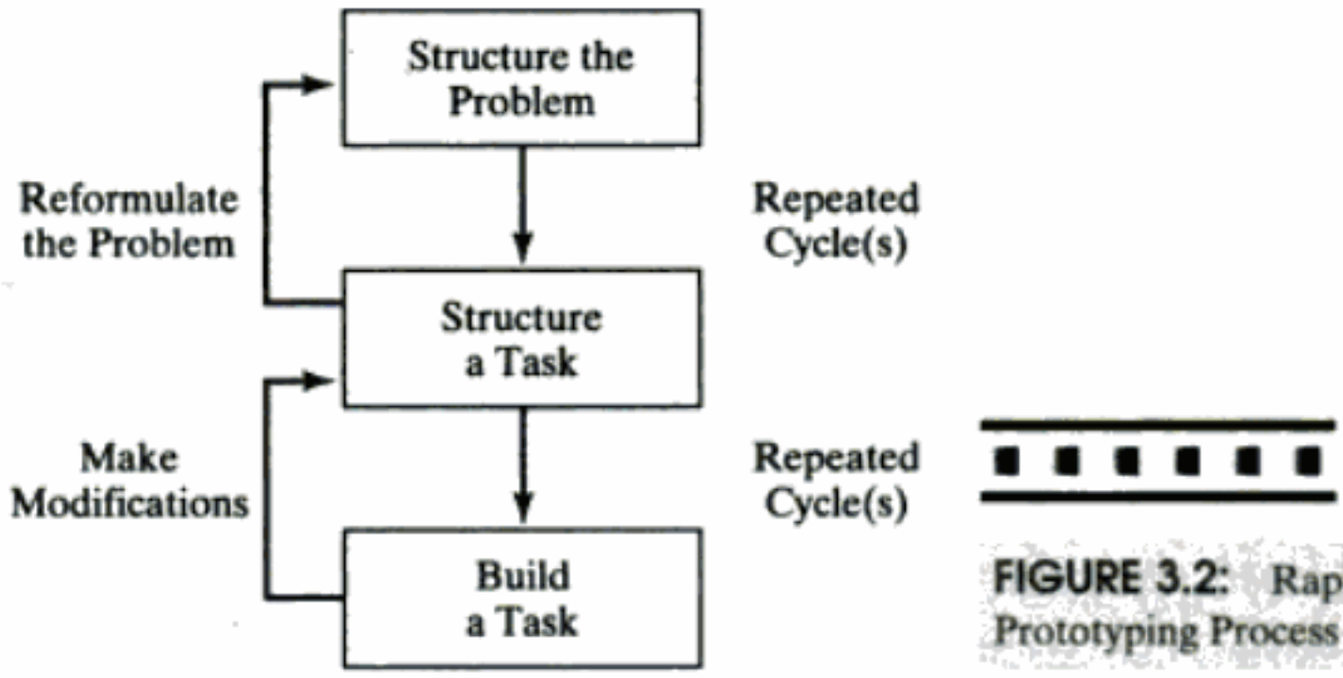


FIGURE 3.2: Rapid Prototyping Process

into the final KM system. As shown in Figure 3.2, in knowledge capture, tasks are structured, and the knowledge sought is reformulated until the knowledge worker or the resident expert judges that it is right. This process promotes verification of the KM system. Verification answers the question, *Is the system built right?* The final test is validation, which ensures that authorized users are satisfied with what the KM system offers.

Key Similarities

Although obvious differences exist between the conventional information system development life cycle and KMSLC, so, too, do certain similarities:

1. Both cycles begin with a problem and end with a solution. The problem solution is pitched to benefit the company user and the organization as a whole.
2. After setting up the strategic plan, the early phase of the conventional system life cycle begins with information gathering to ensure a clear understanding of the problem and the user's requirements. In KMSLC, the early phase requires knowledge capture, which later becomes the foundation of the knowledge base. Both information and knowledge must be represented in order for a system to produce results.
3. Verification and validation of a KM system resemble conventional system testing. Verification ensures that the KM system is clear of errors. This is similar to alpha testing or debugging a conventional system program(s). In contrast, KM system validation and conventional system beta (user acceptance) testing ensure that the system meets the user's requirements prior to deployment.
4. Both the knowledge developer and the systems analyst need to choose the appropriate tools for designing their respective systems. Choice of tools and methodologies will be covered in Chapter 4.

Users Versus Knowledge Workers

Users and knowledge workers have similarities and differences. For example, in terms of cooperation, the user must work with the systems analyst by providing the information or documents needed for building a successful information system. In contrast, the knowledge worker or the expert "owns" the knowledge being shared or given away. Most experts are cooperative, although no knowledge developer should take them for granted. The main difference is that the expert does not have the same vested interest in the system that the user has; in most cases, the expert will not be the final user. Table 3.1 summarizes differences between the user and the expert.

TABLE 3.1 Comparison of Users and Experts

Attributes	*User*	*Expert*
Dependence on the system	High	Low to nil
Cooperation	Usually cooperative	Cooperation not required
Tolerance for ambiguity	Low	High
Knowledge of problem	High	Average/low
Contribution to system	Information	Knowledge/expertise
System user	Yes	No
Availability for system builder	Readily available	Not readily available

Knowledge Management System Life Cycle (KMSLC)

Due to a lack of standardization in the field, several approaches have been proposed for a KMSLC. Some approaches borrow from the conventional system development life cycle; others prescribe steps unique to knowledge management. Table 3.2 lists representative

TABLE 3.2 Alternative Approaches to Knowledge Management Development

Step	*Tiwana (2000)*	*Dixon (2000)*	*Garvin (2000)*	*Liebowitz and Wilcox (1997)*	*Davenport and Prusak (2000)*
1.	Analyze existing infrastructure	Team performs a task	Acquiring knowledge	Build knowledge	Acquisition
2.	Align knowledge management and business strategy	Team explores the relationship between action and outcome	Interpreting knowledge	Organize and hold	Dedicated resources
3.	Design the knowledge infrastructure	Common knowledge gained	Applying knowledge	Distribute and pool	Fusion
4.	Audit existing knowledge assets and systems	Knowledge transfer system selected		Apply knowledge to work object	Adaptation
5.	Design the KM team	Knowledge translated into a form usable by others			Knowledge networking
6.	Create the KM blueprint	Receiving team adapts knowledge for its own use			
7.	Develop the KM system				
8.	Deploy, using the results-driven incremental methodology				
9.	Manage change, culture, and reward structures				
10.	Evaluate performance, measure ROI, and incrementally refine the KMS				

Stage	*Key Question(s)*	*Outcome*
Evaluate existing infrastructure	What is the problem? Is the system justifiable? Is the system feasible?	Statement of objectives Performance criteria Strategic plan
Form the KM team	Who should be on the team? How will the team function?	Standardized procedure for system development
Knowledge capture	What and whose knowledge should be captured? How would knowledge capture proceed?	Acquisition of knowledge core
Design KM blueprint (master plan)	How will knowledge be represented?	Design of KM system Hardware/software implementation details Test plan Security, audit, and operating procedures
Test the KM system	How reliable is the system?	Peer reviews, walkthroughs
Implement the KM system	What is the actual operation? How easy is it to use?	User-friendly system Training program
Manage change and reward structure	Does the system provide the intended solutions?	Satisfied users
Post-system evaluation	Should the system be modified?	Reliable and up-to-date system

FIGURE 3.3: KM System Development Life Cycle

approaches. A cursory examination reveals many similarities and overlaps. We propose a hybrid life cycle that makes best use of the existing ones (see Figure 3.3). A representative knowledge management system is summarized in Box 3.4.

Note that although conventional system development and KM system development differ in some important ways, the two approaches are fundamentally similar. The conventional approach may still be used in developing KM systems, but it is being replaced by iterative design, prototyping, early testing, and other variations.

BOX 3.4

THE LIFE CYCLE OF A KNOWLEDGE MANAGEMENT SYSTEM

BUILDING A KNOWLEDGE MANAGEMENT SYSTEM FROM THE GROUND UP

With the Wall Street scandals of 2002 (Arthur Andersen, Enron, WorldCom), a large commercial bank ordered the development of a knowledge management auditing system to advise the bank on compliance with the federal bank examiners who audit the bank on a quarterly basis. The office of the Comptroller of the Currency (OCC),

(*continued*)

(*continued*)

a bureau of the U.S. Treasury, is the regulator of the national banking system. To oversee this system of 4,500 banks, the OCC administers 125 offices across the country, staffed by 2,500 bank examiners. These examiners range from 25-year veterans to novice assistants.

To create a bank knowledge management auditor or BANKOR, the bank's president formed a knowledge management team consisting of the bank's auditor, a representative from each major department, and a member of the board of directors to launch the project. The senior vice president of the loan department chaired the team. BANKOR's knowledge was captured through extensive interviews with six federal examiners over a 15-month period. Fortunately, one knowledge developer was an examiner, and the other was an IT expert in knowledge management system design.

Interviewing the Examiners Given the serious nature of bank auditing and solvency, six seasoned examiners were chosen for the job. With each examiner coming from different states where the bank does business, this strategy helped BANKOR address everyone's concerns and made it easier to gain universal acceptance. Once selected, the knowledge developers scheduled a weeklong session with each examiner. They held the first interview not really knowing what to expect. They had selected several case studies for the examiners to analyze. The first mistake was that the cases were too obvious. After the first interview, it was apparent that it did not take an experienced examiner to analyze the cases and reach conclusions. So, in preparation for the succeeding interviews the developers selected more complex cases that would require the examiners to wrestle with their own decision-making process and apply true expertise.

Following the first interview, it took 3 months to assemble and collate the captured notes. The developers reduced the notes for an individual examiner's cases to a general conclusion about how that examiner worked. Finally, the developers combined the six methods into one set that described the examiners' consensus.

Taping the sessions was tremendous help. It saved having to write everything down and allowed the developers to concentrate on what was said, and they were better able to probe their thought process for inconsistencies and missing pieces. The transcripts also allowed them to see their responses verbatim.

Three more sessions were held. The fourth and last session used four cases and involved visits to all six examiners. This round was the sign-off for testing the model. During this visit, the examiners analyzed the cases and compared their results with that of the system. After some minor modification, the examiners approved BANKOR as a "fair representation" of their own analyses. At this point, the developers were ready to present the system for final user acceptance testing.

After knowledge capture, the developers designed a blueprint that specified how BANKOR would be codified. They adopted CORVID—a knowledge automation package developed by EXSYS Corporation. In addition, they decided on the implementation and testing details. Testing plays a critical role in the codification of knowledge, using rules. The package is capable of interfacing with databases as well as documented knowledge in various repositories. It also is capable of importing and exporting text information for printout or documentation update.

The bank president turned out to be the best champion of the project. He let it be known that the system must be a winner. He attended several meetings of the KM team and brainstormed issues dealing with auditing procedures and integrity. He also made sure that all details were properly documented for maintenance and future upgrade. The team also became the end user when it was time to test the system. It was totally committed to seeing the system succeed at each phase of the life cycle. The experience turned out to be an effective knowledge-sharing experience.

Evaluate Existing Infrastructure

The basis for a KM system is satisfying a need for improving the productivity and potential of employees and the company as a whole. To do so, we need to gain familiarity with various components making up the KM strategy and supporting technology. Identifying and evaluating the current knowledge environment makes it easier to point out the critical missing gaps and justify the formation of a new KM environment. The psychology behind evaluating the current knowledge infrastructure is giving the perception that the current way of doing things is not conveniently abandoned in preference for a brand new system.

As a part of this phase, we focus on system justification, scoping the evaluation, and determining feasibility. Each step is explained here:

SYSTEM JUSTIFICATION

The goal of this step is for the knowledge developer to justify whether it is worth undergoing the kinds of changes and investment that ensure top management support. KM system justification involves answers to specific questions:

1. *Is current knowledge going to be lost through retirement, transfer, or departure to other firms?* Existing knowledge infrastructure becomes a problem when knowledge workers who have been handling highly complex problems for years suddenly decide to leave or are due to retire, resign, or simply go with the competition. Because replacing company experts whose knowledge has been individually hoarded is not easy to do, a KM system that provides shared expertise could be added assurance for company survival and future growth. In the case of BANKOR (see Box 3.4), the auditing process of existing bank auditors needed verification and possible update to a system that assured federal bank examiner compliance. The need was timely and a necessary step to ensure integrity of operation.
2. *Is the proposed KM system needed in several locations?* If a company has only one expert to handle a particular problem at a given time, similar problems in other locations have to wait for the expert's attention or someone in that location might have to address the problem from scratch. (This is why it took more than 18 months to put out the fires in Quwait's 650 oil wells after the Gulf War.) In such a case, a KM system can be used to distribute application expertise uniformly throughout a company's facilities.
3. *Are experts available and willing to help in building a KM system?* Without reliable knowledge or knowledge workers, there can be no knowledge-based system. For certain complex problems, a knowledge developer may have to work with several knowledge workers, although dealing with several knowledge workers presents all kinds of knowledge capture or validation challenges. With the BANKOR project, multiple examiners were needed to ensure consistency of decision making, especially with the bank doing business in several states.
4. *Does the problem in question require years of experience and cognitive reasoning to solve?* One indicator that a problem might be a candidate for a KM system is its nonprocedural or nontrivial nature. If the knowledge can be learned in a few weeks and the pattern of solution is routine, then the problem is probably not sufficiently heuristic to qualify for a KM system application. With BANKOR, years of practical experience were required for bank auditing.
5. *When undergoing knowledge capture, can the expert articulate how the problem will be solved?* The ability to explain a procedure or illustrate how a problem is to be solved is not a skill everyone possesses. Often, the more of an expert a person

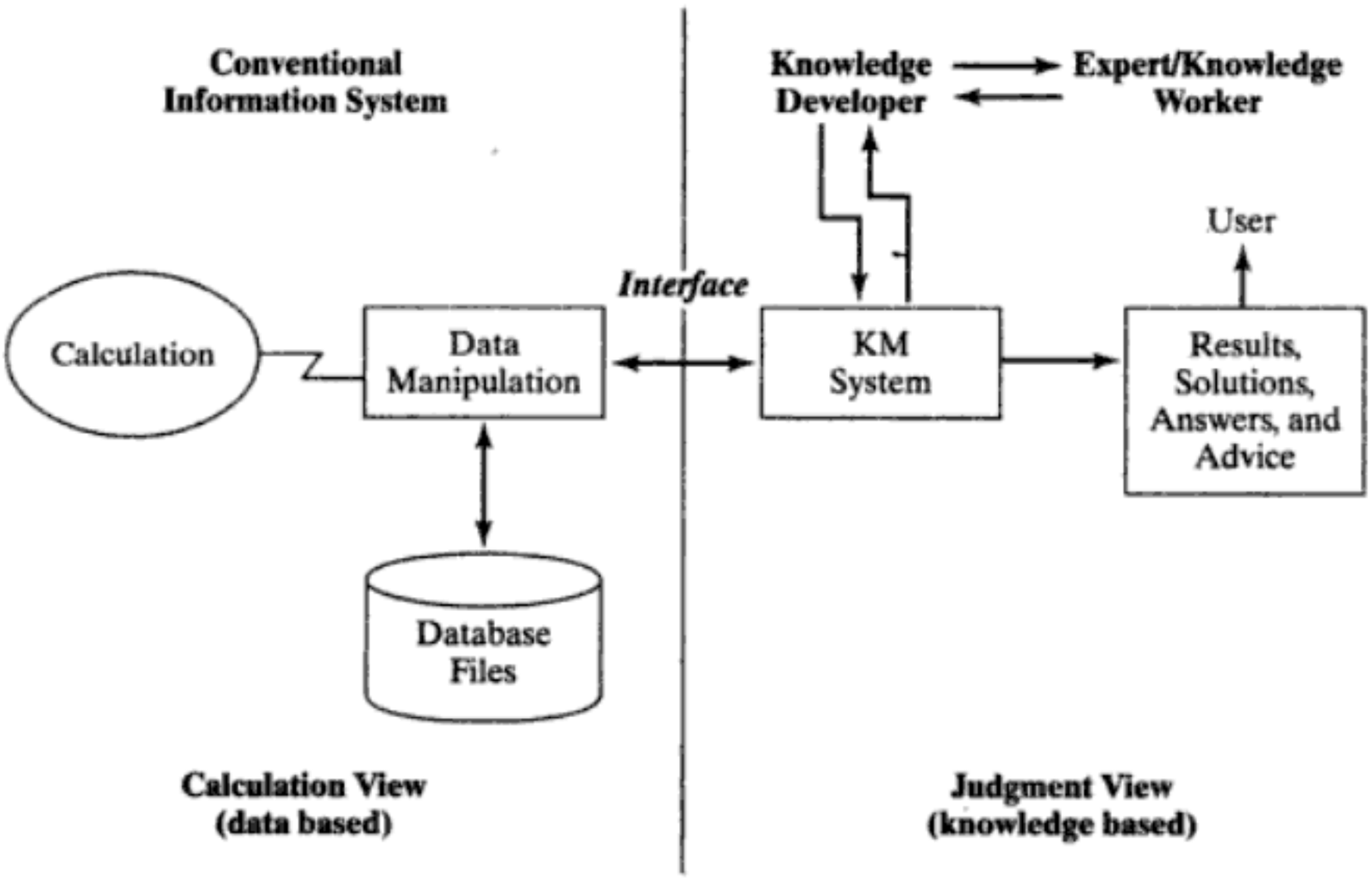
is, the more difficulty that person has explaining a complex procedure or a solution. One of the main obstacles is explaining heuristics. In order to do this, experts must dig into their deep knowledge and verbalize stored heuristics. For the process to work, the knowledge developer must also have good communication and interpersonal skills to elicit the expert's responses.

6. *How critical is the knowledge to be captured?* Criticality of an application has to do with how vital it is to the company's survival or productivity. A project that is considered a reaction to a recent catastrophic failure in an area of the firm's operation deserves close evaluation. The BANKOR project was a reaction to the corporate scandals resulting from devious auditing corruption.
7. *Are the tasks nonalgorithmic?* That is, are heuristics used to solve the problem? The problem domain should be considered a judgment maker rather than a calculation processor. Conventional software performs calculations on data to produce information; a KM system takes information and transforms it into knowledge and practical advice. See Figure 3.4 for a comparative view of the two systems.
8. *Is there a champion in the house?* For a KM system to succeed, it must be supported from within the organization. The organization must have a champion who believes that a KM system can be beneficial for the company and is willing to support its development aggressively. The champion is often in a good position to coordinate the development of the system. Such a person usually has credibility with the employees, understands their concerns, speaks their language, and knows the key people in the organization. With BANKOR, the president was popular with bank officers and employees, even though he had been president for less than 2 years. His enthusiasm and honesty got the team to work overtime many days at a time.

The Scope Factor

When deciding how large the KM system should be, it is important to "scope" the project first. The term *scoping* means "limiting the breadth and depth of the project within the financial, human resource, and operational constraints." The project should

FIGURE 3.4: Calculation and Judgment Views in Problem-Solving



be small enough for the knowledge developer's capabilities, especially if it is the organization's first attempt at developing a KM system. It must also be completed quickly enough for the users to foresee its benefits. A complex, drawn-out project whose development takes months and years is likely to falter on the way to completion or cause the user to lose patience and interest, which makes training and successful use difficult.

As part of the scoping factor, several areas must be included:

- Readiness of the company's current technology. This includes intranet, local area networks, extranet (a company's extended network connecting suppliers, customers, and salespersons), decision support tools, and other information technology tools.
- Identification of gaps and areas needing improvement in current technology to see how well such technology will match the technical requirements of the proposed KM system.
- General review and understanding of the benefits and limitations of KM tools and components that become part of the feasibility study.

The Feasibility Question

The first phase to consider is feasibility. A feasibility study addresses the following questions:

- Is the project *doable?* Can it be completed within a reasonable time?
- Is it *affordable?* Do the system's potential benefits justify the cost of development?
- Is it *appropriate?* Just what can the firm expect to get out of it?
- Is it *practicable?* How frequently would the system be consulted and at what cost?

In BANKOR's experience, the project was clearly doable, affordable, appropriate, and practicable, because the bank wanted to be the leader in demonstrating integrity and reliability to customers, stockholders, and federal examiners. Actually, the project had to be carried out, given the sensitivity of accurate auditing in the banking sector.

Including an assessment of costs against tangible and intangible benefits, these questions evaluate the project in detail. The result of the study is a proposal that summarizes what is known and what is going to be done. Once approved by top management, it paves the way for KM system design. Although a feasibility study is not considered a formal part of KM system development, identifying the proposed system's many ramifications (economic, technological, and behavioral) is necessary front-end work. This way, there should be no surprises. Attempting such a project makes no sense unless the heart and soul of the company are committed to the effort, especially if it is the organization's first KM system.

Economic feasibility, better known as *cost/benefit analysis*, determines to what extent a new system is cost-effective. *Technical* feasibility is determined by evaluating the hardware and supportive software within the framework of the company's IT infrastructure. *Behavioral* feasibility includes training management and employees in the use of the KM system. All these factors must be viewed collectively for a successful installation.

The traditional approach to conducting a feasibility study could be useful in building a KM system. It involves several tasks:

- *Form a KM team.* Forming a KM team means formalizing a commitment to the KM development process. Team members are selected from various areas in the organization; selection is based on criteria designed to bring the best representatives for the duration of the project. This is exactly what was done to form the

KM team for BANKOR. There was fair representation of both talent and departments on a full-time basis.

- *Prepare a master plan.* A master plan lays out the steps to be taken throughout the life cycle of the project. It could be a physical representation like a flowchart that specifies the activities to be carried out and the relationships among the activities.
- *Evaluate cost/performance of the proposed KM system.* In this phase, the key question is "What are we getting in return for the cost of building this new KM system?" The terms used are *breakeven analysis* and *payback analysis.* Breakeven is the point at which the costs of the current and the proposed systems are equal. Beyond that is net savings or net benefits. Payback is deciding how long it will take a system to produce enough savings to pay for developmental costs.

  Essentially, performance criteria are evaluated against tangible and intangible costs to determine the most cost-effective system. Obviously, the more tangible the costs, the easier it will be to measure the benefits. It is often the case that the benefits are more intangible than tangible, which makes it difficult to sell to top management (see Box 3.5).
- *Quantify system criteria and costs.* There are various metrics to do so. One procedure for quantifying system criteria is as follows:
  - Determine a weight factor for each criterion based on its perceived impact on the system.
  - Assign a relative rating to each criterion. For example, on a scale of 1 to 5, 1 is rated "poor" and 5 is rated "excellent."
  - Multiply the weight factor by the relative rating and sum the score for each alternative system. Table 3.3 shows an example of a weighted candidate evaluation system compared to the existing or an alternative one. Assuming the weight and rating factors are accurate, the system with the higher score is judged to be the better system. Additional supportive information would be helpful in reinforcing the choice.

In summary, several factors must be considered in identifying an appropriate KM system. Many such projects fail because of poor front-end evaluation. Also, without a champion or someone within the firm who can support and promote the project at all times, the project is likely to fall by the wayside.

Importance of User Support

In conventional information systems, systems analysts often build the system and then worry about selling it to the user through demonstrations and training. Such "selling" should begin early in the development process. The same is true with KM systems. The user should be sold on it early in the KMSLC. At this stage of the development life cycle, a knowledge developer needs to address a number of questions:

- Does the intended user know the new KM system is being developed? How is it perceived?
- How involved should the ultimate user be in the building process?
- What user training will be required when the KM system is up and running?
- What operational support must be provided?

These questions prompt idea generation. They help determine whether the proposed KM system is doable and justifiable; they also allow a move to the next step, knowledge capture. Without an honest "sell" to the user, all kinds of problems can arise when it is time to implement the system. Upper management should also give its blessing to the project early by allocating sufficient resources for its development.

BOX 3.5

VALUATION OF KNOWLEDGE CAPITAL

CALCULATING KNOWLEDGE CAPITAL

The valuation of knowledge capital makes it possible to assess the worth of the people who possess the accumulated knowledge about an organization. They are the individuals who leave the workplace every night (and may never return), storing in their heads the know-how acquired while receiving full pay. Their brains are repositories of knowledge accumulated over untold hours of listening and talking while not delivering any goods or services to paying customers.

The employees' minds, and the files they manage, carry a share of the company's knowledge capital. This makes every employee a custodian of the most important assets a firm owns, even though these assets never show up on any financial reports.

In contrast, the custodianship of financial assets has become a well-defined discipline that depends on procedures and regulations on how to account for and report these resources. Over a period of many years, an elaborate framework involving accounts, auditors, reporting standards, and government oversight has been developed to do that. The financial assets of corporations represent only a small share of total corporate assets. By far, the most important assets are now in the form of corporate knowledge, but the custodianship, accounting, and reporting standards for these resources do not exist.

Financial executives have shown a remarkable reluctance to put numbers on something many consider to be intangible. However, with the rising importance of knowledge assets, the time has come to place the management of knowledge on the agenda of executive managers, financial analysts, and shareholders. To that end, one must start by developing an independently verifiable quantification of the worth of knowledge assets.

The allocation of the respective contributions of knowledge capital and financial capital to profits can be made if one recognizes that financial capital is now a commodity—readily available at a price that reflects the interest rate that a firm pays for its borrowings. However, what makes a company prosper is not financial capital—which anyone can obtain for a price—but the effectiveness with which knowledge capital is put to use. Therefore, the annual returns realized on knowledge capital can be isolated after paying a "rental" for the financial capital and then subtracting that amount from the profits.

What remains is "economic profit," or the economic value-added, because it accounts for those missing elements that represent everything not shown on a conventional balance sheet. By filtering out the contributions of financial capital from the reported profits, we are left with a residual that is entirely attributable to what knowledge capital has actually delivered. In other words, knowledge value-added is the annual yield a firm realizes from its knowledge capital assets.

SOURCE: Excerpted from Strassmann, Paul A. "Calculating Knowledge Capital," files.strassmann.com/pubs/km/1999-10.php, October 1999. Date accessed August 2002.

In summary, the first step in the KMSLC is to decide what is wanted, identify the goals of the proposed system, assess feasibility, plan how to begin, locate a champion, inform users and their managers of the project, and gain their support within the scope of the project. Above all, every KM system must begin with ready knowledge, knowledgeable experts ready to work with a knowledge developer in building the infrastructure.

TABLE 3.3 Weighted Evaluation Matrix

		System A		*System B*	
Evaluation Criteria	***Weight***	***Rating***	***Score***	***Rating***	***Score***
Performance					
Knowledge quality	4	5	20	4	16
System reliability	2	4	08	4	08
Knowledge currency	3	4	12	3	09
Costs					
Payback	2	3	06	4	08
System development	4	4	16	3	12
System operation	3	4	12	3	09
User training	5	5	25	3	15
			99		78

Role of Strategic Planning

As with any other application, there are concerns to ponder before launching a new system. Issues such as planning your new KM system, selling it to the employees and top management, providing good service and maintaining security—all take on a new meaning when applied to KM development and support. As a consequence of evaluating the existing infrastructure, the company should devise a strategic plan with vision aimed at advancing the short-term and long-term objectives of the business with the KM system in mind.

What is being emphasized is the ultimate goal of a KM system—connecting users with knowledge content. That is why it is so important to review knowledge needs throughout the company and to inventory knowledge content assets that you wish to capture. It is risky to plunge ahead before strategizing. Consider the following areas:

- *Vision*—What is your business trying to achieve? How will it be done? How will the KM system fulfill the goals? How will you measure success?
- *Resources*—How much can your business afford to build the right KM system? Is there talent aboard that can take the responsibility and assure that vision becomes reality?
- *Culture*—Is your business politically amenable for coordinating efforts to support this new approach to knowledge sharing? Who will ultimately control the KM system's content and user feedback?

Once business strategy is made final, the next step is to demonstrate a viable link between KM and strategy. The idea is to elevate KM to the higher level of strategy and ensure that the final system is in compliance with strategy. Related to this step is the importance of analyzing knowledge gaps (things that need corrections or additions) and relating them to strategic gaps. There is also the need to determine the right questions to ask and to package knowledge as part of the proposed KM system. The upshot is to use knowledge to create value for the product, the service, or the organizational process.

Figure 3.5 illustrates the relationship between and the need to match business strategy with that of KM strategy early in the KM system life cycle. Threats and feedback

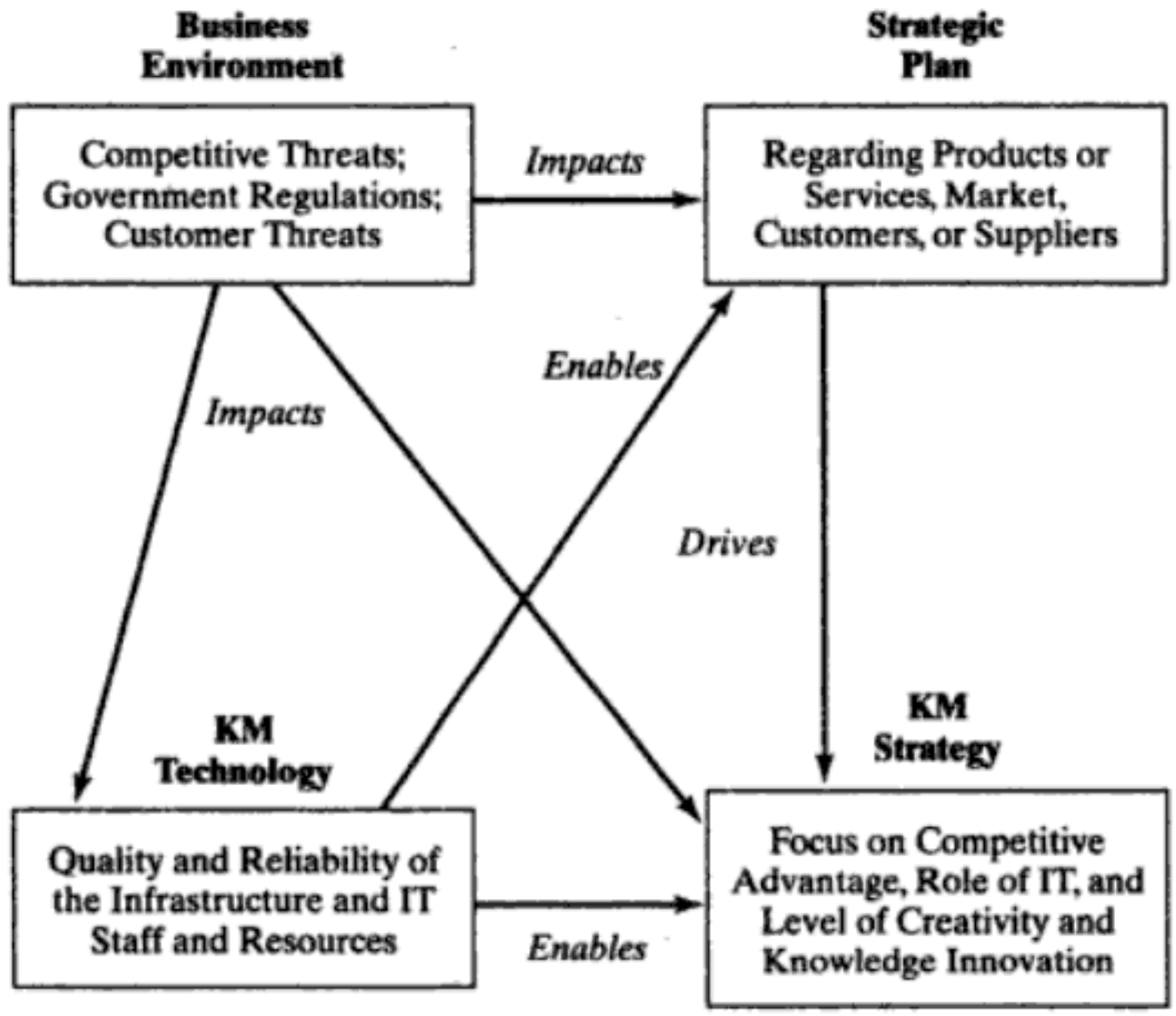


FIGURE 3.5: Matching Business Strategy with KM Strategy

from the environment (such as government regulations, customers, and competitive threats) impact business strategy on a day-to-day basis. Likewise, the business environment impacts both KM strategy and KM technology, which enable KM strategy. The strategic plan, in turn, drives KM strategy, which means that KM strategy must be within the framework of the company's strategic plan for it to work and be supported by top management.

Form the KM Team

After evaluation of the company's existing infrastructure is complete, a KM team should be formed; this team stays with the building process until the final installation. Forming a KM team means:

- Identifying the key units, departments, branches, or divisions as the key stakeholders in the prospective KM system. Each stakeholder unit has certain knowledge requirements and one or more experts who could represent the unit on the KM team. In forming the BANKOR KM team, a representative from every department involved in the federal examiners' quarterly bank audit was included in the KM team. Each member brought unique knowledge and cited specific audit strategies that were tested through knowledge capture; the outside examiners acted as experts.
- Balancing the team size and competency organizationally, strategically, and technologically. In other words, the KM team should have a balanced complement of experts in each of these areas to collaborate on the multidimensional nature of the KM system building process.

Teamwork can be pleasurable and smooth running or it can be fraught with problems. Team success depends on a number of factors:

- *Caliber of team members in terms of personality, communication skills, and experience.* Engaging personalities with good communication skills usually do better at

problem-solving and conflict resolution than laid-back personalities. Also, team members with experience in a specific domain garner attention and respect within the team.

- *Team size.* There should be representation with qualifications. In a large multinational firm, where there are hundreds of departments or divisions, a representative from each area would make teamwork unwieldy and counterproductive. Based on the author's consulting experience, team size from 4 to 20 is manageable. Beyond that, a team is divided into subcommittees with more distinctive assignments. When that happens, things tend to drag, and coordination among subcommittees becomes a challenge.
- *Complexity of the project.* The complexity of a KM system depends on the size of the organization, the nature of the products, the level of sophistication of existing technology, and the expertise of team members. Working against a tight deadline can also make the project more difficult to handle. In the case of BANKOR, the KM system was extremely complex, especially with the tax and regulatory requirements of the states in which the bank conducted business.
- *Leadership and team motivation.* Effective leadership can generate motivation, cooperation, and coordination within the team to ensure a successful outcome. Team motivation means a volunteering spirit and willingness to devote time for the KM system building process. This is influenced by the size of the team, the perceived level of expertise of each team member as compared to other team members, and how freely team members are encouraged to participate.
- *Promising more than can be realistically delivered.* There is nothing worse for a team than to build high hopes for top management when the odds are stacked against such achievement. Underestimating factors such as development costs and outcomes beclouds credence of the team to deliver with integrity.

Knowledge Capture

In the third step in the KMSLC, knowledge capture takes on several directions and meanings. Briefly, explicit knowledge is captured in repositories from documentation, files, and other media. In contrast, tacit knowledge is captured from company experts and from knowledge stored in databases for all authorized employees. Data mining also enters the picture in terms of using intelligent agents that analyze the data warehouse and come up with new findings that could lead to new products or services.

The focus of Chapter 5 is on capturing tacit knowledge by using various tools and methodologies. Knowledge capture involves eliciting, analyzing, and interpreting the knowledge that a human expert uses to solve a particular problem. It corresponds to systems analysis in conventional system development. In both cases, interviews with knowledgeable people are used to capture information and knowledge. Sometimes, interviewing the ultimate user of the knowledge management system is just as important as interviewing the expert whose knowledge you are trying to capture.

In KM system development, the knowledge developer acquires heuristic knowledge from the expert(s) in order to build the knowledge base. In Chapter 4, we discuss problems and procedures in the knowledge capture process. For example, the user has more to gain from the knowledge base than the expert who is helping to build it. The expert hands over years of knowledge for a system that someone else will use. The benefits are not the same, which explains some experts' lack of cooperation and motivation throughout the system development life cycle.

Knowledge capture and transfer are often carried out through teams, not just through individuals. As shown in Figure 3.6, common knowledge is created by asking a

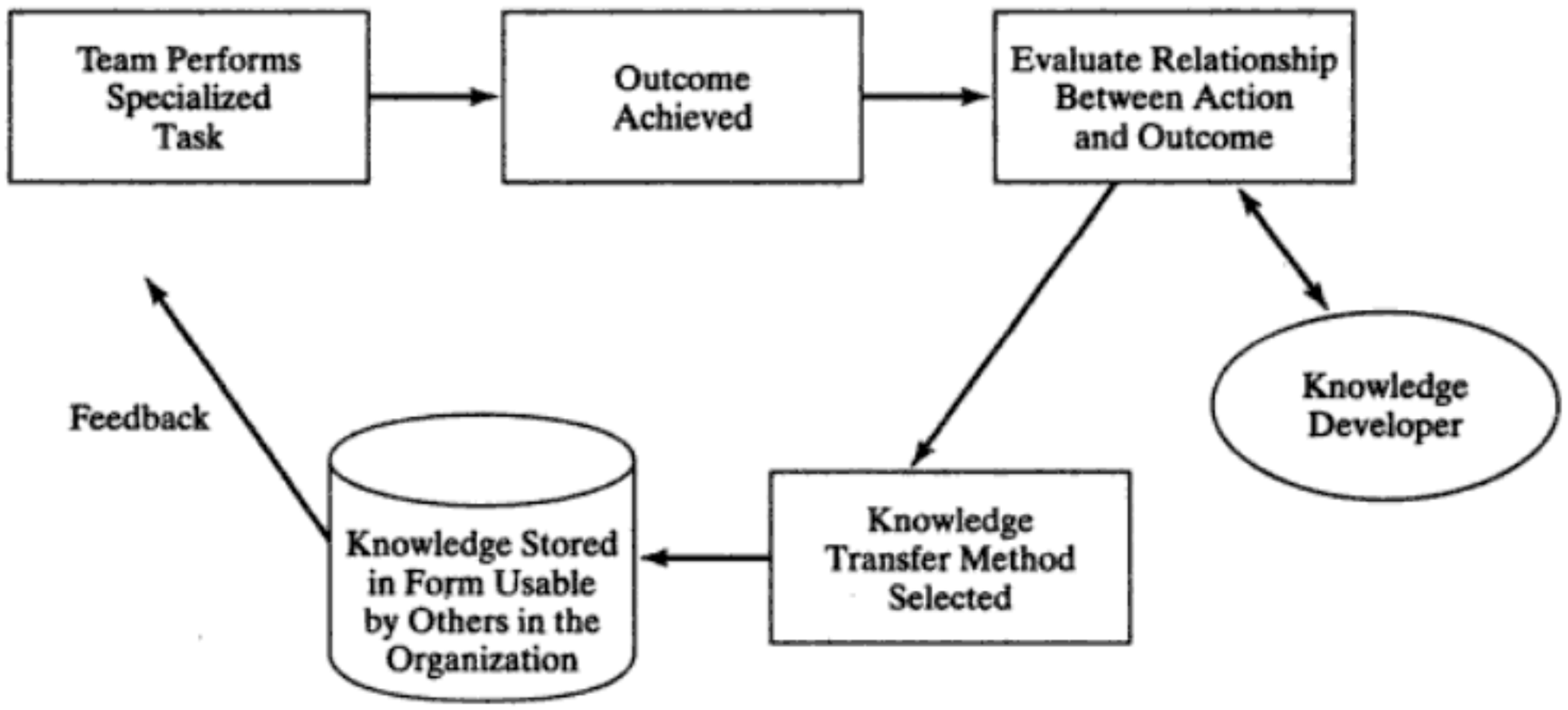


FIGURE 3.6: Knowledge Capture and Transfer Through Teams

team to perform a task. After the outcome is achieved, the knowledge developer explores with the team the relationship between team action and outcome. If the team agrees that common knowledge has been gained, it becomes available in a knowledge base by translating it into a form usable by others in the organization. It can be in the form of a document, a case with rules and parameters, or a scenario.

Knowledge capture plays a unique role in various phases of the KMSLC. As shown in Table 3.4, knowledge capture includes determining feasibility, choosing the expert, tapping the expert's knowledge, and retapping knowledge to plug gaps in the system and to verify and validate the knowledge base after the system is in operation. So, in KMSLC, knowledge capture is an evolving step, not a one-time, front-end step as it is in conventional information system development.

TABLE 3.4 Knowledge Capture Activities in the KMSLC

KMSLC Step	*Knowledge Capture Activity*
1. Determine feasibility	• Seek out a champion • Locate a cooperative expert
2. Capture knowledge	• Apply appropriate tools to capture expert's knowledge
3. Design KM blueprint	• Design KM architecture
4. Verify and validate the KM system	• Correct for knowledge integrity and work closely with expert through rapid prototyping
5. Implement the KM system	• Work with the user to ensure system acceptance and proper training
6. Manage change and reward structure	• Reinforce change and reward compliance through human resources
7. Evaluate postsystem	• Recapture new knowledge and update the knowledge base

ROLE OF RAPID PROTOTYPING

Most knowledge developers use an *iterative* approach in knowledge capture, which means a series of repeated actions. For example, the knowledge developer starts with a small-scale system, a *prototype,* based on the limited knowledge captured from the expert during the first few sessions. What turns the approach into rapid prototyping is the following:

- The knowledge developer shows the expert a skeletal procedure based on rudimentary knowledge acquired from the expert during the past two sessions.
- The expert reacts by saying, "This is all right, but there's more to it. Let me tell you what you need to incorporate into this prototype . . ." This is precisely how the knowledge developers in the BANKOR system conducted their interviews.
- While the expert watches, the knowledge developer enters the additional knowledge into a computer-based system that represents the prototype.
- The knowledge developer reruns the modified prototype and continues entering additional knowledge or making modifications as suggested by the expert until the expert says, "This is about right. I think you've got it this time."

This spontaneous, iterative building of a knowledge base is referred to as **rapid prototyping**. The process continues through several sessions and weeks of work until the knowledge base moves out of the prototype stage and becomes a full-fledged knowledge base that is ready for use. Rapid prototyping is essential for large systems, because the cost of a poorly structured system that is unusable can be prohibitive. Other benefits of rapid prototyping include the following:

- It documents for the expert and others that progress is being made on the project.
- Mistakes can be quickly corrected.
- The system is tested each time new knowledge or modifications are incorporated.
- It yields a tangible product at an early stage.
- The system "grows" in step with increasing understanding of what the user will learn and how the expert will provide it.
- It promotes accelerated knowledge capture.
- It demonstrates the capabilities of the resulting knowledge base.

The "smash and grab" approach—in which the knowledge developer "grabs" the attention of the expert for a few hours over a few sessions and ends up with a "workable" knowledge base—is not recommended. Remember that knowledge bases are based on human heuristics (rules of thumb) and human knowledge, not on quantitative or syntactic data. Rapid prototyping fosters maturation and "value-added" activities. It requires patience, concentration, and knowing how to make changes on the fly without errors.

SELECTING AN EXPERT

In expressing their differing views about the nature of expertise, some argue that the entire breadth of human expertise must be studied before attempting to capture the knowledge necessary to build a knowledge base. Others support a narrower focus that limits the role of the expert to knowledge capture activities. In either case, the goal is a knowledge base that represents expertise, rather than the expert.

In working with the expert, the knowledge developer will occasionally run into vague expressions of thought or reasoning processes that must either be clarified by the expert or factored into the system. For example, "fuzzy" expressions can be assigned certainty factors to reflect the extent of "fuzziness" of the expression. Certainty

factors require careful analysis to assure proper representation in the knowledge base. In fact, much of the knowledge that the expert provides is based on heuristics, which tend to be qualitative, rather than quantitative.

Finally, a competent and cooperative expert is essential to the success of knowledge capture. The expert must be able to communicate information understandably and in sufficient detail. The questions that face every knowledge base project are as follows:

- How can one know that the so-called expert is in fact an expert? In the example of BANKOR, the examiners were certified and each had more than 10 years' experience.
- Will the expert stay with the project to the end?
- What backup is available in case the expert loses interest, decides to leave, or simply is no longer available?
- How is the knowledge developer to know what is and what is not within the expert's area of expertise?

Sometimes, either because of the nature of the problem or its importance to the organization, more than one expert should be involved in addressing the problem domain. Dealing with several experts is not an easy task. The knowledge developer may have to use different tools in different ways to access the experts' knowledge and promote agreement among them before the captured knowledge becomes part of the knowledge base. Dealing with single and multiple experts is discussed in Chapter 5.

ROLE OF THE KNOWLEDGE DEVELOPER

The knowledge developer is an important player in the KMSLC. As explained in detail in Chapter 4, he or she is the *architect* of the system. This one person identifies the problem domain, captures the knowledge, writes and tests the heuristics that represent the knowledge, and coordinates the entire project from beginning to end.

Such a pivotal job requires certain qualifications. The most important attributes are excellent communication skills, an understanding of knowledge capture tools, familiarity with technology, tolerance for ambiguity, ability to work well with other professionals including experts, being a conceptual thinker, and having a personality that motivates people to work together as a team. The knowledge developer's job requires interaction with a number of individuals throughout the KMSLC. The most frequent interactions, shown in Figure 3.7, are with the organization's knower(s), the knowledge worker, and most likely, the champion. Each person can make or break the project. In the case of BANKOR, the knowledge developers had a great rapport with the president, whose time and effort championed the application through implementation.

Design the KM Blueprint

This phase is the beginning of designing the IT infrastructure and the knowledge management architecture. The knowledge management team relies on such a blueprint to proceed with the actual design and deployment of the KM system. A KM blueprint, referred to as the *KM system design,* addresses several important issues. Once created, the next step is to actually put together the KM system.

1. Aim for system interoperability and scalability with existing company IT infrastructure.
2. Finalize the scope of the proposed KM system with realized net benefits in mind.
3. Decide on the required system components, such as user interface options, knowledge directories, and mining tools.

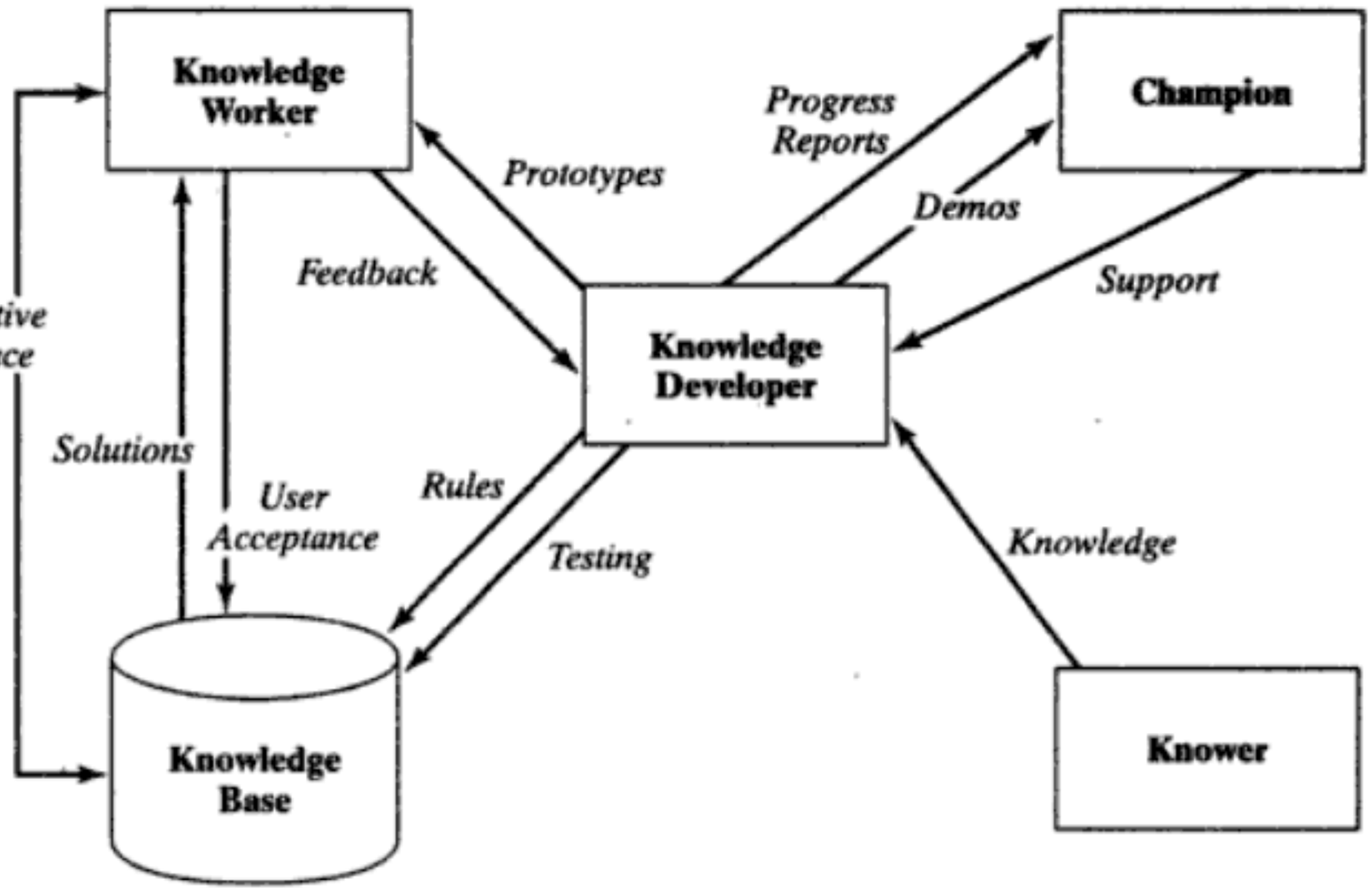


FIGURE 3.7: The Central Role of the Knowledge Developer

4. Develop the key layers of the KM architecture to meet your company's requirements. As shown in Figure 3.8, the key layers are as follows:
   a. The *user interface* is what the user sees and works with in terms of accessing and working with the knowledge base and other repositories. Without an effective user interface, even the best KM system is bound to fail. A browser is used to link the user to the Internet.
   b. The *authentication/security layer* screens incoming requests for security purposes. For example, firewalls are installed by the company's IT department to ensure that certain files do not leave company premises or certain incoming information does not contaminate existing repositories. Passwords and other authorization protocols are used to ensure integrity of the knowledge base and reliability of the overall systems at all times.
   c. *Collaborative agents and filtering* are designed to provide a near-personalized presentation of knowledge or information to meet the user's requirements. **Intelligent agents** (specialized software) are employed to do "intelligent" searches in a database, knowledge base, or other repositories to expedite user requests and display the right information.
   d. The *application layer* is used to communicate with the actual application in use. This is where the user begins to do something useful with the networks—browsing a Web site, sending e-mail, or transferring a file between file servers and client computers. It answers the question "What information do I send to my partner?" It is simply two useful programs talking to each other. It also defines request and response formats. For example, an e-mail client browser program talks to the e-mail server program, saying something like "Deliver this message to ema3z@virginia.edu." Remember that each type of program (e-mail, file transfer, and so forth) has its own protocol. The application layer protocol assumes that the next layer down (transport layer) will take care of passing the message along to the destination.

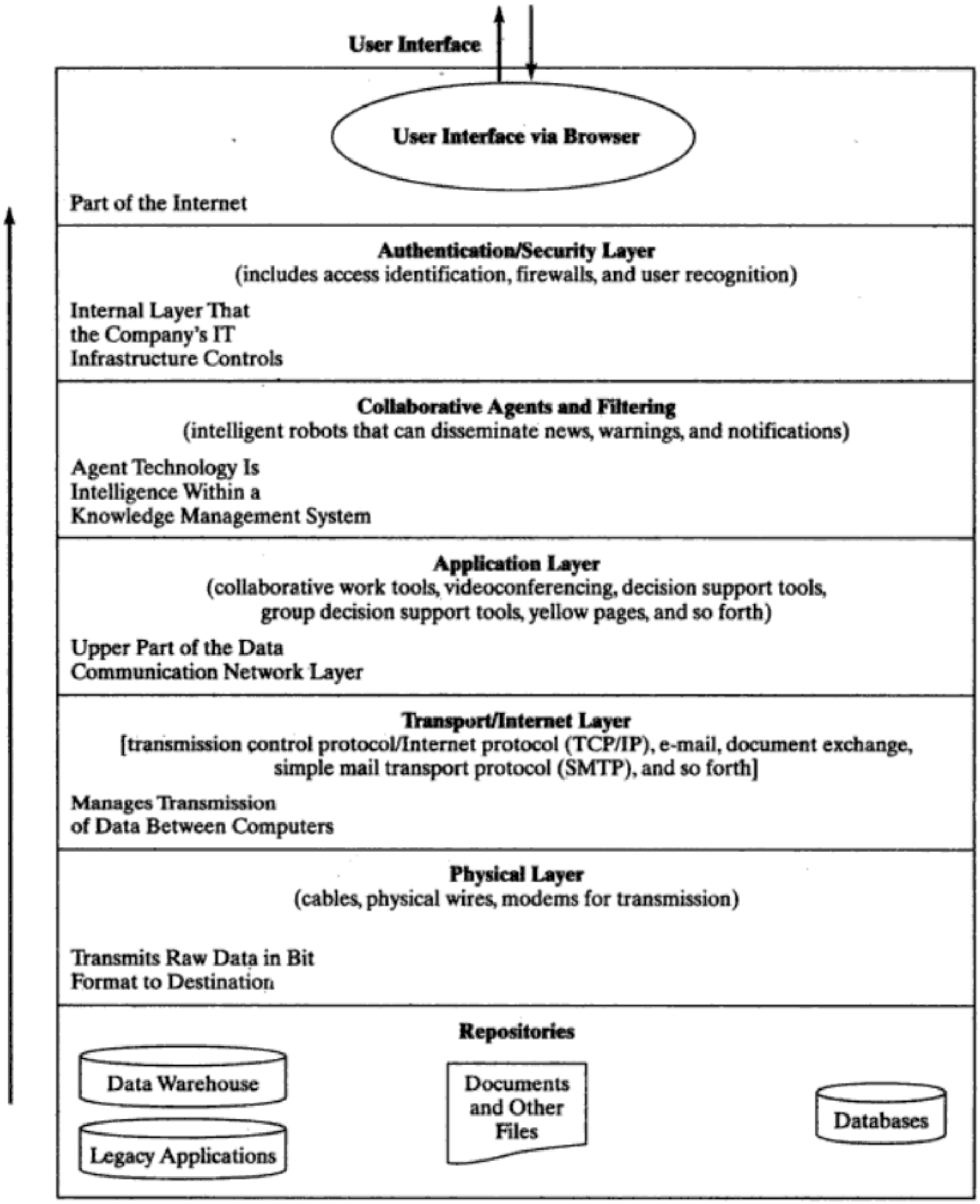


FIGURE 3.8: Key Layers of a KM System Infrastructure

SOURCE: Adapted from Tiwana, Amrit. *The Knowledge Management Toolkit.* Upper Saddle River, NJ: Prentice Hall, 2000, p. 309.

Remember that there are standards that specify how two application programs should communicate at the application layer. For example, in Web service, there is a program called "browser" that resides on the client PC and a Web server application program on the Web server. The standard on the application layer is the hypertext transport protocol, or HTTP. Its function is to govern requests and responses between the browser and the Web server application program. It is usually the beginning of a Web address in the form

of http://. E-mail uses other applications that use different application layer-standards such as SMTP (simple mail transfer protocol) and POP (point of presence) application layer standards to send and receive e-mail, respectively.

e. The *transport Internet layer* is the most critical part of the KM network system. The function of the transport layer is to manage the transmission or the flow control of data between two computers or across a network. It also allows two computers to communicate, even if the computers were made by different vendors. The standard for the transport layer is **transmission control protocol (TCP)**, which specifies how two host computers will work together.

   In contrast, the Internet layer routes messages across multiple nodes of networks for delivery. It also handles network congestion to minimize performance problems. A typical message is "Send this packet to computer number 190.172.63.08 via computer number 123.32.12.14, which is on a network one hop away." The standard for routing messages is **Internet protocol (IP)**. TCP and IP work together, and that is the reason that in the literature you always see them as TCP/IP.

f. The *physical layer* is the lowest layer in the journey of a message from source to destination. It converts bits into signals for outgoing messages and signals into bits for incoming messages. It answers the question "How do I use the medium (cable, physical wiring) for transmission?" The physical layer also uses modems (telephone network standards) to transmit the message as raw data to the destination. Modems are used only to link a user host to the first router (a box with intelligent software that routes messages to other routers).

g. *Repositories* are hard disks or storage devices that hold explicit and tacit knowledge and the rules associated with them. Other repositories include legacy (old or traditional applications like accounts receivable) databases, Web databases, e-mail databases, and UNIX databases.

Test the KM System

The testing phase involves two steps: a verification procedure and a validation procedure. A **verification** procedure ensures that the *system is right*—that the programs do what they are designed to do. The internal makeup of the system is checked to see that the right knowledge is available when needed in the format needed and that any rules will fire when they are supposed to fire. In this way, the technical performance of the system is evaluated.

The second procedure is called **validation**. This test ensures that the system is the *right system*—that it meets the user's expectations, that it is user friendly, and that it will be usable and scalable on demand. Validation provides assurance that the solutions or advice derived from the knowledge management system comes close enough to that of the human expert. In other words, the validation process checks reliability of the knowledge management system. In the case of BANKOR, the system was initially tested weekly to see how well the bank met the federal regulatory audit procedures. Several changes had to be made because of oversight on embedding old auditing requirements into the current system. Also, a money laundering module had to be rewritten to reflect the changes made after the federal government began to track Bin Laden's assets in the United States and abroad.

Validation of KM systems is not foolproof. System validation is a long-term item: Human experts must monitor system performance continually. Eventually, systems will be able to renew their certification and vouch for their own reliability.

Implement the KM System

Once the appropriate knowledge has been captured, encoded in the knowledge base, verified, and validated, the next task of the knowledge developer is to implement or deploy the proposed system on a computer or a server. **Implementation** means converting a new KM system into actual operation. **Conversion** is a major step in implementation. The other steps are postimplementation review and KM system maintenance. Another way of looking at implementation is that it is the transformation of a precise representation of knowledge into a machine-executable equivalent—a specific program or software package.

ROLE OF QUALITY ASSURANCE

Quality assurance is the development of controls to ensure a quality KM system. This feature is actually emphasized in every stage of the system development process. The goal is to have as error-free and reliable a system as possible. Knowledge developers under time and budget constraints could compromise quality, especially during knowledge capture. The chief knowledge officer (CKO) has the responsibility to ensure that every step in knowledge management is error-free.

There are several kinds of errors to look for in knowledge base design:

- *Reasoning errors.* Errors can occur in inductive or deductive reasoning. An example of an inductive reasoning error is *This firm has never had a layoff. Therefore, it will never have a layoff in the future.* The likelihood of error is higher if this conclusion is accepted. Likewise, a deductive reasoning error is *If you are pregnant, then you will be overweight.* The deduction that pregnancy causes weight gain does not apply in *all* cases. Even if it did, one must still consider the question of how much weight is "overweight." Such issues are illustrative of fuzzy logic, covered in detail in expert systems courses.
- *Ambiguity.* A statement is ambiguous when it has more than one meaning or can be interpreted in more than one way. For example, "Sell the bad stock" is an ambiguous directive. Which stock is bad? What is meant by "bad"? How bad is "bad"? The subjective nature of decision making in such a case raises questions of validity, reliability, and integrity of the decision and, therefore, the knowledge base.
- *Incompleteness.* A statement that represents some but not all pieces of knowledge is incomplete knowledge. For example, does "Adjust the air conditioner" mean to turn it on or off, or to make it cooler or warmer?
- *False representation.* A statement that incorrectly represents pieces of knowledge is **false representation**. Take the example, "The small key will open the door." Which small key? An incorrect representation presents the possibility of two kinds of errors: false positive and false negative error. With **false positive** error, a rule is accepted when it should be rejected. In the "small key" example, if the small key will not open the door when it should, then accepting the key gives a false positive. In contrast, when a rule is rejected when it should be accepted, it is descriptive of **false negative**.

USER TRAINING

A major part of the implementation phase is training company employees on the new KM system. The level and duration of training depend on the user's knowledge level and the system's attributes. Users range from novices to experts. A *novice* is generally a casual user with limited knowledge of IT. An *expert* is someone with prior IT experience and who keeps abreast of the technology. Users are also classified as tutor, pupil, or customer.

The **tutor user** acquires a working knowledge of an existing knowledge base in order to keep the system current. This end user is responsible for system maintenance. The knowledge developer normally trains the tutor user on procedures for incorporating new knowledge into the knowledge base.

The responsibilities and interest of pupil users and customer users fall within the actual use of the KM system. The knowledge developer's role is to familiarize the end users with the ways in which the system will be best used. The **pupil user** is an unskilled worker trying to gain some understanding of the captured knowledge. The purpose of training pupil users is to gain their acceptance of the KM system. The **customer user** is one with interest in knowing how to use the KM system on a regular basis.

Neither the pupil user nor the customer user needs in-depth training during the early stages of KM system development. Training in the early phases uses development funds inefficiently. During the time between prototyping and a working system, the pupil users and customer users may forget most details.

User training is also influenced by the requirements of the KM system. System requirements range from simple and user friendly to advanced and less user friendly. A user friendly KM system is almost self-instructional with menu-driven features and easy-to-use manuals. The duration of training is usually measured in hours to days. Advanced KM systems require knowledge of queries in high-level programming or artificial intelligence (AI) languages and take days to weeks to learn, even for the experienced user.

Training must be geared to the specific user based on capabilities, experience, and system complexity. The most effective training is supported by a well-written user manual, easy-to-use explanatory facility, and job aids. User manuals can be invaluable training documents, especially if the user is geographically isolated. A well-written user manual is highly illustrated and contains an index for reference. Graphics, photographs, and templates provide quick reference and are invaluable teaching aids. Comparable information should also be available in the software via a help key on the keyboard.

Manage Change and Reward Structure

Regardless of what is being converted or how well deployment is carried out, knowledge sharing does not come easy to many people. *Implementation means change, and people in general resist change.* Implementation of a KM system is the initiation of a new order. People become anxious when they do not know what the system will offer and how it will affect their current jobs and decision-making quality. The result is stress and further resistance to change. The resistors include the following:

- *Experts.* Some domain experts have anxiety about the potential impact of sharing knowledge of their jobs in the organization. Experts on the way to retirement worry less, but they may still lack motivation unless they are properly compensated for their efforts.
- *Regular employees (users).* Participants in general resent lack of recognition (sometimes compensation), especially when they have put time in building the KM system.
- *Troublemakers.* Those left out of building the KM system or chronic complainers tend to obstruct the installation, cause delays, and may even prompt cancellation of the installation.
- *Narrow-minded "superstars."* Technical people in the organization's IT department sometimes resist any change that they did not initiate or approve in advance. Others veto a project not in their area of interest. Without management support, such resistance can spell doom for a new installation.

Resistance is displayed in three personal reactions:

- Projection: hostility toward peers.
- Avoidance: withdrawal from the scene, such as calling in sick.
- Aggression: killing the system, because of uncertainty of its operation or use.

A psychological element that explains resistance to change is the value that users place on knowledge and decision making. In most organizations, knowledge means power. While knowledge developers build KM systems that promote knowledge sharing through knowledge bases, domain experts who stand to lose monopoly on knowledge may resist a new system installation. Most resistance relates to the perceived impact of the system on one's job or status in the organization. Of course, a few people resist change of any kind.

Resistance also has much to do with the individual personality, the organizational structure, and the group relations within the area where the KM system will be installed. User education, training, and participation in the building process can help reduce resistance to change.

Because a major user concern in KM system implementation is how to work the system, users frequently ask such questions as What functions are available? How do I access each function? How do I know if the system has answered my questions correctly? How current is the knowledge base? Another user concern is how the KM system reaches conclusions or lines up with the real-world problem as seen by the user. The knowledge developer must demonstrate the system and provide detailed training.

Postsystem Evaluation

After the KM system has been deployed and the operation is "up and running," the effect of the new system on the organization should be carefully evaluated. System impact must be assessed in terms of its effects on the people, procedures, and performance of the business. More specifically, the main areas of concern are quality of decision making, attitude of end users, and costs of knowledge processing and update.

Several key questions are asked in the postimplementation stage:

- How has the KM system changed the accuracy and timeliness of decision making?
- Has the new system caused organizational changes? How constructive have the changes been?
- How has the new KM system affected the attitude of the end users? In what way? Was it worth it?
- How has the new KM system changed the cost of operating the business? How significant was it?
- In what way has the new system affected relationships between end users in the organization?
- Do the solutions derived from the new system justify the cost of investment?

The objective is to evaluate the KM system against standards and determine how well it meets the goals set in advance. This process is actually related to validation. The user initiates the review, which prompts a procedure for maintenance or enhancement. *Enhancement* means upgrading the system to meet a new set of requirements; *maintenance* means making corrections to meet the initial system requirements.

Implications for Knowledge Management

Assuming the technology is available and ready to use, several managerial factors should be considered:

- An organization considering a KM system as part of its information systems environment must make a commitment to user education and training prior to building the system. Knowledge sharing is not that straightforward in many organizations.
- Top management should be approached with facts about the costs and benefits of the proposed KM system. Being sold on the project means assurance of financial and technical support.
- If a KM system is anywhere on the organization's horizon, human resources or the IT department should begin training knowledge developers and others who have the potential to do knowledge engineering.
- Domain experts must be recognized and rewarded in ways that make them feel it is worth their time to cooperate. Assigning an expert to the project without such rewards can jeopardize the whole process.
- Finally, for an organization to anticipate its future technology needs, it is extremely important to do long-range strategic planning. Such planning can help the firm to attain its desired outcomes. Introducing leading-edge technology such as KM systems can help the organization to achieve competitive advantage.

One of the critical issues raised during implementation is knowledge system maintenance. Maintenance of KM systems continues to be a nebulous area. Some of the questions to be addressed by management include the following:

- Who will be in charge of maintenance?
- What skills should the maintenance specialist have? What is the best way to train him or her?
- What incentives should be provided to ensure quality maintenance?
- What kinds of support and funding are needed?
- What relationship should be established between the maintenance of a KM system and the IT staff of the organization?

The *enhancement* function is closely related to maintenance. Because experts constantly upgrade their knowledge, it makes sense to do the same with the KM system to keep it current. One question is "How quickly does the problem change?" The answer then determines how one would justify the enhancement, given the nature of the solution(s).

Another managerial issue to consider is how one would know whether the implementation would be a success. In addition to technical considerations, one must be aware of the people factor. People rallying behind technology can increase the success of implementation. Additionally, a KM system cannot succeed if the issues of cost and how that cost is going to be absorbed have not been resolved. Any of these issues can inhibit successful implementation.

Other managerial issues affect the direction and outcome of KM system projects. For example, the depth of the knowledge required to solve the problem is often an unknown commodity due to the nature of the expertise and the limitations of the knowledge developer. Forcing clarification too early in the building phase can result in a less-than-satisfactory system. Therefore, managing expectations and scoping the system are crucial early tasks.

Finally, the role of the expert in system implementation is also important. Management should properly compensate the domain expert for his or her effort in developing a KM system. The CKO may also play a proactive role in the implementation phase by simply sharing interest in the KM system. A lack of this kind of enthusiasm and overt support puts a damper on the whole idea of knowledge sharing and knowledge management.

SUMMARY

- Building a KM system can be viewed as a life cycle. The life cycle begins when a knowledge management system is determined to be doable, affordable, and practicable, with value added for company profitability and growth. Knowledge developers interview users and work with experts to develop a system. Discipline, good documentation, coordination, and regular management review characterize the development of KM system life cycle.
- Conventional and KM systems' development life cycles differ.
  - A systems analyst deals with data and information obtained from the user; the knowledge developer deals with tacit knowledge acquired from human experts.
  - The main interface for the systems analyst is the user, who knows the problem but not the solution. The main interface with the knowledge developer is the human expert, who knows the problem and the solution.
  - Conventional system development is primarily sequential; KMSLC is incremental and interactive.
  - Testing is done at the end of conventional information system development; verification and validation are performed throughout the KM development life cycle.
- Conventional and KM systems' development life cycles are also similar.
  - Both begin with a problem and end with a solution.
  - Both begin with information gathering to ensure a clear understanding of the users' requirements or the problem at hand.
  - Both involve testing the system and ensuring that the system is satisfactory.
  - Particular development tools are used to build each system.
- The first step in building a KM system is identifying the problem domain, followed by a feasibility study for evaluating the problem in detail. This includes weighing the total costs against the potential tangible and intangible benefits. Early scoping is important. The project should be of a manageable size, and the organization should be able to foresee its benefits.
- Knowledge capture involves elicitation, analysis, and interpretation of the knowledge that a human expert uses to solve a particular problem.
- Most KM systems begin as small-scale prototypes based on the limited knowledge acquired during the first few sessions with the human expert. The system grows gradually as the knowledge developer gains new insights from the expert and adds them to the prototype.
- Once the KM blueprint is made final, verification and validation ensure that the system is right and that we have the right system, respectively.
- System implementation is the process of organizing the knowledge and integrating it with the testing strategy of verification and validation. A system must be modified or updated as new knowledge is captured.

- Most barriers to the development of a KM system are nontechnical. Lack of support from top management, knowledge developers' limited interpersonal skills, experts' poor communications skills, and users' resistance are all barriers that must be addressed.
- The ultimate goal of every KM system is successful implementation and deployment. Implementation means change, and people in general resist change. The resistors include experts, nonexperts, troublemakers, and narrow-minded technical "superstars." Resistance is displayed in the form of projection, avoidance, and aggression and has much to do with the individual personality, the organizational structure in which the user works, and the group relations in the area where the system will be installed. User education, training, and participation can help reduce or control resistance to change.

TERMS TO KNOW

Aggression: Resistance to KM systems through employee sabotage of the system.

Avoidance: Resistance to KM systems through employee withdrawal from the job or scene.

Champion: Individual within the organization who believes the project will benefit the company and is willing to take risks in supporting its development; has credibility with management, experts, and users; and has access to key persons in the business.

Customer user: A user interested in knowing how to use the system for problem solving on a regular basis.

Deployment: Physical transfer of the technology to the organization's operating unit.

Enhancement: Upgrading the system to meet a new set of requirements.

Implementation: The process of organizing the knowledge and integrating it with the processing strategy for final deployment.

KM system life cycle (KMSLC): The steps through which a knowledge management system project goes before it becomes operational.

Maintenance: Making necessary corrections so that the KM system continues to meet the initial system requirements.

Projection: Resistance to expert systems through employee display of hostility toward peers.

Pupil user: An unskilled employee trying to learn or gain some understanding of the captured knowledge.

Rapid prototyping: Spontaneous, on-the-spot, iterative approach to building KM systems; an iterative process by which the knowledge developer shows the domain expert what the KM system looks like based on the knowledge captured to date.

Systems analyst: A specialist who gathers information from the user or the user's staff in order to define a problem and determine alternative solutions and their consequences within conventional information system development processes.

Tutor user: A user with a working knowledge of the KM system or knowledge base and the responsibility for system maintenance.

Validation: A system test to ensure the right system from a technical view; a system that meets the expert's expectations.

Verification: A system test to ensure the proper functioning of the system; addresses the intrinsic properties of the KM system.

TEST YOUR UNDERSTANDING

1. Why is it helpful to view the building of a KM system as a life cycle?
2. In what ways do conventional and KM systems' development life cycles differ? How are they similar?
3. Distinguish between:
   a. verification and validation
   b. knowledge developer and systems analyst
   c. pupil user and tutor user
   d. projection and avoidance
4. Successful KM system implementation depends on several factors. Briefly explain each factor.
5. How important are organizational factors in system implementation?

6. Why is the place of training important? Why is duration of training important?
7. What do you think determines the success of user training?
8. How do users differ from experts?
9. Of the steps making up the KMSLC, which one do you consider the most critical? Why? Which would be the most time-consuming?"
10. What is rapid prototyping? How is it useful in building KM systems?
11. Elaborate on the main steps of a feasibility study. When should a feasibility study be conducted? Why?
12. What does it mean to "scope" a project? Give an example.
13. What is your understanding of a human expert? How would you select one?
14. Write an essay in which you describe the role of the knowledge developer and his or her relationship with the key persons in the knowledge capture process.
15. Briefly highlight the functions and attributes of the chief knowledge officer (CKO).

KNOWLEDGE EXERCISES

1. Crozet Country Club's use of a knowledge management system can be justified on several fronts. The system captures the human resources manager's knowledge of how she makes her hiring decisions. If she leaves the club, the system will help to ensure that her expertise and know-how are not lost.

   The "Hiring KM System" saves the club time and money by making accurate decisions more rapidly than the normal way of deciding on an applicant. Because the club receives a large number of applications to fill a relatively small number of positions, efficient applicant evaluation is of critical importance. However, handling and sorting the plethora of applications was formerly time-consuming and haphazard. This system reduces the time taken to fill vacant positions. More importantly, it helps to ensure that employees have the necessary qualifications.

   The hiring KM system promotes a higher level of consistency and quality in hiring decisions. Prior to implementing the system, the manager did not have a "wage matrix" to use in determining appropriate wages for employees, and the process was quite random. This led to some conflict within the organization. Furthermore, the manager hired some applicants without focusing enough on their ability, and they turned out to be poor employees. In essence, the KM system helps guarantee that all of the necessary variables are fully considered in each decision.

   a. Is this sufficient justification for the KM system? Why or why not?
   b. Is the system likely to replace the human resources manager, who was instrumental in sharing her knowledge, which is captured in the knowledge base?
2. The goal of this project is to develop a consumer-lending knowledge base to guide the junior bank officer through the decision of whether an auto loan should be approved. In the loan department, there are experienced senior loan officers who are willing to share their knowledge with others.

   You have been assigned the job of building a KM system for the bank. Explain in detail the life cycle of this project.
3. A KM system for a large retailer was designed to help human resources develop a qualified candidate pool from the many applications they receive on a daily basis. The knowledge on hiring available in the KM knowledge base suggests the wage each accepted applicant should receive, based on his or her skills and relevant experience.

   The three positions addressed are (a) floor salesperson, (b) customer service representative, and (c) gift wrap employee. The system encodes the

knowledge of the expert in each area and the knowledge of the person who makes the hiring decisions into rules that are used to perform the task. The store's human resources manager played a key role throughout knowledge capture; her experience is stored in a specialized knowledge base. During her absence, a junior human resources person can query the knowledge base for information based on the expert's (human resources manager) opinion in various combinations of circumstances and constraints. This made certain decisions easy to make, which made the hiring process faster and improved the overall efficiency of the human resources department.

a. Is anything missing from the development life cycle? What made you think so?
b. Do you think more than one person developed the KM system? Explain.

4. A high-tech firm designed a KM system for the student housing office of a major university in March 2001 and made the system available through the university's intranet; three campuses were involved. After the system passed verification and validation, the knowledge developer held a wrap-up meeting with representative end users from each branch. She spent 2 hours going through the operations manual and running examples through the newly installed system to demonstrate ease of use and ease of access.

   The attendees were quite impressed with the many features—a color screen, easy-to-follow menu, and display of the reasons to justify all kinds of answers. The system also links legacy databases such as tuition adjustment and meal plans, depending on the housing arrangements.

   One month after the 2-hour training session, the knowledge engineer sent a questionnaire to all attendees, who, by then, were end users of the KM system. Some of the questions were as follows:

   - Did the operations manual help you understand the system?
   - Did the knowledge developer give you a working understanding of the system?
   - Did you understand the questions asked by the system?
   - Does the system meet your expectations? If not, please offer any suggestions you might have.
   - Did the system provide adequate and correct answers?
   - Do you think that the system is usable in your environment with immediate change? Be specific.

   a. Based on the information provided, evaluate the training approach followed by the knowledge developer.
   b. Could you deduce a training plan in this case? Explain.
   c. Critique the questionnaire used to follow up on the installation.

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CHAPTER 4

Knowledge Creation and Knowledge Architecture

Contents

Where success is concerned, people are not measured in inches, or pounds, or college degrees, or family background; they are measured by the size of their thinking.

—J. M. CUPELLO

In a Nutshell

In the previous chapters, we discussed the concept of knowledge management, what knowledge is, and the development process that deploys a KM system for a business organization. In this chapter, the key questions are: Where does knowledge reside? How would one create knowledge? What does it take to design a KM system? The literature differs on how to address these questions, because much depends on the type of knowledge, the culture of the organization, and how one strategically makes use of knowledge management. For example, Churchman interpreted the viewpoint of philosophers Leibniz, Locke, and Kant by emphasizing that knowledge resides in the user and not in the collection of information. "To conceive of knowledge as a collection of information seems to rob the concept of all of its life. Knowledge resides in the user and not in the collection. It is how the user reacts to a collection of information that matters" (Churchman 1971). He emphasizes the human nature of knowledge creation in an environment characterized by discontinuous change. Malhotra also discusses the nature of knowledge creation (Malhotra 2001).

The focus on tacit knowledge being the primary type of knowledge to tap is reinforced by Boland, who pointed out that by considering the meaning of knowledge as "unproblematic, predefined, and prepackaged, they ignore the human dimension of organizational knowledge creation" (Boland 1987). In 1995, Gill reinforced the view a different way. He stated that "prepackaged interpretation of knowledge works against the generation of multiple and contradictory viewpoints that are necessary for meeting the challenge posed by wicked environments: This may even hamper the firm's learning and adaptive capabilities."

In this chapter, we also discuss knowledge architecture as a framework of the *people core.* We explore the types of people making up the organization, the knowledge they own, and where they use it. Under the *knowledge sharing core,* the focus is on deciding where knowledge resides and where it is used, and identify those responsible for knowledge sharing. Finally, the *technology core* illustrates how to leverage the Internet and the technical layers for building a technology base for knowledge sharing. With all these issues, the CKO plays a critical role in the KM process.

Knowledge Creation

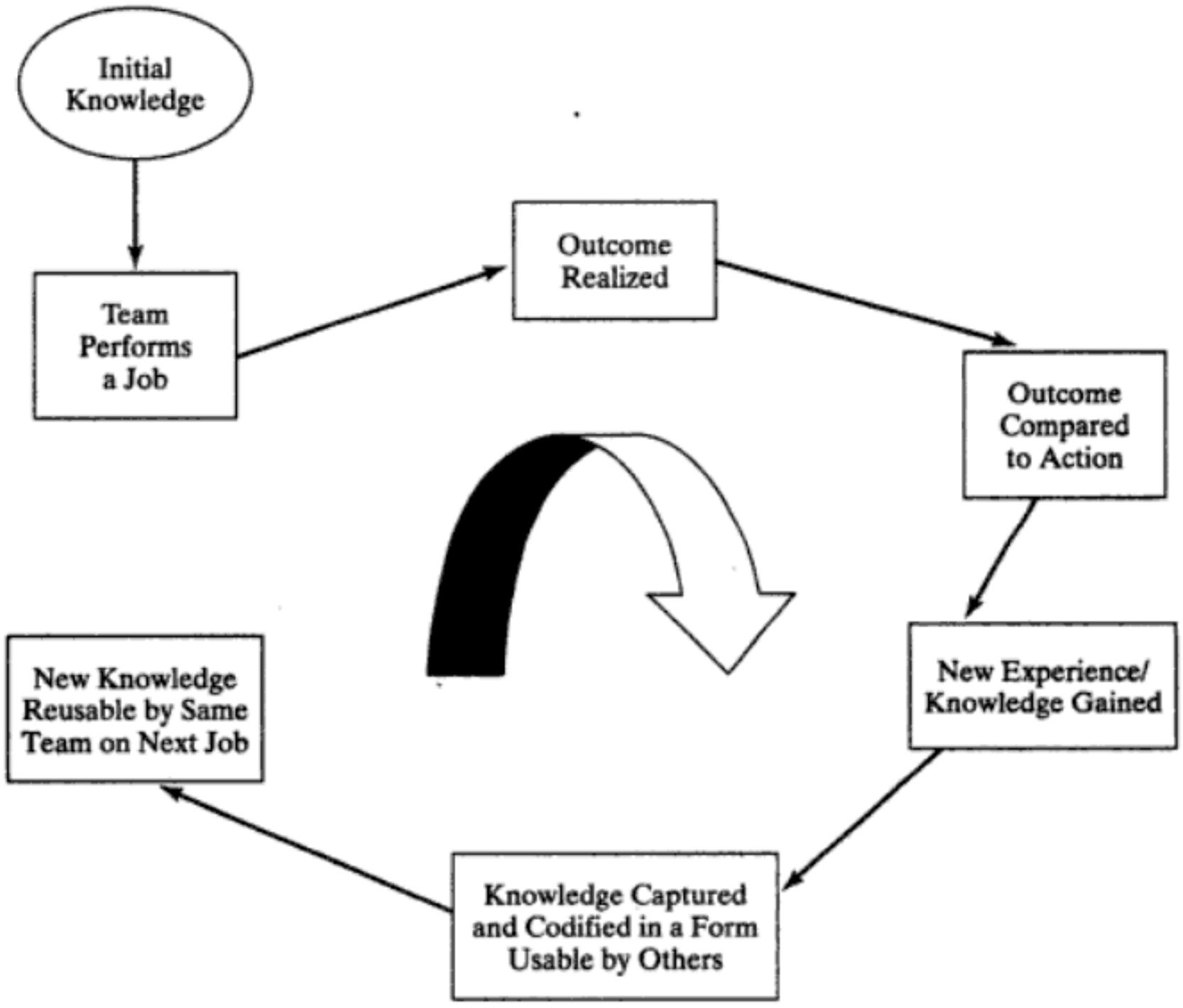
Most of us live in a world where today's knowledge will not solve tomorrow's problems. This means updating our knowledge on a regular basis. You probably have heard the old joke about the teacher who used the same experience with a course 20 times rather than having 20 years of teaching experience. The two are not the same. Knowledge update is creating new knowledge based on ongoing experiences in a particular problem area and then using the new knowledge in combination with the initial knowledge to come up with updated knowledge for knowledge sharing. Unfortunately, most organizations have a very competitive culture, where no one wants to share. With a change in culture, values, and improved mutual trust, sharing creates a learning culture that feeds itself in terms of improving knowledge sharing—giving away, holding in common, and improving bonds within the firm. In contrast, our view is to look at explicit and tacit knowledge as the two primary knowledge types and learn how to capture them for organizational inquiries and growth in an unpredictable environment. Either type can be created and should be captured. Capturing explicit knowledge is covered later in the text under data warehousing and data mining. In the next chapter, we focus on capturing tacit knowledge, and Chapter 6 elaborates on the main tools

used in knowledge capture. We approach knowledge and "knowing" as deeply personal. Keep in mind that KM is not a technology. It is an activity enabled by technology and produced by people. It is also how people share the type of knowledge that will add special value to the growth and competitive nature of the business. The use of technology is a critical aid for processing and deploying knowledge whenever it is needed.

An alternative way of creating knowledge is through teamwork. Figure 4.1 shows how a team translates experience into knowledge. Essentially, a team commits to performing a job over a specific time period, such as weeks or months. A *job* is more than a task. It is a series of specific tasks carried out in a specific order, format, or sequence. In the end, a job is completed, and the results are either successful or disappointing. The team looks back and compares the experience it had when starting the job to the outcome. This comparison is what translates experience into knowledge. When it performs the same job in the future, the team takes corrective steps, modifying actions based on the new knowledge they have acquired.

With either knowledge creation alternative, the outcome is the same. Individuals or teams begin a commitment to a job with specific knowledge. After the job is completed, a comparison of the "before and after" occurs. In most cases, the outcome is extended knowledge that should improve the quality and effectiveness of performing the same job the next time around. In some quarters, this is called *maturation* or *seasoned experience.* Over time, experience leads to expertise, where one person or one team becomes known for handling a complex problem very well. This knowledge can be transferred to others in a reusable format. The receiving individual or team adapts the knowledge for use in a special context.

FIGURE 4.1: Knowledge Creation and Knowledge Transfer via Teams



Team formation and teamwork begin with experienced individuals working jointly on a project. In consulting assignments, for example, an experienced individual manages a team of experienced and semiexperienced members (see Box 4.1). The manager assigns tasks and decides how much knowledge sharing will occur. In a way, tacit knowledge begins with the individual, not the team. Real knowledge continues to be held by people (Berry 2000). In a team environment, shared exchange results in collaborative decision making and problem-solving. So, when it comes to knowledge capture,

BOX 4.1

ROLE AND FORMATION OF KM TEAMS

DRAFT YOUR DREAM TEAM

By definition, it takes at least two people to share something. When that something is knowledge applied to the goals of a large enterprise, the sharing multiplies, and the number of people involved must increase. Therefore, most organizations make establishing a project team an early priority in their knowledge management initiatives.

Choosing and recruiting the right people for the team is a vital task that will have enduring consequences. Accomplishing corporate business objectives requires a mix of skills, experience, and stakeholder interests, so the team members usually will come from multiple disciplines. Team developers also must consider issues of trust across departments and business units as well as between individuals.

Successful KM initiatives, experts say, focus first on people business processes and company culture. Only later should the emphasis shift to the technology and tools that facilitate knowledge sharing. Members may need expertise in management, administration, human resources, and business processes as well as in the supporting technologies.

"A knowledge management project must leverage the strengths of each of these professional perspectives to be successful," says Ray Merrill, a consultant at Ariel Performance Centered Systems, Inc., in Fort Lauderdale, Florida. When helping clients to implement knowledge management projects, consultants at Chicago-based Andersen Consulting suggest staffing teams with individuals from the business process in question and from the human resources and information technology departments. According to Christina Schultz, manager of global knowledge services at Andersen Consulting, a team needs members from all three sectors. "You don't find all these skills in one person, so you have to ensure that all are represented," she says.

CASTING ROLES

A team member's primary duty within the group is as important as his or her qualifications. From his KM project experience, Merrill has derived six key roles, which he calls "hats," that one team member or another must play. They are as follows:

Business leads: Specialize in understanding the measurable result to be obtained

Organizational leads: Specialize in communication plans, motivational incentives, and other organizational needs

Super users: Can influence the user community and provide practical feedback

Interface design leads: Specialize in computer/human interaction and integrating content into work processes

Training leads: Specialize in cognitive needs, learning strategies, and repurposing legacy content

Technical architects: Specialize in technology installation and administration

SOURCE: Excerpted from Robb, Drew. "Draft Your Dream Team," *Knowledge Management*, August 2001, pp. 44–50.

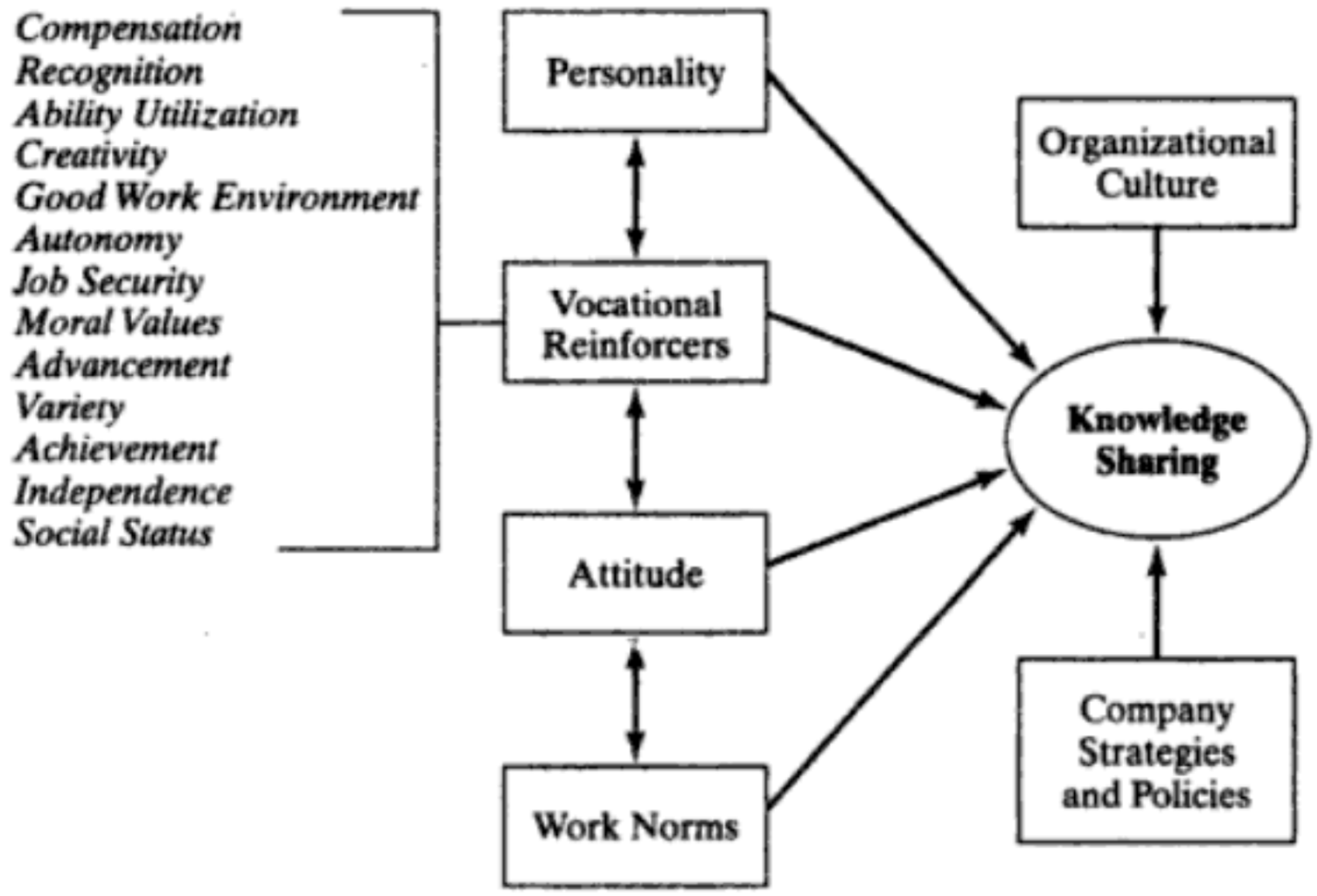


FIGURE 4.2: Impediments to Knowledge Sharing

the approach is to tap the individual's tacit knowledge, which could be a single expert or multiple experts, as the situation warrants.

With knowledge transfer and knowledge sharing, there are impediments to consider. Whether it is the individual expert or the "expert" team, knowledge sharing is not that straightforward. As shown in Figure 4.2, there are factors that encourage or retard knowledge transfer—from personality and attitude to vocational reinforcers. Whether knowledge sharing causes change in the organizational culture or the other way around continues to be a hotly debated area. In either case, a review of the motivational factors that encourage people to share is important if the KM process has a chance of succeeding.

As shown in the conceptual model in Figure 4.2, personality is one factor in knowledge sharing. For example, people who are extroverts, display self-confidence, and feel secure tend to share experiences more readily than those who are introspective, self-centered, or security conscious. Attitude and work norms are additional considerations. People with a positive attitude, who trust others, and who work in an environment conducive to knowledge sharing tend to be better at sharing than those working in a "cutthroat" environment.

Finally, vocational reinforcers are key to knowledge sharing. Based on the authors' vocational psychology research, people whose vocational needs are met by job reinforcers are more likely to favor knowledge sharing than those who are deprived of one or more reinforcers. One may conclude that the totality of attitude, personality, work norms, and vocational reinforcers determines how likely people are to view knowledge sharing and knowledge transfer in a positive light.

Nonaka's Model of Knowledge Creation and Transformation

Another way of looking at knowledge creation and knowledge transformation is to use Nonaka's model. Nonaka (1995) coined the terms *tacit knowledge* and *explicit knowledge* as the two main types of human knowledge. Tacit knowledge is considered the most

valuable knowledge. The key to knowledge creation lies in the way it is mobilized and converted through technology. Conversion of knowledge between tacit and explicit knowledge is shown in Figure 4.3.

Tacit to tacit communication, referred to as *socialization,* takes place between people in meetings or in team discussions. Such knowledge sharing, transfer, or collaboration often produces no explicit knowledge. Experience among people in face-to-face business situations is mostly shared, and technology plays a minimal role. However, there is an increasing trend for online groupware tools be used in work groups or teams. In such a synthetic atmosphere, especially in geographically dispersed settings, team members can conduct meetings, listen to presentations, or simply carry out discussions. Lotus Notes is one example of a software product that allows people to share documents and discuss them via video and text-based chat.

Tacit to explicit communication, or *externalization,* is essentially articulation among people through dialogue. Brainstorming, where a team carries out discussions around a specific problem is one example. Comments and suggestions are entered into a PC and displayed on a screen, but no one knows who made the comment. Brainstorming is covered in detail in Chapter 6.

Online discussions can capture tacit knowledge and apply it to an immediate problem (Marwick 2001). The database becomes a repository of useful knowledge. On the surface, the exchange gives the impression that it is purely explicit knowledge. However, the participant first has to decide on the nature of the problem before he or she can give the best solution—both prompting the use of tacit knowledge before such knowledge becomes explicit. After the knowledge has been made explicit and has been stored in a repository, persons facing a similar problem can consult the database at their convenience.

Explicit to explicit communication (also referred to as *communication*) is one transformation phase that is best supported by technology. Explicit knowledge can be easily captured and transmitted to a worldwide audience. For example, sending an attached memo or document via e-mail expedites knowledge sharing in an efficient and effective way. In this respect, technology helps by motivating people to capture and share what they have or what they know.

Explicit to tacit communication (also referred to as *internalization*) is taking explicit knowledge such as a report and deducing new ideas or taking constructive action. Creating technology to help users derive tacit knowledge from explicit knowledge is an important goal of knowledge management. By searching and finding associations, technology makes information more useful by making it easier to derive new tacit knowledge from it. For example, supermarkets profiling customers when they use

Tacit to Tacit *(socialization)* Team Meetings and Discussions	**Tacit to Explicit** *(externalization)* Dialog Within Team Answer Questions
Explicit to Tacit *(internalization)* Learn from a Report	**Explicit to Explicit** *(communication)* E-Mail a Report

FIGURE 4.3: Conversion of Knowledge Between Tacit and Explicit Forms

SOURCE: Marwick, A. D. "Knowledge Management Technology," *IBM Systems Journal*, vol. 40, no. 4, 2001, p. 815.

a store-issued card to get discounts is an example of explicit to tacit knowledge. Through data mining, the store can derive a number of new ideas regarding the kind of product that is popular or the preference of customers by age, location, or price. Such tacit knowledge is critical for competitive advantage.

In conclusion, one can see that Nonaka's model divides knowledge creation processes into four categories. It focuses on tacit knowledge and the use of technology in generating or transmitting such knowledge to others. Using electronic meetings or chat rooms for collaboration, knowledge sharing, and transfer are well known in today's knowledge organizations. Despite the advancement of technology, one limitation remains: the ability of technology to support the use of tacit knowledge in face-to-face meetings and direct interactions (Marwick 2001). Human knowledge continues to be a valuable resource, and technology is expected to trickle slowly into a human domain where knowledge creation and knowledge transfer can be expedited for human decision making regardless of time or location.

Knowledge Architecture

Knowledge architecture is a prerequisite to knowledge sharing. We view the infrastructure as a combination of people, content, and technology. As shown in Figure 4.4, these components are interdependent and inseparable. People with knowledge provide content, relying on technology to transfer and share knowledge. This combination provides the efficiency and performance to managing the knowledge core of the corporation.

THE PEOPLE CORE

Knowledge management is about people and the way they creatively perform in an environment conducive to knowledge sharing. By *people,* we mean knowledge workers, managers, customers, and suppliers. The first step in knowledge architecture is to evaluate the current information and documents people use, the applications they need, the people they contact for solutions, the associates they collaborate with, the e-mail they send and receive, and the database they access. All these sources make up an employee profile, which is later used as the basis for designing a knowledge management system that best serve people's long-term needs via technology.

The goal of *profiling* the people part of an organization is to get a handle on existing knowledge exchanges that the organization uses and ways to capture them. As a procedure, it involves not only asking the right questions but also providing answers that become part of the KM system infrastructure. Discovering whom to profile, in what sequence, and for what duration and using the right knowledge capture tool are discussed in Chapter 5.

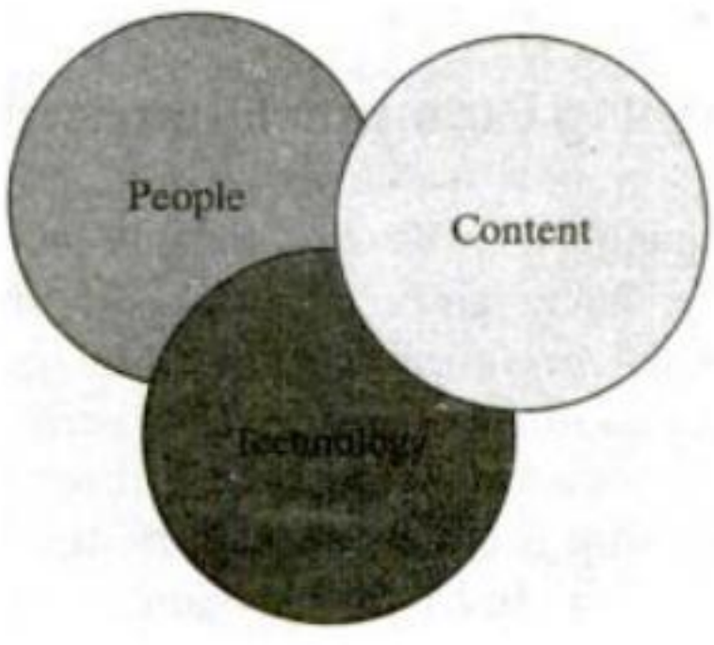


FIGURE 4.4: Conceptual View of Knowledge Management

Profiling can be approached in several ways. The worst way is to send a survey or questionnaire by e-mail. When it comes to knowledge capture, the most important prerequisite is selecting the employees and planning the questions. Planning whom to elicit knowledge from means deciding whether to talk with senior employees only, younger or newer employees, or some mix based on criteria that make sense. The next prerequisite is type of question to ask. Each question should be phrased and intended to elicit information accurately and completely.

Finally, the whole idea behind assessing the people core is to do a good job in assigning job content to the right person and to ensure that the flow of information that once was obstructed by departments now flows to the right people at the right time. For example, customer service need no longer have an exclusive on troubleshooting information, any more than the legal department should have an exclusive on settling customer litigation. To expedite knowledge sharing, a knowledge network should be mapped in such a way as to assign people authority and responsibilities for specific kinds of knowledge content. It means:

1. Identifying knowledge centers (for example, sales, products, or marketing).
2. Activating knowledge content satellites—lower level knowledge centers that hierarchically fall under higher level centers (for example, customer support or product documentation in repositories).
3. Properly staffing experts over each knowledge center. The outcome is a corporation-wide knowledge structure that blends the best of existing organization structure and the best of technology—e-mail, intranets, extranets, and networking—to ensure a smooth, 24-hour knowledge sharing environment.

IDENTIFYING KNOWLEDGE CENTERS

Once you have determined the knowledge that people need, the next step is to identify where knowledge resides and how to capture it. By *knowledge center,* we mean areas in the organization where knowledge is available for knowledge capture. For example, in Figure 4.5, a retail organization might have at least four knowledge centers: sales, customer service, human resources, and marketing. These centers become the skeletal framework for knowledge capture. They also serve to identify individual experts or expert teams in each center who could be candidates for the knowledge capture process.

Activating Knowledge Content Satellites

As mentioned earlier, this step simply breaks down each knowledge center into lower, more manageable levels, satellites, or areas. The focus is on searching for knowledge content, not evaluating departments or divisions in the way we evaluate the traditional organizational structure.

Assigning Experts to Each Knowledge Area

Once the new framework is made final, each knowledge satellite should be assigned a manager to ensure integrity of information content, access, and update (see Figure 4.5). In the assignment process, it is important to identify management-type people for each satellite knowledge center; these people will provide contact sources for knowledge capture. This enforces discipline and quality of information, because managers have vested ownership in their respective departments.

Ownership is critical to knowledge capture, knowledge transfer, and knowledge implementation. In a typical organization, departments tend to be territorial. So-called

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