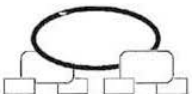
Knowledge Management

The Central Management Focus
for
Intelligent. Acting Organizations

Karl M. Wiig



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This series could not have been created without the help and support by many parties. Primarily, it has been made possible by the unwavering support by my wife, Elisabeth, who from her research, provided me with many of the ideas expressed in all three books and who taught me much about how people think, reason, and differ depending on their make-up. And more importantly, she taught me what love is, and how it relates to our human condition and performance.

I owe much to my parents who taught me to be curious, to think, to understand that value can only be realized after the task is completed, and that it is permissible to have fun!

My coworkers have helped me realize much of the complexity that **real** challenges present and how to perceive and deal with them. Sue Stafford and Helen Ojha in particular pulled me into the areas of philosophy and social sciences that I had never discovered and that have direct bearing on the topics in this book. They also showed me how these disciplines can be applied directly in the "real world." Many others have helped shape the insights that led to perspectives on the practical role of knowledge. My managers during many years, David Boodman and Martin Ernst, allowed me to attack challenges that "nobody should be paid to work on" -- they were that fun, educational, and difficult.

Without my clients who continually have posed incredibly interesting and challenging problems, I would have little understanding of the importance that knowledge plays in the modern organization. The insights, concerns, and encouragement that my clients in many industries, many settings, and six continents have provided me with over the years, have been invaluable. My clients have also taught me how little I know -- and how bright they are and how difficult it is for them to balance the multitude of conflicting requirements they have to deal with.

My editor, Kirsten McBride, have provided invaluable help to make this series of books readable -- in spite of my continued attempts to the opposite!

Preface

The worldwide industrial and economic transformations that are now taking place have already led to significant upheavals for both workers and professionals in nearly all fields. More critical than the worker issues, however, are the tremendous societal restructuring that has taken place and which many perceive to be permanent. The turmoil stems from several factors: greater pressures to increase product quality and decrease costs; basic and frequent changes in business practices and consumer and high-technology products; price wars in most segments of the world economy; and crucial and often painful shifts in markets, policies, and economic structures caused by a worldwide recession. Many of these changes and the underlying factors are discussed in-depth by Drucker, who argues that we already have started a transition into the global "knowledge society" -- although we do not yet understand what that entails, and probably will not really have a good grasp overview of what is happening for several decades.*

These changes have a profound impact on the complexity of the workplace, requiring higher levels of knowledge and skills on the part of every individual who wishes to hold a responsible job and every organization that wishes to be consistently successful.

Although we face enormous challenges in general education to prepare entrants to the job market, the greatest challenge lies in the need to reeducate our current workforce. Given the rapid changes and advances in most fields, skills and techniques learned more than a decade ago are inadequate to compete in today's job market. In the face of these challenges, the major defense for organizations is to *manage knowledge on a broad basis* -- to educate, build their internal knowledge base, pool and deploy the knowledge they have, invest in the development of new and proprietary knowledge, and put their knowledge to use as effectively as possible.

This book is about a new set of foundations for management methods. Specifically, it is about what knowledge is, and how business can use knowledge, harness, enhance, and manage it to the maximum benefit to the

"' Peter Drucker (1993), in hjs book Post-Capitalist Society, provides extensive discussions of the transition to a "knowledge society."

organization.

The central premise behind knowledge management (KM) is that all the factors that lead to superior performance -- organiza tional creativity, operational effectiveness, and quality of products and services -- are improved when better knowledge is made available and used competently. While this premise supports the management philosophies and corporate cultures of highly successful companies, it is in direct contrast to traditional Taylorism.** KM complements and must be considered in combination with modern management methods such as Dr. Deming's Total Quality Management.*** In short, the KM perspectives, approaches, and methods help promote and enhance such practices as:

- Business process reengineering
- Enterprise-wide integrated operations
- Participative management with empowerment of all knowledge workers
- Total quality management and quality function deployment (QFD)
- Collaborative workstyles
- Supportive work environment and corporate culture

Knowledge management programs provide the organization with powerful processes that allow its managers to use innovative ways to support their pursuit of leadership. When considering the value of KM, we need to define what we mean by "knowledge." In particular, it must be seen in contrast to "information." To avoid misconceptions, we must differentiate between the two terms using an operational definition such as the following:

Knowledge *consists of facts, truths, and beliefs, perspectives and concepts, judgments and expectations, methodologies and know-how.*

** "Taylorisrn" refers to the operation and management practices advocated by the "father" of scientific management, Frederick W. Taylor (1856-1915). A description of Taylorism may be found in Craig Littler, "Understanding Taylorism," in *British Journal of Sociology* 29 (1978, pp. 185-207). Taylor and Western practitioners of "rational approach to management" (nearly all companies), are argued to have promoted the view that workers should be told explicitly what to do and not be encouraged to use their own knowledge and ideas to change or improve work practices or work process. According to that view, workers who improve these areas on their own are counterproductive and such worker involvements are discouraged.

According to Drucker (1993), however, this is a totally incorrect interpretation of Taylor's work and philosophy. In reality, Taylor promoted worker participation and ownership -- directions that were threatening to both management and labor at the time. He was consequently vilified and intentionally misinterpreted, resulting in the general misrepresentation mentioned above.

*** Dr. Deming's management method is described very readably by Walton (1986), and in greater detail by Deming (1986).

Knowledge is accumulated and integrated and held over longer periods to be available to be applied to handle specific situations and problems.

Information *consists of facts and data that are organized to describe a particular situation or condition.*

Knowledge is subsequently applied to interpret the available information about a particular situation and to decide how to manage it. We use knowledge to determine what a particular situation means.

By sharing some of the perspectives and approaches we have found to be useful, we hope that this book will generate visions for new ways of doing business based on different uses of knowledge.

The book is partially motivated by the concern that in most U.S. companies knowledge and expertise are not recognized as directly manageable assets. Thus, most managers express that they do not know how to characterize, appraise, or manage knowledge explicitly and actively even though we are becoming a knowledge-based, postindustrial society where knowledge and expertise play a more important role than ever before. This concern was strongly substantiated by the results of a small survey of chief executives of Fortune 50 companies in 1989.

Major questions confront any manager who introduces new management methods or who advocates change. Introduction of KM is no different. Some of the questions that must be addressed are:

- What is KM all about?
- Is it worth for me to consider KM at this time?
- Which business advantages might we realize from active KM?
- Which experiences have others had, and where should we start?
- What are the risks and pitfalls?
- How do we determine the value of K."J\1, and how do Ijustify it?
- Which framework exists for KM and which paradigm can I adopt to "wrap my arms" around this concept and for important knowledge situations that require my attention?
- Which KM approaches and methodologies are available, and how practical are they?
- How does KM relate to existing programs and management activities? How does it differ from, and complement, what we are doing already?
- What are expert systems and how do they support K\1?

These are complex questions but hopefully the treatment of these issues will be of help to the manager who wants to succeed in the competitive game and to do so with confidence and decisiveness.

This book is intended for managers who want to **build,** not **dismantle.** It is not for managers who manage with short-term "cash-cow" attitudes in a hand-to-mouth existence. Rather, the concepts presented are for managers who work to build the strength of the organization to excel for a longer time in the global business environment. It is for managers who want to change the organization by improving its processes and letting its people work smarter and by exploiting the organization's strengths without depleting its resources.

This book is the result of varied experiences, the last 24 years in management consulting. In the 1960s I had the opportunity to work with applied research and application of technology to areas where competitive knowledge was very important and where knowledge transfer and its management were keys to success. Later, I was fortunate to work with many clients who needed to manage knowledge -- as we now understand it -- to evaluate and exploit knowledge, intellectual strategies, technology, and transfer of technology, skills, and expertise. These engagements occurred in many countries and for many purposes, and included automation of human expertise in knowledge-based systems of many types.

In the 1970s, I was asked to help large organizations and governmental agencies develop approaches to achieve knowledge-related business objectives. These engagements ranged from business and policy analyses, strategizing, and creation of manual and automated planning systems, to development of executive information and decision support systems. During the beginning of the 1980s, my work largely focused on the application of artificial intelligence -- often with motivations that were extensions of conventional systems thinking.

Around 1985, it became apparent that we had been approaching application of artificial intelligence much too narrowly. We were automating small and relatively simple aspects of human reasoning in isolated business situations. A broader perspective was needed. That is, we needed to consider how to manage knowledge across the whole organization. In 1986 the thinking in my group at Arthur D. Little had progressed to the point that we went public with our concepts.****

Since then, my associates and I have had many opportunities to help clients organize and carry out their KM programs. It is the perspectives derived from these experiences and the corresponding research that I have attempted to

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**** My first presentation on knowledge management, Management of Knowledge: Perspectives of a new opportunity, was delivered to a 1986 conference sponsored by the United Nations' International Labour Office. That presentation was later published (Wiig, 1988).

share in this book. In working with different organizations in the U.S. and abroad over the last decades, we have become acutely aware of the importance of placing a central focus on knowledge. We have enjoyed opportunities to work with approaches to managing knowledge both with detailed methods and with broader strategies while at the same time seeing the challenges faced by executives to place knowledge-related opportunities, priorities, and conflicts in the context of all the other pressures they are under.

Arlington, Texas, 1994

Part I

The Role of Knowledge in Business

A major goal for management of most organizations is to direct and motivate them to **act intelligently** during all routine tasks and in the face of all challenges. Management's fondest wish is that every individual -- and therefore every department, and in the aggregate, the whole organization -- would respond to every situation and challenge with the best insight of how to fulfill the organization's short- and long-term objectives to the full1est. In the extreme this goal is clearly ideal and beyond reach. Nevertheless, it is a clear target that all strive to achieve to the greatest extent possible within their means.

The notion that underlies this goal is that when the organization acts intelligently, it will conduct its internal operations with great effectiveness, it will create highly desirable products and services that its customers will demand above those from its competitors, it will establish an internal environment that is positive and rewarding to its employees at all levels, and it will be considerate to all outside parties -- the local community and society at large, the economy, and the physical environment. By acting intelligently, the organization will be both creative and vigilant in exploiting all relevant opportunities.

When the organization acts in this manner it will become successful to the largest extent possible. The commercial organization will become financially

successful. It will increase its market share, maximize its short- and long-term financial position, and become a leader. However, the ability to act intelligently is not automatic. The major requirement is to have appropriate knowledge at each point-of-action -- first, to understand each and every situation from the most appropriate perspective and second, to determine how to handle it in the best manner possible. It is the objective of KM to build the requisite knowledge, deploy it to all points-of-action, and to create a culture and an environment that are conducive to using the knowledge to act intelligently.

Chapter 1

The Knowledge Focus: A New Perspective for Effective Businesses

Managing Knowledge Is Vital

In any business, nothing is as important as focusing on the activities that promote and safeguard the success of the organization. The challenge is to innovate and identify what is important, understand it well enough to pursue it adroitly, secure the resources to undertake it, and devote the attention needed to make it happen.

Executives and business commentators alike are expressing their conviction that knowledge -- in one form or another -- is the basic ingredient behind the modern organization that underlies its success. Students of business also observe that we -- the global society -- have already passed into a new era where knowledge, not capital or technology, is the primary driving force. We have entered the knowledge society.[1] France, Japan, and Singapore include explicit considerations for knowledge growth and leadership in their national plans and are undertaking programs to implement it. In the U.S., President Clinton has included knowledge-related concerns implicitly when dealing with education, research, and the position of our high-technology industries.

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[1] Many influential authors discuss the emergence of the knowledge society. See for example Gernot Bohme & Nico Stehr (1986) The Knowledge Society, Harlan Cleveland (1985) The Knowledge Executive, Peter Drucker (1989) The New Realities, Taichi Sakaiya (1991) The knowledge value revolution - or a history of the future, Tom Peters (1992) Liberation Management, Peter Drucker (1993) Post-Capitalist Society, and Stan Davis & Jim Botkin (1994a) The Monster Under the Bed: How Business Is Mastering the Opportunity of Knowledge for Profit.

In surveys of senior executives in major progressive corporations in the U.S. and Europe, executives repeatedly indicate that they now consider knowledge to be the most important asset of their organization. However, they also indicate that they do not have sufficient insight to deal with it and to manage it explicitly and actively. Others indicate that the KM concepts are unfamiliar and too complex and that they would rather work with simpler approaches -- even if these are not as effective!

This does not have to be! Knowledge can be dealt with effectively using proven methods. In the past, it has been possible to succeed well without paying much explicit attention to knowledge. Few were directly concerned with knowledge on a broad scale and distinct knowledge-based competition was only implicit. That is now changing with the worldwide realization that expertise is vitally important to satisfy increasing market demands for exceptional quality products and individualized services at reasonable prices. To compete successfully, therefore, organizations are now asked "do more with less," to work smarter -- i.e., to act intelligently with better knowledge more than ever before and to constantly improve to keep ahead.

These requirements are already very real. However, dealing with them successfully requires approaches that are not yet taught in business schools and few managers know how to approach the full breadth of these challenges. Responses through initiatives such as "total quality management," "learning organization," and "business function reengineering" are all appropriate but are limited by only dealing with separate parts of the challenge. Additional approaches are needed to deal with the specific knowledge-related issues and to manage knowledge assets on a broad scale.

Knowledge, Its Management, and the Intelligent-Acting Organization

The subtitle of this book implies that one of the most important goals for managers is to ascertain that their organization is intelligent-acting. Since this notion has not traditionally been of explicit concern for most, it immediately raises questions. What does it mean to be "intelligent-acting," and why is it important? If it is important, how can it be achieved? The main title also raises questions. What is "knowledge management"? Why is it important? How may it be conducted? And which role can knowledge

management play to achieve an intelligent-acting organization to the best degree possible?

Prudent managers need to understand answers to these questions before they can be expected to pursue knowledge management (KM) by devoting attention and committing resources. More than anything else, they need to understand how they can approach and adapt KM practices to fit their own situation. They need to be provided with a vision of the value of KM and the realization that it can be achieved. Most managers do not, however, need to possess the detailed knowledge of how to deal with **all** the facets of knowledge. That is the purview of the knowledge professionals and others who will perform the detailed work.

WHY ARE INTELLIGENT-ACTING ORGANIZATIONS DESIRABLE?

Intelligent-acting behavior is important in all knowledge work. We tend to think of it as particularly important in "valuable" problem-solving or decision-making situations such as those that set corporate strategy and other high-level functions. However, acting intelligently can be equally important "on the line." Improving the quality of the myriad of minute problem-solving situations cumulates into a significant improvement in knowledge worker performance for the organization as a whole and makes the difference between a high-performing organization and a well-intending, but stumbling organization.

At the risk of stating the obvious, we can identify several reasons why it is highly desirable to make the organization as intelligent-acting as at all possible. To sustain business effectively and successfully, an organization must consistently provide good products and services and secure customers who are willing to accept them and pay for them. For example we expect an intelligent-acting organization to:

- Identify markets, strategies, and operating principles that will bring lasting success and position the corporation advantageously relative to its competitors.
- Create exceptionally high-quality products and service offerings by being creative, knowledgeable, and well informed of opportunities, needs, and available capabilities.
- Provide exceptional customer service by responding vigilantly and creatively to individual customer situations and needs within the organization's practical constraints.

- Operate highly effectively by handling routine tasks, variances, and anomalies speedily, efficiently, creatively, and correctly with constant attention to preventing problems and exploiting opportunities.
- Learn continuously from an active pursuit of internal and external knowledge sources and learning opportunities.
- Balance and prioritize all its actions by prudently observing and weighing needs, opportunities, and constraints.
- Be considerate by taking into account broad objectives for the effect on all parties without jeopardizing the organization's own goals.

But these intermediate results, by themselves, are not enough. The intelligent-acting organization generates highly desirable bottom-line results as well. Thus, only when the results satisfy the organization's basic objectives such as improved market acceptance, competitive position, sales, and short- and long-term profitability does the intelligent-acting organization become desirable to the point that it merits management's top priority.

WHAT IS REQUIRED TO BE INTELLIGENT-ACTING?

Organizations primarily become intelligent-acting through the behavior of their people. However, other factors also influence the organization's ability to act intelligently. Overall, the major characteristics of an intelligent-acting organization include:

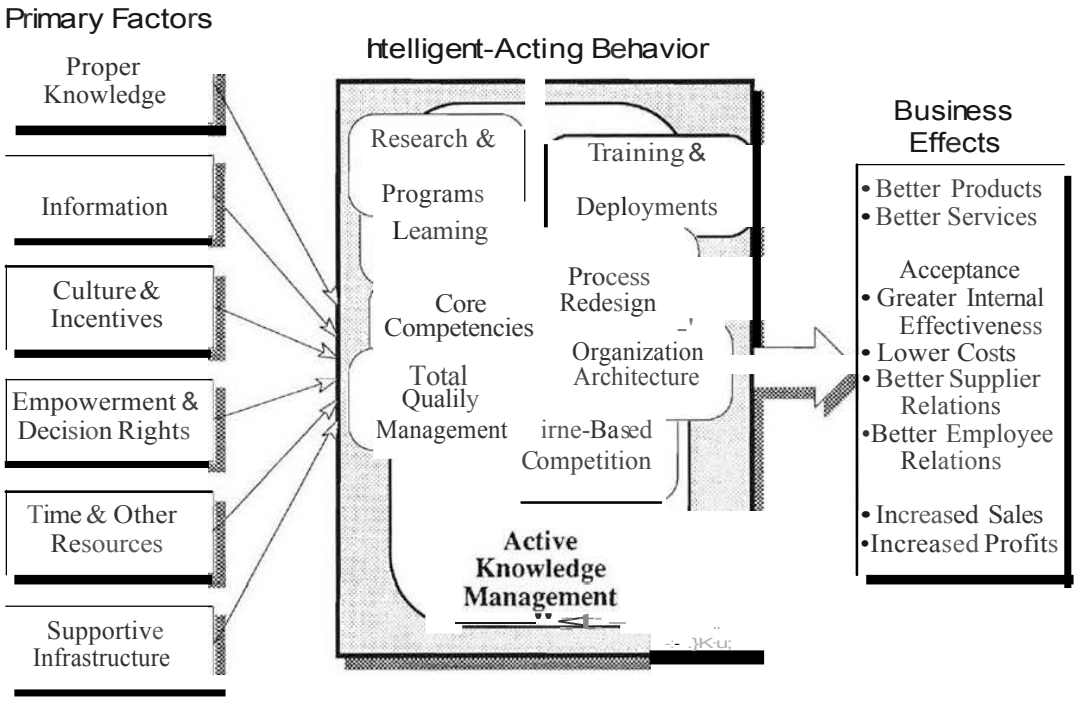
- Proper knowledge made available and accessible to every knowledge worker at all points-of-action and ascertaining that it is used effectively.
- Extensive information about work tasks, operational conditions, and all other situations and affairs that affect work, the knowledge workers, and the organization and its suppliers, customers, markets, and competitors.[1]
- Supportive incentives and culture that promote quality performance and use of the best approaches, methods, and knowledge that can be made available. They must also provide and support permission for individuals to innovate, learn, and improve.
- Delegated empowerment and decision rights that allow knowledge workers to take initiatives and act and to monitor and bring to conclusion the tasks they initiate.
- Initiative and encouragement to learn and seek continued improvements in all areas.
- Sufficient time and other resources to perform work that promotes the

[1]Thls factor includes Shoshana Zuboffs concept of an organization's need to be "informated," Zuboff (1988).

organization's goals.

- Supportive infrastructure and organizational configuration making it possible for knowledge workers to act intelligently on behalf of the organization. Systems, procedures -- even management and operational practices -- must be supportive of making the organization intelligent-acting.

Figure 1-1. Primary Factors and Resulting Business Effects of Intelligent Acting Behavior.



The most important and frequently overlooked factor relating to intelligent-acting organizations is that of making proper knowledge available and accessible. Knowledge workers must be given the knowledge resources to "work smarter," the capability to keep their knowledge up to date, and the permission to use what they know. These are the factors that provide the motivation for this work.

A schematic overview of the relations between primary factors, intelligent-acting behavior, and business effects is shown in Figure 1-1. Intelligent-acting behavior includes such management initiatives as "Learning Organization,"

"Core Competencies," "Total Quality Management," "Business Process Redesign," "Organization Architecture," and "Time-Based Competition." We also suggest that active KM underlies and supports these initiatives and is a major aspect of acting intelligently.

Most of these factors are closely related and are favorably influenced when people and, therefore, the whole organization act more intelligently. In fact, the very success of the organization is directly dependent upon how intelligent-acting it is possible to make everyone within it. Consistent intelligent behavior requires that both individuals and the organization: (1) Act in effective and acceptable ways; (2) Are well prepared; (3) Choose appropriate tactics; (4) Engage in excellent problem-solving; and (5) Make outstanding decisions and implement those decisions decisively -- that is, act! An overview of factors that we consider necessary for people and organizations to be intelligent-acting is presented in Table 1-1.

What Is Knowledge Management?

In its broadest sense, knowledge management (KM) is a conceptual framework that encompasses all activities and perspectives required to making the organization intelligent-acting on a sustained basis. KM includes activities to gaining overview of, dealing with, and benefitting from the corporation's knowledge assets. It pinpoints and prioritizes those knowledge areas that require management attention by identifying salient alternatives, suggesting methods for dealing with them, and conducting activities to achieve the desired results.

In a narrower and very practical sense, KM is a set of distinct and well-defined approaches and processes to find and manage positive and negative critical knowledge functions in different kinds of operations, identify new products or strategies, augment human resource management, and acrueve a number of other, highly targeted objectives. In so doing, KM addresses both managerial "top-down" and individual "bottom-up" activities. Of particular importance are the activities related to fostering individual behaviors that lead to innovation and discovery, knowledge creation, and improved knowledge use. Based on this definition, KM focuses on eight important areas:

1. Survey, develop, maintain, and secure the intellectual and knowledge resources of the enterprise.
2. Promote knowledge creation and innovation by everyone.

Table 1-1. Representative Requirements for Acting Intelligently.1

Exhibit effective PERSONALITY TRAITS:	
• Show initiative and responsibility • Adopt behavior suitable to the situation • Think before acting • Be flexible and responsive	• Be persistent • Be a good listener • Think independently • Be idealistic and principled • Be willing to self-correct
Be well PREPARED:	Choose appropriate TACTICS:
• Acquire knowledge from all sources and build it into an integrated and congruous whole • Be versatile • Be jnformed • Create new and important perspectives by integrating seemingly unrelated information • Understand the surroundin_g_ world	• Anticipate future developments and plan accordingly • Invest effort in proportion to the situation's importance • Coordinate with all relevant parties and build consensus when required • Take relevant actions when appropriate
Engage in excellent PROBLEM-SOLVING:	Make outstanding DECISIONS:
• Use all relevant "knowledge • Consider all readily accessible information --but use only what is relevant • Reframe the problem and consider different perspectives • Be imaginative, innovative, and creative • Analyze situations beyond what is apparent at the surface -- beneath symptoms • Discriminate and categorize • Reason rationally and make few errors	• Accept the challenge and take charge • Identify the objectives behind a situation • Consider all Televant alternatives • Consider consequences • Set priorities • Check reality of the best alternatives • Select the best alternative considering all constraints, objectives, and uncertainties • Communicate decisions convincingly • Implement decisions effectively

3. Determine the knowledge and expertise required to perform work tasks, organize it, make the requisite knowledge available, "package" it (in training courses, procedures manuals, or knowledge-based systems, for example), and distribute it to the relevant points-of-action.
4. Modify and restructure the enterprise to use knowledge most efficiently, take advantage of opportunities to exploit knowledge assets, minimize knowledge gaps and bottlenecks, and maximize the value-added knowledge content of products and services.
5. Create, govern, and monitor future and long-term knowledge-based activities and strategies -- particularly new knowledge investments -- R&D, strategic alliances, acquisitions, important hiring programs, etc., based on the determined opportunities, priorities, and needs.
6. Safeguard proprietary and competitive knowledge and control use of knowledge to ascertain that only the best knowledge is used, that valuable

1 Further discussions of what it means to be intelligent-acting can be found in Knowledge Management Foundations (Wiig, 1993), pp. 37-49.

knowledge does not atrophy, and that knowledge is not given away to competitors.

7. Provide KM capabilities and a knowledge architecture so that the enterprise's facilities, procedures, guidelines, standards, examples, and practices facilitate and support active KM as part of the organization's practices and culture.

8. Measure performance of all knowledge assets and account for them -- at least internally -- as capitalized assets to be built, exploited, renewed, and otherwise managed as part of fulfilling the organization's mission and objectives.

Four factors are particularly important in managing knowledge: (l) Efforts to create, acquire, and exploit competitively important knowledge to remain in a leadership position; (2) Daily management of knowledge to operate the enterprise smartly and effectively -- **intelligently** (this includes such aspects as producing and delivering quality services and products to the highest customer satisfaction and with the least effort, i.e., operating as inexpensively and environmentally desirable as possible without sacrificing quality and future viability);!(3) Building knowledge within the enterprise to take advantage of innovation and increased experience and the capability to pursue new opportunities; and (4) Having an explicit overview of the knowledge assets within the enterprise.

The KM perspectives presented in this book provide new ways to look at knowledge as it is used in business. The book offers selected perspectives for many types of knowledge-related situations. Some of the new approaches and processes are given as examples below, although detailed discussions of the processes and detailed approaches fall outside the scope of this book.2

KM should be considered as a complementary activity to valid, more traditional management perspectives and approaches. We do not think the present approaches are the only way to manage knowledge. Instead, we suggest that they provide feasible and valuable ways of dealing with many knowledge issues that previously have not been easy to address. Further, we believe it is necessary to be both flexible and vigilant in order to create new methods and perspectives as our collected understanding and experience grow in this area.3

1When we use the term "environmentally desirable" we consider the physical, economic, and social environment, as well as the organization's internal work environment.

2 Many KM methods are discussed in Wiig (1994) A Knowledge Management Framework.

3 As examples we can observe how different organizations like Chaparral Steel, Analog Devices, and Digital Equipment Corporation have approached their knowledge management

HOW CAN KNOWLEDGE MANAGEMENT MAKE THE ORGANIZATION MORE INTELLIGENT-ACTING?

Knowledge is the primary force that determines and drives our ability to act in general, and particularly to act intelligently. While that includes knowledge of our primary work function, it is typically essential also to possess a broad base of world knowledge and specific understandings of many different areas that are related to our work. Innate capabilities clearly provide the basics for acting intelligently, but without specific and general knowledge we cannot attain the necessary practical and subject-specific problem-solving and make the proper decisions. With improved knowledge, we can improve the quality of our work and generally progress by working smart, rather than hard -- both as individuals and as organizations.

With improved knowledge we will know better what to do and how to do it. We will also know why we can do something better and why it will serve us and our organizations well. These are basic reasons why the major purpose of KM is to make the enterprise intelligent-acting by facilitating the creation, cumulation, deployment, and use of quality knowledge.

Acting intelligently requires proficiency in many areas. Six separate knowledge domains need to be developed:[1]

- Knowledge of knowledge and thinking about thinking
- "World knowledge" of society, science, people, etc.
- Knowledge of primary work-related domain
- Knowledge of adjacent work-related domains
- Knowledge of private life, hobbies, etc.
- Basic knowledge of "walking," "talking," Three Rs, social skills, etc.

We postulate that the single most important factor in making the organization intelligent-acting is to make appropriate knowledge available and accessible -- and to make sure it is used. From this perspective, the management of knowledge -- its creation, preservation, organization, deployment, control, and exploitation -- becomes a key activity. To be effective, it must be well planned and be carried out deliberately, competently, and with appropriate momentum. As discussed throughout this book, many KM activities can be undertaken to make the organization intelligent-acting.

Examples of knowledge-related initiatives coordinated in this way include:

(Garvin, 1993).

1See Chapter 4 of Wiig (1993) Knowledge Management Foundations.

- Identify professional knowledge required to perform quality work -- particularly in mission-critical positions but also in other important areas and, ultimately, in all areas throughout the organization.
- Identify requirements and opportunities for knowledge building in all areas.
- Determine and coordinate knowledge transfer modes from knowledge sources -- through knowledge transfer functions for organizing, verifying, and validating knowledge, designing training program, and building knowledge-based systems (KBSs) -- in an effort to deploy the best knowledge in the most effective ways to points-of-action.
- Create and maintain a knowledge-supportive infrastructure.
- Foster development of a learning-promoting culture.

Approaches to building a knowledge-exploiting corporate strategy include:1

- Determine which products and services might be sustained and delivered with present and future knowledge capabilities.
- Decide levels of effort to be appropriated for knowledge-related activities and initiatives and assign priorities to each.
- Determine changes in organization operation and management practices to place the organization in the desired position.

As we become an increasingly aware knowledge society, we will find that all successful organizations manage their knowledge proactively and aggressively and that the knowledge focus is the most important area within management's purview.

Do More with Less! -- Use Knowledge!

Increased competitiveness, leaner organizations, improved quality, more favorable profitability, better standard of living, higher productivity, higher GNP per capita – in other words: progress through better performance – all depend on being able to do more, do it better, and preferably with fewer resources and often with fewer people. These are difficult challenges. We normally accept the fact that in order to achieve this tall order we need constant innovation, through incremental daily improvements as well as comprehensive "revolutionary" changes. Instead of working harder, we would like to achieve progress by working smarter -- as individuals and as

1See for example Deming (1986), Drucker (1993), Hammer & Champy (1993), Jacques (1989), Kanter (1989), Peters (1992), Porter (1985), and Zuboff (1988) for additional discussions of these factors.

organizations. In particular, we would like to act more intelligently.

There are many ways to work smarter and act more intelligently. We can make better decisions to avoid costly errors and choose more favorable courses of action. We can make quicker decisions to save ourselves and our customers time and money. We can collaborate with other departments, suppliers, and customers to improve the quality of our knowledge work and create better product designs in shorter time. We can reengineer and streamline our operations to implement totally new ways of operating or to cut costs and time. We can provide better information to prevent misinformed work. We can improve the nature of our products and services to make them more valuable. We can leverage ourselves by using automation. All these, and most other ways to work smart and intelligently depend directly on people possessing good personal knowledge as well as access to expert and institutional knowledge. Therefore, the central challenge is to create, build, and leverage knowledge on both the personal and organizational level

A second challenge is associated with managing knowledge more broadly. That deals with the need to embed the best conceivable knowledge in products and services to make them as valuable as possible to customers. Thus, the goal is not only to increase the immediate demands for our offerings, but also to increase our customers' capabilities and quality of life and thereby create customer loyalty and a lasting leadership position for ourselves..

The Value of Knowledge ·A Beginning Perspective

When asked, American executives respond that their company's most important asset is the knowledge held by their people. At the same time, however, they admit that they do not know how to manage this asset properly. Furthermore, they say that more effective management of knowledge within their firms is highly important and that active and explicit KM is a requirement to remain competitive in the 1990s and beyond.

These executives also note that they consider the issue of handling knowledge to be very abstract and complex, making it difficult to "wrap their arms around it." But they also admit that once they see good and practical guidelines, they will be ready to adopt KM approaches and be willing to devote the necessary resources to obtain whatever business advantages may be

possible. Already a few highly advanced firms have started to work actively on how to manage knowledge. Some companies have teamed with others to form public collaborative consortia to develop proprietary ways to manage knowledge.

Managers and professionals must be provided with relevant understanding of knowledge, how it is used in the business and operation of any enterprise, and how it can be organized and managed to improve how we work and, thereby, the enterprise's performance. We need a coherent and practical framework for KM for it to be useful within the high-pressure environments of the modern enterprise. This book presents emerging practical experiences with managing knowledge that have proven useful in the hands of progressive managers who work to make their organizations act more intelligently as discussed in greater detail in the next chapter.1

THREE THEMES OF KNOWLEDGE MANAGEMENT

1.Krwwkdge Is the Foundation of the Whol,e Enterprise

Three major themes underlie the concept of KM. The first theme is: Knowledge is the *foundation* of all functions and aspects of the enterprise. Without its knowledge, an enterprise could not continue to operate and exist. Its organization and management structures, traditions and culture, technology and operations, systems and procedures, and the quality of its services and products are all based on and embed the enterprise's knowledge and expertise. As indicated in Figure 1-2, "Knowledge and expertise underlie the success of your enterprise!" Continually, there are opportunities to learn how to improve knowledge -- and with it, the way the improved knowledge performs when used -- from internal and external information feedbacks.

2.Krwwkdge Management Must Make the Enterprise Intelligent-Acting

The second theme is: KM's purpose is to make the enterprise intelligent· acting -- to innovate, to make creative and sound decisions, and to produce high-quality knowledge work continually at all levels thereby creating and

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1The purpose of knowledge management is to foster and promote intelligent behavior. Intelligent behavior requires individuals and organizations to be: (1) Be well prepared; (2) Choose appropriate postures; (3) Engage in excellent problem-solving; and (4) Make outstanding decisions.

delivering more valuable products and services and improving the organization's overall effectiveness. The nature of KM is to build and leverage knowledge -- to facilitate the creation, cumulation , deployment, and application of quali ty knowledge. It is of the greatest importance to the modem , progressive enterprise that all its knowledge be of the highest quality and that only the best knowledge is made avaHable to all levels and as close as possible to the function where it will be used and can have the greatest impact.

3. The Best Knowledge Must Be Embedded into Ml Products and Services

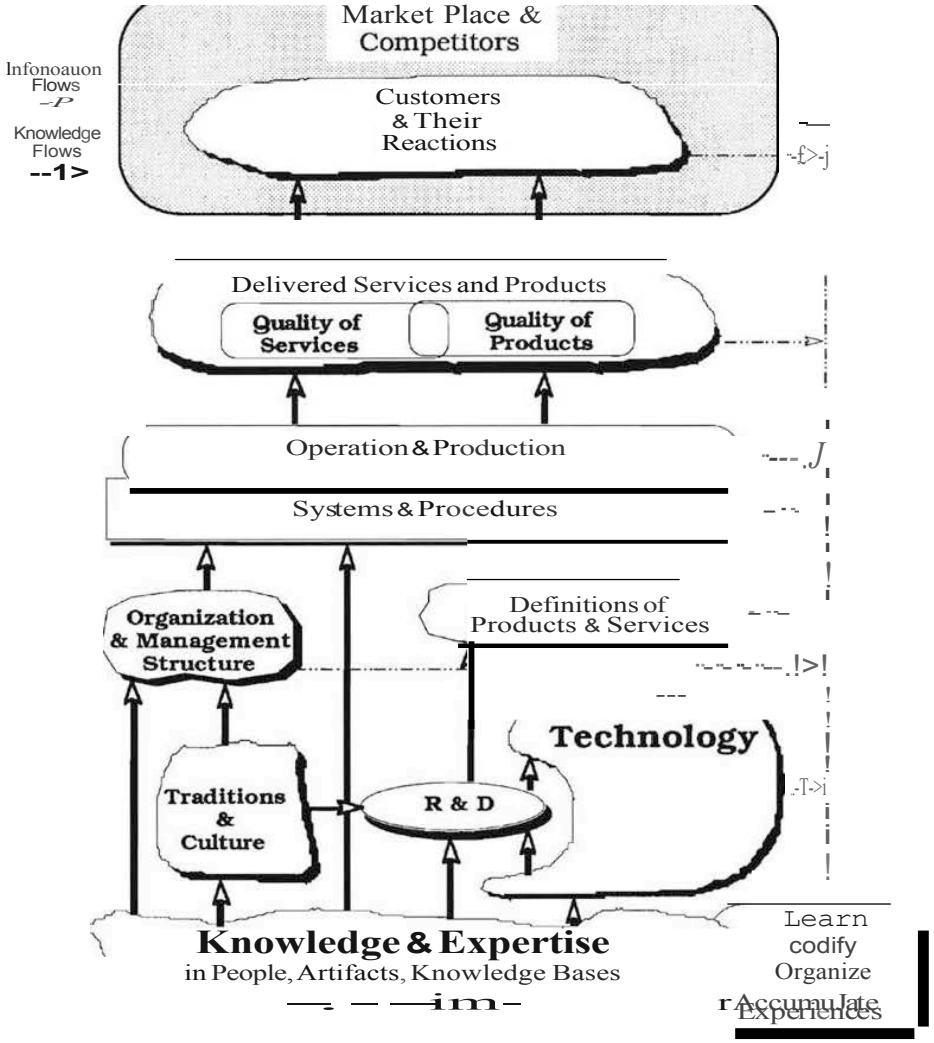
The third theme is: Embed knowledge -- *in all applicah/,e manifestations* -- into all the enterprise's products and services and its systems, procedures, and management practices. The value to customers of an enterprise's products and services is directly related to the quality of knowledge embedded within them. Excellent knowledge may be manifested as superb product technology or as creative designs that make the products easy to use. Knowledge may also be embedded in services as relevant customer support and advice that reduces customer costs and increases value.

Important as management of knowledge is, we do recognize that it comes as an add-on to other important areas to which executives must pay attention, including the company's finances, customer and supplier relations, the loyalty and happiness of employees, effectiveness of operations, and visions and plans for the future. To be of real value, it has to be incorporated using efficient and systematic methods. Besides, it must be implemented with care to ensure it becomes a vital benefit rather than a burden.

One fundamental management function is to coordinate and motivate people to realize the best use of their knowledg e. Enterprises expend substantial resources to train people and codify knowledge in manuals, training programs, and a wide variety of on-the-job education and other activities. In short, KM has been a direct, if not explicitly stated, focus for managers for a long time. However, at times, corresponding incentives and organizational changes have not been made to follow up the intents to encourage people use knowledge to best advantage.

However, the lack of framework for managing knowledg e on a broad and relevant basis has been a problem for managers. That is, they have not had ways of "thinking about thinking" with practical directions for how to deal with all required knowledge-related aspects and supported by practical methods.

Figure 1-2. Knowledge and Expertise Underlie the Success of Your Enterprise!



Many indicate that it is particularly difficult to obtain overview of where their attentions are required -- much less how they should set priorities among the critical knowledge areas that they already know about.

From a cognitive perspective, we use knowledge on four conceptual levels.[1] (1) Goal-Setting or Idealistic knowledge: We use selected, often partly

[1] See Appendix A for explanations of the four conceptual knowledge levels.

understood knowledge to represent the extreme in ideals and sophisticated concepts to form our goals and beliefs and to ju stify why we proceed in particular directions. (2) Systematic knowledge: We use other knowledge that may be more theoretical and systematic, and often better understood, to guide our insight into specific approaches that must be followed to achieve our goals. (3) Pragmatic knowledge: We use explicit knowledge that pertains directly to the tasks we perform to reason with and make deliberate decisions based on "how things work." And (4) Automatic knowledge; We have some knowledge that we are so familiar with that we have automated it and are able to use it without thinking explicitly about it.

All of use idealistic knowledge to generate ideas and an understanding of what is possible, what we should strive for, and thereby obtain conviction that it is feasible and achievable. We use systematic knowledge to give us a basic understanding of how things work and how to proceed. Such knowledge allows us to map out the strategies, tactics, and specific programs that enable us to pursue our goals. We use pragmatic knowledge to provide us on an ongoing basis with judgments and insights required for the daily implementation of our plans -- to manage, coordinate, and control the implementation of projects. Finally, we use our automatic knowledge to make the minute decisions and perform the detailed knowledge work from minute to minute that proper implementation requires.

These are some of the many aspects of knowledge that we need to be cognizant of to be able to manage these resources -- to build them, deploy them, and ascertain that they are used to the enterprise's best advantage. As indicated by the four conceptual knowledge levels, there are many aspects of knowledge that allow us to identify how we can make our employees more valuable knowledge workers by giving them broader horizons and deeper and more flexible knowledge.

Why Should I Be Concerned about Knowledge Management?

Many executives ask this very valid question. From one perspective, KM is a new concept with unproved approaches. Therefore, many think it is wise to wait until additional experiences and many applications have been reported before investing valuable personal time and company resources.

From another perspective, knowledge is the most valuable asset of the

enterprise and its active and well coordinated management is long overdue. In addition, with our entry into the "global knowledge society" where knowledge more than ever provides the competitive edge, many consider KM to be critical to company survival and competitive position. In addition, it takes several years before a broad KM program can be operationalized. Therefore, if two years from now, KM is judged to be of immediate importance, it may be too late to start since more progressive competitors will already have gained an unreachable head start.1

To get a better understanding of KM, it may be helpful to review some of the motivations, approaches, and experiences reported by enterprises that have actively pursued KM. As illustrated in the following examples, Table 1-2, as well as by examples throughout this book, the applications areas are diverse and the approaches can vary widely.2

EXAMPLE: FIND AND MANAGE THE MOST IMPORTANT KNOWLEDGE AREAS

The executive management of a large, high-technology engineering and manufacturing organization realized that the major value-added contributions to their products were derived from their employees' knowledge and expertise. The company's technology could be viewed as manifestations of part of this knowledge and continued to increase in value as more of the employees' expertise was incorporated.

The company's role was as marketer, designer, specifier of components to be manufactured by others, and as assembler and integrator of final products. Realizing this situation, executive management wanted to gain an overview of critical knowledge throughout the organization to identify the major knowledge areas that should receive management attention and be strengthened to maintain the company's advanced competitive position.

A small and highly competent multidisciplinary task force was assembled to survey knowledge and its use throughout the organization. The members had advanced degrees in technology, management, psychology, and therefore, philosophy and most were long-term employees of the company and, well acquainted with all its operations. Information was gathered through several hundred comprehensive interviews with

1 Stewart (1991) pTovides a number of examples of companies that consider "Brainpower" management to be of utmost competitive importance.

2 The examples provided here were considered by the firms to offer important competitive advantages. We were not able to name the companies involved, nor were we permitted to describe precisely the situations or experiences. We have, therefore, hidden the identity of the companies and altered the precise nature of the situations.

senior and middle managers over a one-year period. The main objective was to find the most important "Critical Knowledge Functions" and the best competitive knowledge and relate them to the way business should be conducted in the future. Another objective was to determine potential management actions that would improve these situations. Scenarios were assembled of how the world could be expected to evolve and how business could be conducted in the future.

A large number of highly valuable areas of expertise were identified in individuals and teams and many critical knowledge functions were described. The areas of competitive expertise were analyzed further to ascertain that they would play a role in the corporation's strategy and that appropriate plans for continued building were in effect.

Six general areas were found to be of enough importance to require top management's attention. Additionally, many situations requiring middle management attention were also identified and outlined. The six major areas were:

- *Product design knowledge - particularly, the knowledge associated with practical application of advanced theory to final products so these products would perform exceptionally well in both the short and the long terms.*
- *Subcontract procurement knowledge - in the areas of finding and developing competent contractors, and working with them to modify design specifications within allowable limits to obtain products with acceptable quality that could be produced in minimum time and at reasonable costs.*
- *Manufacturing coordination knowledge - to help manufacturing with early discovery and correction of potential production problems and to translate design specifications and requirements into manufacturable designs.*
- *General personnel management skills - in all levels of management to foster better esprit de corps and improved identification of up-and-coming technical and business leaders.*
- *Information systems and computer sciences application expertise - in both management information system (MIS) staff and user organizations to better conceptualize information technology uses to support business and technical operations and to help change the way of doing business.*
- *Overall technical knowledge - in professionals and labor, on both the theoretical and applied levels, with particular emphasis on understanding technology in addition to obtaining in technology-use skills. Breadth of knowledge was also considered to foster fiexibility and understanding of the tasks and problems of "adjacent" functions.*

Based on the results of the survey, the company embarked on a focused program to improve knowledge in the six areas through formal education, internal courses, apprenticeships, and other modes of building skills,

understanding, and expertise in relevant personnel. Top management created special budgets for this purpose and is now monitoring improvements and conditions on a regular basis.

In addition to identifying the most important critical knowledge areas, the team also explored ways to implement knowledge-based systems throughout the organization. It had collected sufficient information to allow an initial description of the system candidates and their potential benefits. This preparation allowed senior management to rank the candidates and set priorities for implementation of systems and to create a knowledge-based system development program.

The program has now been underway for several years. In addition to top management's involvement with the six major knowledge areas, a large number of knowledge-based systems have been implemented and are in full operation with considerable economic and noneconomic benefits.

EXAMPLE: CONDUCT A STRATEGIC KNOWLEDGE AUDIT TO CHANGE CORPORATE STRUCTURE AND DIRECTION

The top management of a large process company became aware that they were a "knowledge-based" company and that their major competitive advantage was the knowledge and expertise their people possessed. Since they had never gained a good overview of knowledge assets and shortages within their enterprise, they decided to conduct a comprehensive knowledge audit to set the stage for wide-ranging changes. A broad study was undertaken to survey and describe the condition of knowledge and relate it to both business and competitive situations in different areas and to its technology developments and opportunities. Knowledge was characterized in general terms, but was covered in enough detail to describe knowledge use, business functions, and company operations. Several hundred operations and product lines were investigated and additional knowledge-intensive functions were analyzed.

Top management was surprised by the findings. In key areas of work, mismatches were found between those who possessed the knowledge required to get the job done and those whose function it was to do the job. Besides, people's work contacts and their reporting relations were at odds with the required knowledge flows and with professional groupings that supported the most important areas of knowledge work.

It was also discovered that many pieces of key knowledge that would have significant competitive impact were missing. These gaps had never been brought to management's attention, and in many cases it was not clear that anyone was aware of the situation; furthermore, no plans existed for supplying the missing knowledge. Finally, there was no focus on, no comprehensive plans for, and little or no monitoring of the development, maintenance, and extended use of key expertise within the enterprise.

As a result, a broad and integrated action plan was developed and reporting relationships and professional groupings were reorganized. Further, the organization was simplified and management levels were reduced by spreading knowledge and delegating functions. Several R&D programs were also revised and new R&D projects were established to develop some of the missing knowledge. Additional key knowledge was obtained through acquisition of a small company. R&D planning was coordinated with marketing and management using a new "partnership model."

Human resource management had previously been responsible for general training and education coordination. This function was redesigned to serve the joint focus of technical-business-management, and tools were provided to maintain overview of the knowledge status, gaps, and progress in personnel and relate it to present and future business needs. Finally, the overall strategic and annual planning process was augmented to include explicit knowledge perspectives. In this context, management reviews at all levels were revised to include knowledge perspectives. As a result, the company now continues to perform KM audits on a regular basis.

The process company, to our knowledge, has not quantified the benefits from its KM program. Management considers the benefits they have obtained to be strategically very important. There have been indications that the efforts have made the company much stronger both from both a competitive and financial a point of view.

EXAMPLE: BUILD A KNOWLEDGE-BASED SYSTEM TO EXPLOIT THE VALUE OF PROPRIETARY KNOWLEDGE

The marketing department and executive management of a medium-sized financial institution had explored new product opportunities for their marketplace. They identified that the institution had expertise in financial planning for individuals and that this knowledge potentially could be leveraged further if made available to the public at large. It was decided to harness the knowledge assets by building a large, sophisticated knowledge-based system (KBS) to provide financial planning services for families with average incomes. Where new conditions made prior knowledge invalid, the available expert knowledge was elicited and codified and was augmented with new research. A new subsidiary was created to provide the service to the marketplace and to operate and maintain the KBS.

The direct effect of offering the new service was the building of a considerable customer base. Revenues from the services paid only for variable operating costs of the new subsidiary. However, a highly valued side benefit was the new knowledge that was developed and codified to develop the knowledge base for the system. This knowledge was considered

priceless for having changed and improved the way financial planning was performed. Although the immediate bottom-line benefits were few, the long-term objectives were to improve the institution's corporate image and to attract new customers for the its other services. These benefits seem to be realized and the project is considered a success.

These examples illustrate only a few of the areas where KM can play a significant role. They do, however, show that KM deals with aspects such as the need to obtain overview of the knowledge and expertise that are available in the enterprise and how they are used, the potentials for managing knowledge using conventional as well as advanced methods, and the need to rethink the way one would like to do business. We are told by managers who pursue KM that they basically look for four things:

1. To make their organization consistently act more intelligently.
2. To better use and exploit the available knowledge within their company.
3. To improve knowledge building -- organizational learning -- and retention of what has been learned.
4. To gain better overviews of where they should direct efforts to improve attainment of the enterprise's goals.

THREE PILLARS OF KNOWLEDGE MANAGEMENT

To manage knowledge effectively and securely, we need to assemble into a coherent framework all valid and relevant perspectives and approaches known to us. With our present understanding, we can visualize a KM framework based on three mutually supportive pillars that rest on a solid foundation as illustrated in Figure 1-3.

These pillars, which connect KM to its foundation, consist of a number of methods and approaches that can be drawn upon to meet a variety of different demands and challenges:

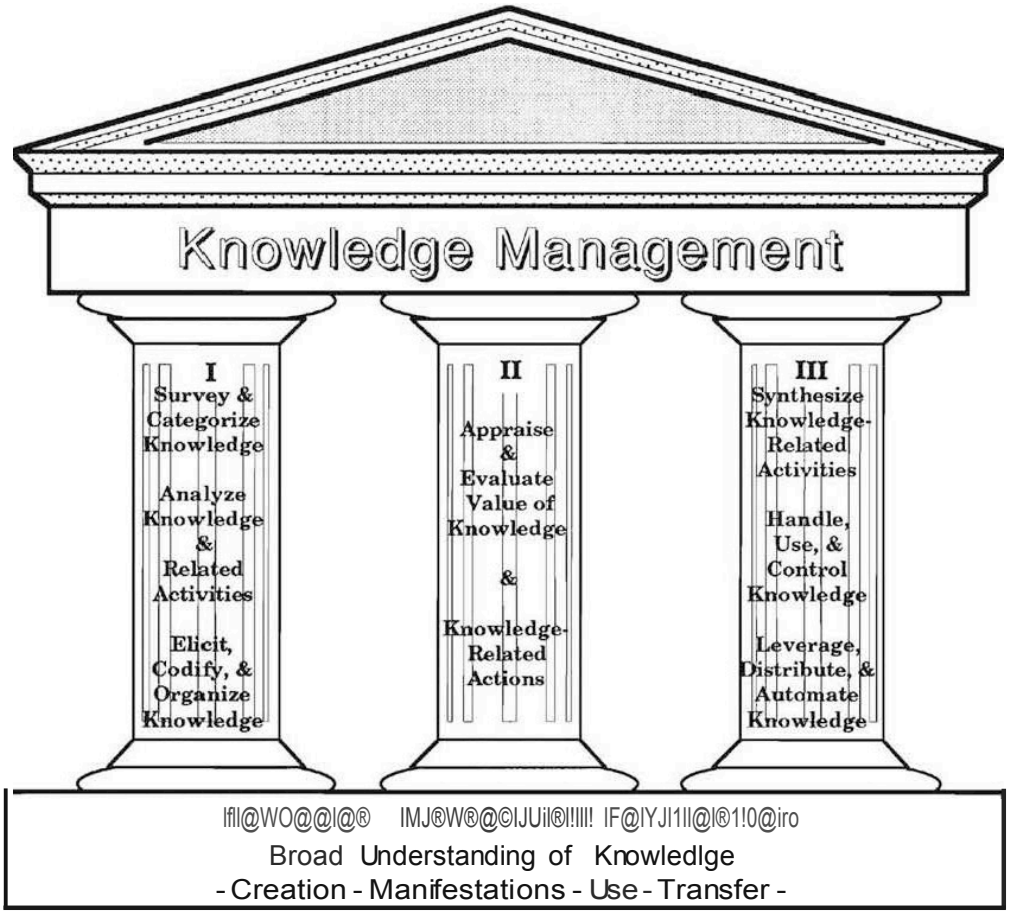
I. Explore the Knowledge and Its Adequacy
   - Survey Knowledge.
   - Categorize Knowledge (i.e., describe and characterize).
   - Analyze Knowledge and Knowledge-Related Activities.
   - Elicit and Codify Knowledge.
   - Organize Knowledge.

II. Find the Value of Knowledge
   - Appraise and Evaluate the Value of Knowledge and Related Actions.

III. Manage Knowledge Actively
   - Synthesize Knowledge-Related Activities.

Handle, Use, and Control Knowledge.
Leverage, Distribute, and Automate Knowledge.
Implement and Monitor Knowledge-Related Activities.

Figure 1-3. The Three Pillars of Knowledge Management.



The framework's foundation is based upon our general understanding of knowledge. That understanding focuses on how knowledge is created; manifested in people's minds as well as in procedures, culture, technology, and organization's structure, systems, procedures, practices, and culture; used to reason, solve problems, make decisions and other knowledge-related work by individuals and businesses; and transferred -- that is, bow we learn

and how we otherwise can capture and exchange knowledge.

The methodologies and approaches of the current KM framework must be considered only preliminary. They will improve and be modified as we gain more experience with applying KM and thereby develop a better understanding. The framework is presented to create a working understanding of the methodologies and approaches, to show how they relate to each other and to the overall task of managing knowledge, and to illustrate how the concepts and methods are made useful in business. The framework is presented in detail in Volume 3 of this series.1

Traditionally,knowledge has been managed **operationally** by the managers directly responsible for a particular function. Often activities were devised or selected to take care of immediate problems, almost to the point of "fixing symptoms." In contrast, the KM framework, supported by the three pillars, provides approaches for both immediate and higher level managers to look at underlying funetions and problems of knowledge-related issues. These individuals can use these framework approaches to plan their actions based on how well they serve the broader needs and goals of the enterprise.

The concept of KM may bring to mind many images and associations. Some stem from preconceived ideas of what such a concept "should be," others spring from visions of what the concept "could be." A few of the "what-it-is" and "what-it-is-not" aspects are outlined in Table 1-2.

How Much Should an Organization Know about Knowledge?

To be able to deal effectively and explicitly with knowledge, an organization needs to be able to bring "knowledge professional" expertise to bear to build, organize, and deploy knowledge. However, deep understanding of knowledge itself and its management is not needed by large numbers of people within an organization.

Even if knowledge is the organization's most important asset, knowing about knowledge should, to a great extent, be tailored to each employee's needs. That is, deciding how much each person should know about knowledge is similar to determining how much employees need to know about their basic professional area versus ancillary areas such as organizational practices,

1Wiig (1994) A Knowledge Management Frameworlc Practical Approaches to Manage Knowledge.

Table 1-2. What Knowledge Management Is, and What It Is Not.

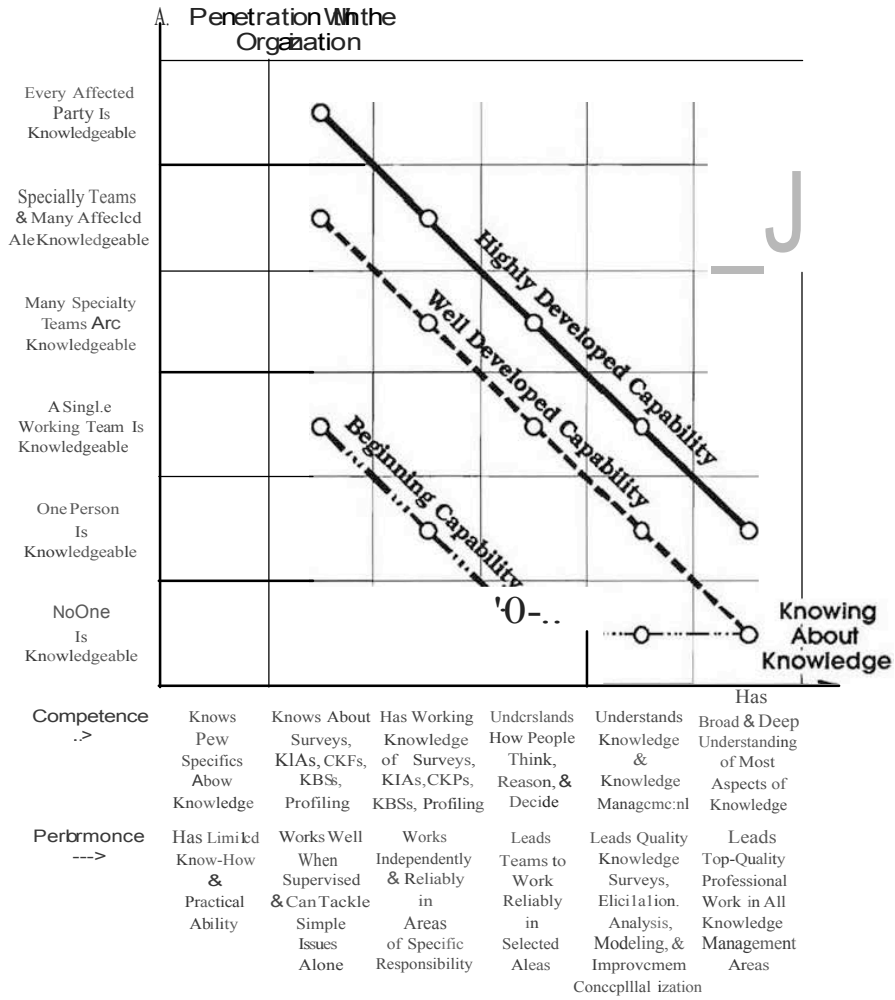
WHAT IT IS
• A management philosophy that takes explicit advantage of knowledge to make the organization act more intelligently.
• A management initiative that views and understands knowledge as it is used in operational situations and for long-term strategic improvements.
• Ways to find, analyze, and focus on critical knowledge areas and associated management opportunities, and ascenain that proper knowledge is available wherever needed.
• Methods that allow managers to identify and characterize knowledge contents, needs, and opportunities associated with specific operations.
WHAT IT IS NOT
• A set of isolated techniques without a common framework.
• A different label for human resources (HR) management and training.
• A standardized methodology for "how-to" KM.
• A different name for "expen systems."
• A set of computer application programs.
• A system to control distribution and security of knowledge.

systems and procedures, and TQM philosophy and methods.

Three examples of organizational capabilities are illustrated in Figure 1-4. A "Beginning Capability" is often found where a single individual has working knowledge of many of the KM concepts and methods -- knowledge surveys, knowledge-intensive activities (K!As), critical knowledge functions CCKFs), knowledge-based systems (KBSs), and knowledge profiling. That person is able to perform reliable independent work using some of these methods and to develop a small team that tackles selected types of knowledge-related problems, perhaps building "expert systems" if their background is systems-related. Only after an understanding of basic KM perspectives and methods is shared by a large number of people, can the organization approach effective handling of knowledge.

To be described as a "Well Developed Capability" -- the next step -- basic knowledge must be spread to many individuals -- managers and knowledge workers at all levels -- who need to know. At this level, specialty teams possess good working knowledge of general KM methods. A single elite team has deeper understanding of how people and organizations process knowledge and its members lead teams to work on more difficult problems. A single individual has further understanding of broader KM issues and approaches and serves as the organization's strategic resource for how to manage knowledge in general. Finally, a "Highly Developed Capability" requires broad sharing of KM perspectives and methods and as well as considerable long-term investment in education and training.

Figure 1-4. Three Examples of How Knowledge Management Expertise Must Be Built and Spread to All Who Need It.



These illustrations are not specific recommendations. Individual organizations have varying needs depending on their size, make-up, and management direction and practices. In general, however, knowledge about managing an important resource that affects all individuals in the organization requires that everybody has a minimal level of awareness in order to avoid neglect and haphazard decisions.

Knowledge Work Changes Our Business Environment

In recent years, considerable change has taken place in work environments and in the levels of professional and operational knowledge required to keep companies competitive. Senior business commentators have suggested that we are moving towards a "global knowledge society" and that we are in the midst of a "knowledge value revolution."[1] Further, it is commonly agreed that businesses and industries are becoming more complex and knowledge-intensive -- a trend that will continue and, indeed, intensify in the next decade.

Karl Erik Sveiby and Tom Lloyd[2] discuss how different organizations have become what they term "knowhow companies." They distinguish between four types of organizations: (1) The factory; (2) The office; (3) The agency; and (4) The professional organization. Their point is that the worth of these organizations have shifted from financial and physical assets to "knowhow resources" or knowledge assets -- they have become knowledge-intensive organizations.

As a result of these changes, business operations in manufacturing and service companies have become more streamlined, requiring increased knowledge to operate efficiently.[3] Also, enterprises are flattened, increasing the need to make knowledgeable decisions at lower levels. Further, cycle times for customer service response, design, manufacturing, and orders and delivery have been shortened. At the same time, emphasis on improved quality has made it necessary to introduce better knowledge and information earlier in the process, in more distributed locations, and closer to the customer. This situation is further complicated by an uncomfortably high mobility of the best and most knowledgeable people, paired with a less-than-ideal preparedness of entrants into the labor force as so often brought up in current debates on our educational system.

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1 See Taichi Sakaiya (1991) The Knowledge Value Revolution for an in-depth discussion of how corporate customers and consumers have started to consider the quality of the "knowledge content" an important factor in their purchasing decisions.

2 Sveiby & Lloyd (1987). Managing Knowhow, p. 24-26.

3 For discussions of fundamental changes in business and society as a whole, see Henry Kelly et al. (1988) Technology and the American Economic Transition and Shoshana Zubotf (1988) In the Age of the Smart Machine.

The emphasis on better and more information has also increased as our information-handling capabilities have improved. To illustrate: In 1980, information equipment investments as a fraction of all producer durables investments was 20% in the United States. In 1986 it had doubled to over 40%, and in the early 1990s it is expected to exceed 50%.1 Similar growths are evident elsewhere, in both industrialized and developing nations.

The new systems and work practices have yielded enormous value to their owners. But they have also increased the flow of information to knowledge workers at all levels, making available more relevant information than most have the time and knowledge to interpret and use. The lack of appropriately placed knowledge has led to considerable knowledge opportunity gaps in many enterprises. It has also led to many situations where the increased sophistication and information generation have not produced the anticipated and potential benefits and improved performance. The bottlenecks have shifted from quality and timeliness of information to the quality and availability of knowledge at the point-of-action.

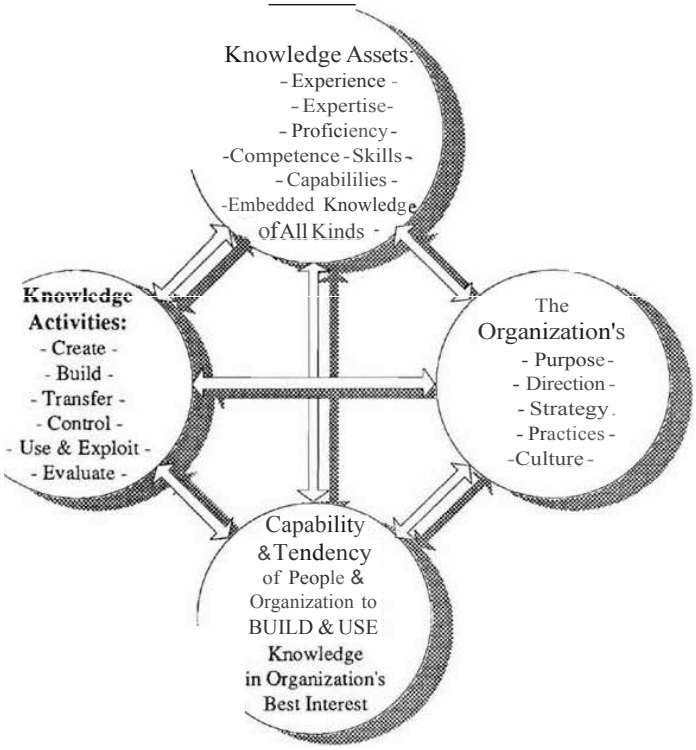
Knowledge Can Be Managed Effectively!

It is the experience of many managers that knowledge can be managed effectively. People have always managed knowledge but with different degrees of awareness and effectiveness. Presently, there is an increasing understanding that it is both effective and profitable to manage knowledge actively and explicitly, particularly when done with a specific focus and as a deliberate activity using approaches and methods that are well designed and adapted to the organization. This understanding is built upon the realization that once frameworks and practical methods become available and internal teams can be established, it makes great sense to devote management time and company resources to exploit existing knowledge assets and steadily better them by improving deployment of knowledge and thereby increasing the capabilities of personnel, operations, products, and services through active KM.

KM requires active coordination of several activities, assets, and other factors within the organization. In particular, as illustrated in Figure 1-5, four areas of the organization must work well together:

1U.S. Department of Commerce, Bureau of Economic Analysis: "National Income and Product Accounts," historical diskettes, Table 5.7.

Figure 1-5. Four Key Areas of Knowledge Management.



L Knowledge assets in people, technology, and all other manifestations such as organizational structure, work flows and division of labor;

2. Activities to build, exploit, and safeguard knowledge assets;

3. Willingness and capability by all in the organization to build and use knowledge effectively to obtain the best benefits; and

4. Organization's goals and moving forces that must benefit from and support the detailed application of available knowledge.

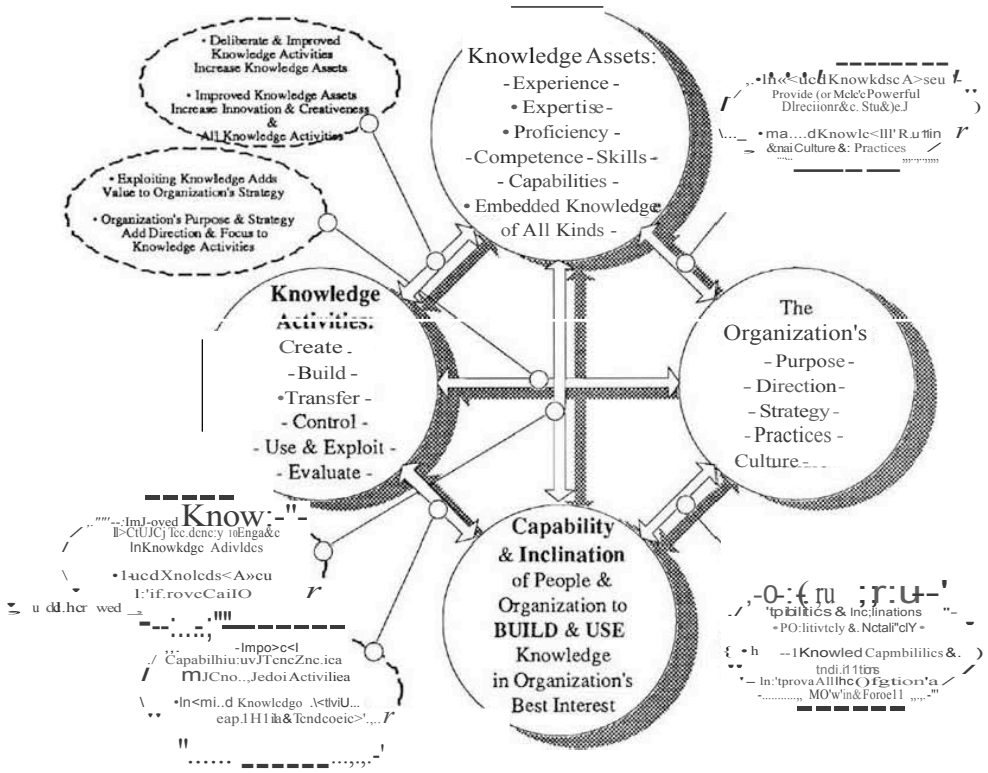
These four key areas of KM influence each other directly. Without direct and attentive management attention to all four areas and their interrelations, therefore, effective intelligent operation cannot be achieved or sustained. Some examples of the nature of these interrelationships are shown in Figure 1-6.

Some of these interrelationships reflect well-known and accepted relations such as: "Improved knowledge assets increase innovation and creativeness." Sveiby and Lloydl discuss in-depth how many organizations already have

1Sveiby & Lloyd (1987). Managing Knowhow, pp. 98-106.

started to manage knowledge -- although often without realizing explicitly that this is what they do. These authors suggest ten success factors for "knowhow" management: (1) Day-to-day leadership; (2) Quality and quality control; (3) Respect for knowhow; (4) Combination of professional and managerial knowhow; (5) Strong, well-defined culture; (6) Focus on core knowhow; (7) Knowhow preservation; (8) Development of people; (9) Changes in key people; and (10) Stable structures.

Figure 1-6. Examples of Interrelationships Between the Four Knowledge Management Areas.



Other interrelationships may be tentative and reflect beliefs that are particular to individual management teams. Some relationships generate "positive feedback." They act upon each other to make a snowball effect -- increased knowledge leads to increased knowledge use, to increased value-added, to improved work practices and corporate culture, to improved capability to build and use knowledge, to increased knowledge use, and so on.

We can see this in many organizations where greater emphasis on knowledge and knowledge-related activities breeds a spiraling effect with very beneficial results.

KM needs not be time-consuming or difficult when proper approaches are used. Besides, it becomes easier when these activities are integrated with other initiatives such as TQM, HR, planning, and management sciences, and when supported by information systems. When KM is introduced into other programs, these additional perspectives help explain many problems and suggest better solutions. Several examples of the value of relatively isolated KM actions in a number of U.S. companies were illustrated in a 1991 FORTUNE article on "Brainpower."[1]

As shown, the KM rests on approaches that provide a starting capability to gain overviews, define interesting and critical situations efficiently and in enough detail to determine how to deal with them, and assess the value of potential actions to set priorities. The approaches also help establish and facilitate ways to characterize and organize the knowledge and expertise, implement the required actions, monitor and control proper implementation, and assess the performance once the changes are operational.

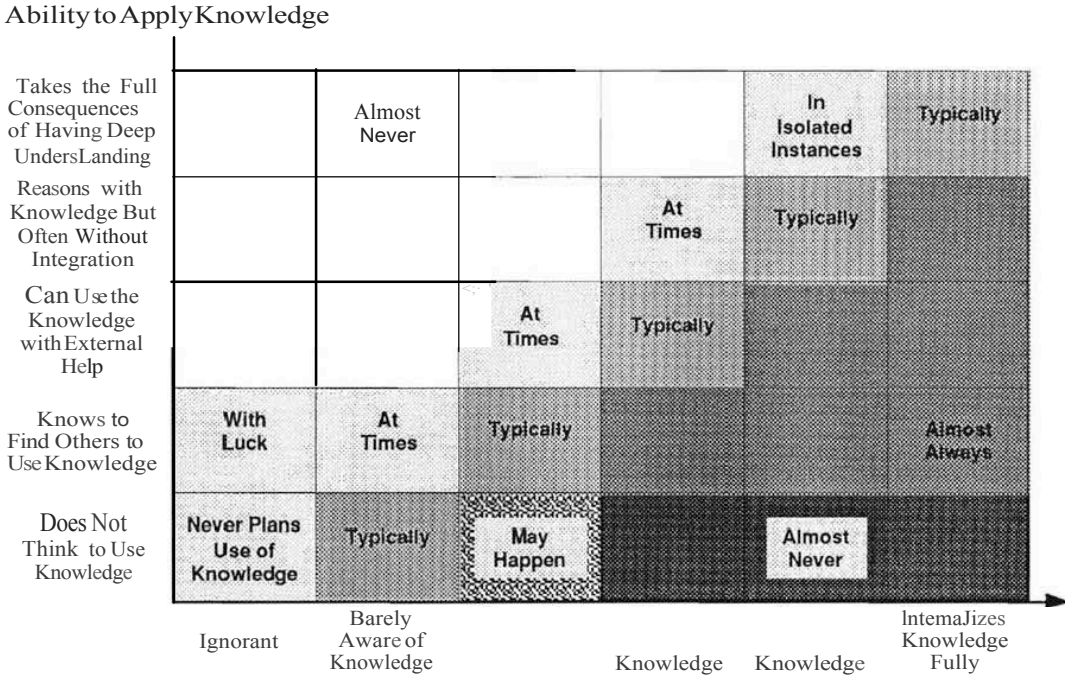
One aspect of the value of managing knowledge is illustrated in Figure 1-7, where the ability to apply knowledge is shown as a function of the degree to which knowledge is internalized by individual knowledge workers. As expected, people who are ignorant about a knowledge area may never plan to use knowledge from that area when they consider how to approach a task. Similarly, as experts internalize knowledge, they either use the knowledge themselves or have others use it when relevant. As one starts to manage knowledge within the enterprise, it becomes routine to identify which knowledge is required, at what level it must be made available, and what its value is in each situation. When this understanding becomes explicit, it becomes clear to which extent knowledge investments are required in certain areas to ensure the desired results.

Until the advent of the computer, there had been no breakthroughs in management of knowledge since printing was invented. And to this day, the reigning paradigm of how to exploit knowledge is often passive work aids or conventional libraries filled with collections of static knowledge combined with a person who interprets and applies that knowledge to do work. Yet, applied artificial intelligence (AI) has been developed into a practical and reliable

[1] Stewart (1991) "Brainpower." Fortune.

technology for managing knowledge. New paradigms are introduced to deal formally with simpler aspects of explicit knowledge such as eliciting and codifying knowledge and implementing knowledge-based (or expert) systems. Thus, it has become possible not only to capture, codify, and deliver static and explicit textbook knowledge, but also to automate less complex aspects of the dynamic and tacit knowledge and reasoning strategies that humans employ when they put expert knowledge to use.

Figure 1-7. The Ability to Apply Knowledge as a Function of How Well It Is Internalized by Knowledge Workers.



Many business authors have described commercial developments and future prospects of applications of artificial intelligence (AI). Considerable advances have been made over the last decade. Moreover, much of the hype and many of the problems that earlier clouded the use of this technology have been corrected and the industry has become more mature. In addition to conventional methods of managing knowledge, we are now able to leverage and deploy corporate knowledge assets by automating selected expert

reasoning to increase business advantages. Many of these capabilities and their realized business values have been discussed by David Hertz and Edward Feigenbaum et al.1

In support of these approaches, most Fortune 500 firms now have significant knowledge-based systems in operation with new projects underway. However, use of computers, information systems, expert systems, and similar approaches is only a very small part of KM.

Knowledge Management Requires New Methodologies and Perspectives

Usually, introducing KM in an enterprise requires adoption of new perspectives and work practices as well as implementation of new approaches. Such changes involve considerable efforts and time. But the changes will provide capabilities to manage knowledge with flexibility and leverage through approaches that allow pursuit of strategic and tactical opportunities in ways that were not possible or even thinkable earlier.

Approaches to managing knowledge include a number of conventional activities, such as methods to survey and catalog; develop and build; elicit and codify; distribute, share, and exploit; and authenticate and control professional knowledge and functional expertise. In addition, new and more advanced approaches focus directly on the knowledge people hold; for example, to determine how to augment it by training, redistribute it to points-of-use, or automate it in knowledge-based systems.

The significant changes that are taking place in management and business practices affect information technology, approaches to managing knowledge, as well as the preparedness of personnel to perform the complex tasks that now are required. A group of U.S. executives were surveyed to obtain clarification of the needs and opportunities associated with these issues and with KM in business. According to this survey better utilization, handling, and building of knowledge assets may lead to substantive changes in both business and operational practices.

Many executives indicate that they are already searching for ways to deal

1For a discussion of the present status of applied AI, see, for example, Edward Feigenbaum et al. (1988) The Rise of the Expert Company, David Hertz (1988) The Expert Executive, Paul Harmon & David King (1985) Expert Systems, Wendy Rauch-Hindin (1988) A Guide to Commercial Artificial Intelligence, and Wiig (1990) Expert Systems: A Manager's Guide.

comprehensively and consistently with knowledge throughout their enterprise. They are looking for powerful, broad concepts supported by practical, down-to-earth approaches. In addition to the global perspectives many executives seek, managers, professionals, and knowledge-workers at all levels need to gain new understandings. Such understandings must focus on how humans reason and make decisions in practical situations, what knowledge is required and how it is used, and how one can build, enhance, and leverage knowledge assets in ways that serve the objectives of the individuals and the company involved.

Applications of Knowledge Management

Many examples may be cited of how companies have made specific use of KM beyond those presented at the beginning of this chapter. In addition to the examples briefly given in Table 1-3, others will be discussed in later chapters.

Table 1-3. Abbreviat:.ed Examples of Knowledge Management Applications.

- Plan R&D based on business values of knowledge to create missing knowledge and exploit existing expertise.
- Identify and strengthen core competencies.
- Support business process redesign (BPR) by improving distribution of knowledge-intensive activities and improved knowledge at points-of-use for higher quality work produces.
- Analyze and redesign .knowledge transfer and knowledge exchange between adjacent operating functions.
- Determine training needs for groups of employees to better perform knowledge worker tasks in particular business functions.
- Review personnel periodically to consider their .knowledge profiles in relevant knowledge areas. These reviews will provide managers with information that allows them to place employees in the most appropriate positions, allocate responsibilities to take advantage of their knowledge, and determine training and educational needs.
- Survey knowledge in specific operating departments to identify critical knowledge functions (CKFs) that need management attention.
- Analyze knowledge bottlenecks and "communication gaps" and alleviate past problems.
- Survey knowledge to identify candidates for knowledge-based systems (KBSs).
- Develop expert systems with particular emphasis on eliciting and codifying knowledge and conceptualizing the system function as it will operate with the new capabilities.
- Codify knowledge from departing personnel.
- Create new knowledge-intensive businesses and subsidiaries.

Perspectives on how knowledge may be managed come from many sources. For example, cognitive sciences and philosophy provide us with the ability to explicate knowledge. The social sciences, particularly anthropology and ethnography, enable us to analyze and describe how knowledge is used and how people collaborate to pool their knowledge. Insights into the business use of knowledge and how it can be exploited come from individual professional fields, as well as management sciences, business administration, and applied artificial intelligence. The understanding of operational value of knowledge comes from economics. Finally, perspectives on how to assemble these approaches into coordinated and integrated management systems have their roots in cybernetics. Hence, KM must be considered as a multidisciplinary activity that requires some understanding of many areas.

In spite of the varied, and at times esoteric, roots of the KM methods, the result has been a set of practical and operational approaches with varied emphases to match the requirements and priorities of different organizations. Some approaches support personnel review and human resource planning and management or complement management initiatives such as TQM and business process redesign or reengineering (BPR). Others support organizational changes and redistribution of responsibilities. Still others are useful in supporting new endeavors such as "strategic management of knowledge" (SMK) to map broad areas of knowledge in an effort to identify weak areas that need strengthening through R&D or acquisitions or strong areas that can be exploited by creating new products and services. The approaches to KM described here have proven effective to identify, leverage, and augment, i.e., manage, knowledge assets. Thus, active management of these assets has brought competitive advantage to corporations seeking new and effective approaches in an increasingly competitive marketplace.

Lack of knowledge is a major shortcoming of important business decisions. For example, insufficient knowledge reduces our ability to identify, explore, and evaluate higher-order effects from potential actions. While relatively little knowledge is required to be aware of the direct effects of such actions, more knowledge is needed to appraise the potential magnitude of these effects. And considerable deeper knowledge is needed to judge the second- and higher-order indirect effects that often are the ones of real interest. Hence, when additional salespeople are added in a store, for example, it takes little knowledge to realize that this will lead to higher payroll and less customer waiting. However, it is more difficult to determine if such an action also will lead to greater customer satisfaction and loyalty, increased market penetration,

larger sales volume, and improved profit margin.

Sound business and professional decisions are typically based on complex judgments that are the result of increased insights and understanding of upcoming situations -- from better knowledge. One major function of KM is to ascertain that appropriate knowledge is made available and internalized and used by people throughout the enterprise in order to ensure that the enterprise's business and professional decisions are of top quality. Only then can the enterprise prosper.

Approaches to Exploiting Knowledge

As individuals and as organizations, we are constantly challenged to do better. Personally, we are eager to increase our earning powers, and as organizations, we wish to keep up with -- if nor outpace -- our competitors.

Companies pursue different approaches to exploit their knowledge assets. Some manufacturing companies with superior knowledge in information systems have spun off subsidiaries to sell their knowledge as information-related products and services to anyone, including their own competitors. Most high-technology companies, on the other hand, guard their knowledge as corporate secrets and build it into new, highly competitive products and services.

According to the approaches they use, some companies appear to cash in on the knowledge they possess with little regard for how that will affect their future competitive position; others use their knowledge as a central tool to strengthen their future position and corporate longevity without losing their present position, and still others use their knowledge to work smarter and improve their short-term financial position by improved operations. According to our observations, there are four basic strategies for exploiting knowledge as indicated in Table 1-4.

Table 1-4. Four Basic Strat.egies to Exploiting Knowledge.

• Cash in on knowledge by selling it as services in the open market.
• Sell knowledge outright as patents, licenses, or in other forms.
• Embed knowledge in proprietary products and sell those inthe open market.
• Use proprietary knowledge to "work smarter" to lower costs and improve quality of products and services.

Chapter 2

Executive Perspectives on Im.portance of Knowledge

A Survey of Executive Perspectives on Knowledge and Its Management

Some of the most valuable assets of the organization are often hidden and invisible to its owners, managers, and other stakeholders. These assets are the organization's knowledge assets, which include its technology assets.

In a 1989 survey, we focused on how competitive stance may be strengthened by active management of knowledge and expertise.1 The survey covered a seleded sample of chief executives or their designees from 18 U.S. corporations with average annual sales of $7.5 billion. In their responses, these executives all agreed that knowledge is the organization's most important asset -- yet, it does not appear on any balance sheet. Every year, considerable investments are incurred to create these assets, but these investments are typically expensed , are not capitalized, and have no accounting value; and most importantly, they are not managed as assets.

Because knowledge assets are not capitalized, they are not included when return on assets are considered. As a result, management is not rewarded for creating these assets or using them effectively, nor are they penalized for wasting them. Several critical perspectives came to light as a result of this survey. Some of the more important include:

- Most executives consider the knowledge and expertise that reside in their employees to be their enterprise's most valuable assets.
- Executives are very interested in managing knowledge actively and effectively and "consider it to be important for competitiveness" in the

1Wiig (1989) Managing Knowledge: A Survey of Executive Perspectives.

future, but they do not know how to go about it.

- The concepts of knowledge management (KM) are new to most, although a few feel that they "have a beginning understanding" of how to manage knowledge.
- The executives and their managers, by and large, do not know where the critical knowledge areas are within their enterprises.
- Executives are keenly interested in surveying (i.e., finding, describing, and evaluating) critical knowledge. However, they do not know how to do so -- they do not know any practical and meaningful methods to perform such work.
- The executives believe that codification and automation of knowledge and expertise in the form of expert systems is desirable and important, and will be part of determining their competitive edge in the future. Some indicated that their companies already are using this technology while others are initiating building staff and prototype expert systems.

It is interesting to observe how consistent the executives' views were regarding the importance of KM -- even at this early stage when most do not have much experience in this area. Thus, it is clear from the opinions expressed that KM may be of considerable competitive and economic value to the companies that understand how to incorporate these concepts into their practices. It is similarly clear, that much work needs to be done to create methodologies, adopt new technology and make the available approaches known and accessible. Finally, it is clear that there is a great need to provide executives and their staffs access to the available KM concepts and approaches.

Observation: Given the nature of the responses and the identity of the partici pants, the perspectives obtained through this survey represent viewpoint s that are both advanced and progressive. Consequently, the opinions revealed should not be taken as indications of general attitudes among U.S. executives. Instead, they may reflect views that will guide the most competitive and successful companies in the 1990s and beyond. Indeed, the sample was partially self-selected, therefore, the viewpoint s should be considered to be biased.

Company Goals and Competitiveness

To better interpret the executives' opinions and perspectives on knowledge and its management, we established their ranking of goals and objectives for

their firms. We asked participants to weight the importance of four goals as seen from their company's perspective. We found the executives' views to place less emphasis on short-term values than anticipated. That is, as a group, the participants considered long-term goals and observation of humanitarian and ethical values to be significantly more important than meeting short-term obligations and profitability (Table 2-1).

Table 2-1. "Indicate the importance that you place on each of the following concerns." (0 is least important and 10 is most important)

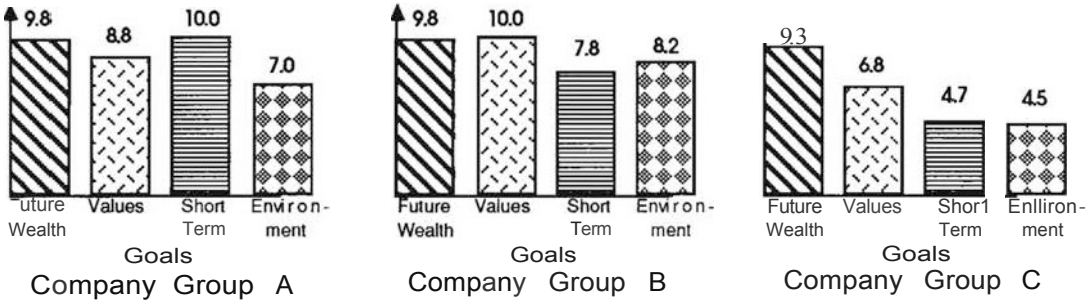
Maximize future wealth, i.e., build longer term value of your company in terms of market value, competitive position, and financial health. ("Future Wealth")	Average: 9.5. 67 % rated this goal at 10.
Observe humanitarian and ethical values in dealing with your employees, your business partners, and the community. ("Values")	Average: 8.3. 56 % rated this goal at 10.
Meet short-term obligations (debt service, payroll, etc.) and maximize present period's goals (net income, revenues, etc.). ("Short Term")	Average: 7.3. 28 % rated this goal at 10.
Maintain or improve the economic, social, and physical environments in which your company will function and its employees and owners will live so that they can enjoy what they have earned. ("Environment")	Average: 6.6. 0 % rated this goal at 10.

Observation: The executives indicated that longer-term and value concerns are more important than meeting short-term financial obligations and goals.

The responses fell into three separate, A, B, and C, that were used to classify several perspectives throughout the survey. Weights given to the four goals by executives in the industry groups are shown in Figure 2-1.

The survey focused on the competitive attitudes and self-images that the executives held for their firms. Slightly over half considered their firms to be dominant or strong within their industry; 39% saw their firms as in a favorable competitive position. None considered themselves to be tenable or weak (Table 2-2). 56% listed their firms' maturity level; 11% of these saw their firms to be in embryonic businesses, 20% in growth businesses, and the majority (69%) in mature businesses. None were in aging businesses.

Figure 2-1. Importance of Goals for Industry Groups A, B, and C.



Company Group A	Company Group B	Company Group C
Chemicals	Telecommunications	Pharrnaceuti cals
Oil & Gas	Aerospace	Semiconductors
Retailing	Automotive	Manufacturi ng
Construction & Engineering	Railroads	Transportation
	Financial	
	Utilities	

Table 2-2. "What is your opinion of your company's competitive position?"

	Total	Industry Group A	Industry Group B	Industry Group C
We are competitively dominant and consider ourselves the pioneer and leader	17 %	Few	Some	Few
We are competitively dominant but we are vulnerable	28 %	Some	Some	Few
My company is competitively strong -- in the forefront	17 %	None	Few	Some
My company is in a competitively favorable position	38 %	Some	Few	Few
My company is competitively tenable	0 %	None	None	None
We are competitively weak and followers	0 %	None	None	None
Total	100 %			
We are in an emerging or embryonic business	6 %	None	Few	None
My company is predominantly in growth businesses	11 %	None	None	Some
My company operates in mature businesses	39 %	All	Some	Some
We are primarily engaged in aging businesses	0 %	None	None	None
Total	56 %			

Since KM is a new approach that often involves new technologies (such as knowledge acquisition and codification, knowledge-based systems, and advanced information technology), it was of interest to explore attitudes towards adoption and use of new technology (Table 2-3).

As shown in Table 2-3, the majority of companies (88%) attempted to be in the forefront of adopting new technology although some liked to wait until uone

or two" other companies have shown the way. Depending upon the application, the technology, and in-house expertise, companies were willing to buy the technology (89%), bring it in-house with outside help (84%), or develop it by themselves (78%). It is interesting to note that 15% of the executives would not consider bringing in technology with outside help and then develop applications in-house.

Table 2-3. "How do you characterize your company when adopting new t:echnology?"

	Always	Sometimes	Never
We attempt to be in the forefront of adopting new technology	44 %	44 %	9 %
We prefer to wait until applications in one or two other companies have shown that the new technology is useful	6 %	72 %	14 %
We wait until the new technology is in general use by competitors	0 %	61 %	0 %
We develop technology and applications in-house without external help	6 %	72 %	0 %
We prefer to bring technology in-house with outside help and then develop applications in-house with our own staff	6 %	78 %	15 %
We buy technology applications from outside sources	0 %	89 %	0 %

The majority (72%) of executives considered their companies to be very competitive as a result of their employees' knowledge (Table 2-4). By comparison, about one in four thought that the company's knowledge assets only increased their competitiveness "somewhat." No one perceived knowledge not to be a competitive factor. These views coincide with the perspectives expressed in Tables 2-6 and 2-18.

Table 2-4."How competitive is your company because of your people's knowledge?"

Very Competitive	Somewhat Competitive	Not a Competitive Factor
72 %	28 %	0 %

Observation: For the most part, the companies were aggressive when it comes to new technology and they ascribed a significant part of their competitive dominance and strength to the knowledge in their people .

Importance of Knowledge

All executives agreed that expertise is of great importance and should be considered highly valuable as indicated in Table 2-5. In addition, more than

one half of the respondents viewed expertise as their enterprise's most valuable asset, while the rest thought it only highly valuable, after other assets such as technology, market position, and financial assets.

Table 2-5."Is expertise of great importance in your organization?"

Knowledge/expertise is our most valuable asset	56 %
Knowledge is highly valuable, but after:	44 %
Technology assets	56 %
Market position	33 %
Financial assets	11 %
Somewhat valuable	0 %
Not particularly valuable	0 %

Observation: Most of the CEOs felt that knowledge I expertise was their "most valuable asset." This perspective has significant implications for how KM is considered by companies.

Our judgment is that technological assets mainly are manifestations of the knowledge that technical people possess and are considered part of the knowledge assets. Accordingly, 80% of the executives actually considered knowledge as their company's most important asset (Table 2-6).

Exhibit 2-6."What are the most important lmowledge areas in your company?"

		Overall Rank	Industry Group Rank A	B	C (most important =l)
Management Knowledge	Executive management knowledge	▮	▮	▮	2
	Middle management knowledge	2	2	2	▮
	Supervisory knowledge	3	3	3	3
	Administrative knowledge	4	4	4	4
Functional Knowledge	Operations/manufacturing knowledge	1	2	1	▮
	Marketing knowledge	2	1	2	4
	Research knowledge	3	5	6	2
	Product design knowledge	4	6	3	3
	Other: Leadership, Human Resources	5	4	5	5
	Financial knowledge	6	3	4	6

Observation: The majority of CEOs ranked "operationsI manufacturing k nowledge" as most important, with "marketing knowledge" second. A few ranked other knowledge areas as highly important, thus indicating different areas of emphasis in specialized companies.

Most important was "executive management knowledge." However, executives from Industry Group C judged "middle management knowledge" to be more important for overall company operation. Perspectives were more divided on functional knowledge. For example, industry Groups B and C considered "operations/manufacturing knowledge" most important overall while Industry Group A considered "marketing knowledge" to be most important as might be expected from mature industries. Group B rated "marketing knowledge" second, while Group C rated "research knowledge" second. It is important to note the diversity in opinions reflected in the ratings since this, we think, properly reflects the relative importance of the different functions in the various organizations and industries.

Executives were asked about expected changes in the business environment as a result of technological and international trade changes. Two quotes were presented to elicit responses. The executives generally agreed that the next 20 years will present large changes in all areas of business and that the rules of competition will change significantly. Most agreed with conclusions quoted from an Office of Technology Assessment report, although some were neutral to these projections. One half of the CEOs agreed with the notion proposed in a quote by Edward Feigenbaum *et al.* that there will be an international battle of knowledge and that a U.S. knowledge frontier will be created to compensate for the loss of our past manufacturing dominance. An almost equal number of CEOs, however, were uncertain on this point (Table 2-7).

Table 2-7. Forecasts predict significant changes in the business environment

"During the next two decades, new technologies, rapid increases in foreign trade, and the tastes and values of Americans are likely to reshape virtually every product, every service, every job in the United States. These forces will shake the foundations of the most secure American businesses. ... An overwhelmi ng body of evidence suggests ... that new technologies for collecting, storing, manipulating, and communicati ng information do have the potential to revolutionize the structure and performance of the national economy. ... Information technologies have the potential to change the performance of the economic system itself." (Henry Kelly et al. in Technology and the American Economic '1'1-ansition, Congress of the U.S., Office of Technology Assessment 1988, pp. 3, 15, 16)
Agree 72 % Neutral 22 % Disagree 6 %
"In the developed nations there is a sense of urgency about building the so-called knowledge-intensive businesses to earn back the wealth that has been lost as manufacturing work has moved to less developed cowttries." (Edward Feigenbaum et al. in The rise of the Expert Company, Times Books, 1988, p. 267)
Agree 50 % Neutral 44 % Disagree 6 %

On the need to improve knowledge in the workforce, there was unanimous agreement that employees must be provided with better knowledge to be able to interpret and use information. Almost all felt that the modern work environment is becoming increasingly complex and most thought there is a significant gap between knowledge that people have and what the job requires (Table 2-8).

Table 2-8. Needs for improving availability of knowledge.

There is a need to provide employees with knowledge of how to interpret and use available information.	Agree 100 %	Neutral 0 %	Disagree 0 %
The work place is becoming increasingly complex to meet competition. There is a need for better management of professional knowledge and operational expertise to provide continued improvements in performance.	Agree 94 %	Neutral 6 %	Disagree 0 %
There is a gap between knowledge required for job performance and knowledge in the workforce.	Agree 83 %	Neutral 17 %	Disagree 0 %
Employees do not know how to use and interpret information available to them through information technology currently in place.	Agree 50 %	Neutral 28 %	Disagree 22%
Most knowledge workers are overburdened with information and cannot take effective advantage of it.	Agree 17 %	Neutral 61 %	Disagree 22%

Observation: CEOs uniformly expressed that there are extensive needs to improve the knowledge levels in employees at all levels.

These needs are in part caused by an increase in the complexity of the workplace, but more importantly, they are caused by the desire to improve competitive position.

When asked if knowledge workers by and large are overburdened with information, the CEOs were not in agreement. One half thought their employees were not able to utilize all information available to them for whatever reason. The CEOs from high-technology companies agreed that their employees were overburdened with information, while CEOs from retail, oil, and resource companies felt that their knowledge workers were able to cope with the information they receive. The majority, however, were neutral or uncertain on this point.

These responses may be interpreted as being in conflict with one another. They may also be in conflict with attitudes and observations by middle managers and supervisors who consistently voice concerns about their subordinates' lack of time and ability to digest and act on all the relevant information provided them.

It is interesting to note that most executives felt that it may be particularly valuable to distribute knowledge and expertise to points-of-action in different areas of their company (Table 2-9).

Table 2-9. Experiences with lack of critical lmowledge.

Do you have situations in your enterprise where it would be particularly valuable to have more employees know what now is only known by one or two?	Yes 78 %	No 11 %
Are you aware of any situations in your enterprise where the expertise of one, or a few people, is of vital importance and where these people may leave, retire, or be promoted?	Yes 56 %	No 33 %
Have you experienced, or do you expect to experience, problems with transfer of knowledge when restructuring operations or transfening persormel?	Yes 56 %	No 33 %
Have you suffered costly errors or mistakes because employees lack sufficient knowledge or expertise?	Yes 39 %	No 50 %

For the most part, the executives also agreed that they knew of situations with potentials for vulnerability due to loss or relocation of knowledgeable people. The majority agreed that there are problems with knowledge transfer when people and functions are moved around. In contrast to these opinions, however, most CEOs thought their companies had not suffered costly setbacks due to lack of knowledge or expertise. That may be true -- or it may be wishful thinking.

On Knowledge Management

The executives were asked how better and more active KM might improve operations and competitiveness. They had high expectations for potential improvements in several areas, noting that many competitive factors (see Figure 2-2) and areas of operation (see Table 2-10) might be significantly improved with better KM. All executives agreed that the two most important factors, as determined by a Boston University study,1 "maintenance of consisten t quality and conformance to customer specifications," and "dependable delivery of products and services" would most likely be improved.

1 Boston University (1987). North American Manufacturing Futures Survey.

Figure 2-2. "Will lmowledge management improve competitiveness?" Executives' Expectations for Improvement inCompetitive Fact.ors Through Active Knowledge Management
(Competitive factors are ranked according to importance, 12 being 1east important)

As shown, the majority of respondents expected that active KM will improve competitive conditions significantly. No one thought that there would be no improvement. As shown in Figure 2-2, according to the competitive importance ranking more than one half of the executives thought it likely that better KM would improve competitiveness for all factors, either "significantly" or "somewhat."

Observation: All the participating CEOs expressed that they expected active KM to significant ly improve both competitiveness and operational effectiveness. The areas that will be improved most vary, but total quality and marketing-related activities were expected to show the greatest benefits.

The executives showed even greater expectations for improvement of operational effectiveness as indicated in Table 2-10. Of the 18 operational areas listed, eight received unanimous agreement that better KM would improve operational effectiveness, either significantly or moderately. In seven other areas, only a small fraction of respondents thought there would be little or no improvements. Some interesting judgments were reflected in the responses. For example, the executives expected that "middle management" and

"supervision" will improve significantly with better KM while "executive managemen t" was expected to be improved only moderately; however, everyone expected moderate or better improvement for all three areas.

Table 2 10. "Will lmowledge management improve operational effectiveness?"

Operational Areas	Significant Improvement	Moderate Improvement	Little or No Improvement
Marketing and Product Development	67 %	22 %	0 %
Middle Management	61 %	28 %	0 %
Supervision	50 %	39 %	0 %
Management Information Systems .	50 %	39 %	0 %
R&D	44 %	44 %	0 %
Engineering	50 %	28 %	0 %
Production and Manufacturing	50 %	28 %	6 %
Staff Functions (Legal, PR, Planning)	39 %	50 %	6 %
Purchasing and Stores	39 %	44 %	6 %
Personnel Management	33 %	56 %	0 %
Customer Service .	33 %	50 %	6 %
Maintenance	33 %	50 %	6 %
Finance	28 %	56 %	6 %
Executive Management	28 %	50 %	0 %
Logistics and Traffic Management .	28 %	50 %	6 %
Accounting	17 %	61 %	11 %
Sales and Order Taking	11 %	61 %	11 %
General Administration and Secretarial	6 %	61 %	22 %

Surprisingly, the executives ranked "general administration and secretarial" as the least likely area to be improved by better KM. This response, we think, reflects the general misconception that clerical work requires little knowledge -- which is contrary to all our findings when investigating knowledge required to deliver high-quality work. In addition, over the next years, many executives and managers will unload additional responsibilities on their administrative staffs as they themselves take on additional responsibilities as enterprises are flattened. As a result, we can expect the knowledge requirements of the administrative and secretarial staff work to increase, leading to a need for better and more active KM to attain the desired levels of quality.

It will be interesting to observe how different companies will conceptualize the use of various KM activities to change their operations and internal practices to benefit from changes in KM. It will be of particular interest to discover what the actual benefits will be. However, such data cannot be

expected for several years.

All executives expressed that they consider KM to be of great importance and that they personally should be involved in many of its aspects. They also indicated that they expect KM to increase in importance. Yet they indicated that they don't know how to go about it in practical terms. Nor do they know how to integrate overall perspectives for how to manage knowledge with their other practices and responsibilities.

How Should Knowledge Management Be Organized?

When the executives were queried about their level of engagement in, and responsibility for, KM, there was full agreement that they should be personally concerned about this area (Table 2-11). Respondents also felt that they should be part of conceptualizing uses of knowledge and setting priorities and guidelines -- areas that they may have been excluded from up to now due to a lack of practical and accepted methods and approaches for managing knowledge.

Table 2-lL "Should executive management be engaged in the *management* of expertise, professional and operational know-how, and other knowledge?"

Should Executive Management:	Yes	No
Be concerned at all?	94 %	0 %
Conceptualize ro strengthen the company through better use of knowledge?	78 %	17 %
Set investment priorities for collecting, structuring, and exploiting knowledge?	72 %	17 %
Set guidelines for how to approach throughout the enterprise?	67 %	22 %
Guide directly to exploit knowledge in the marketplace?	39 %	33 %

Delegate to:	Other Top Management	Central Staff Group	Middle or Professional Management	Human Resources Managemem	Management Information Systems	Individual Professionals	Other Group	Shared Throughout Organization
	33 %	17 %	33 %	11 %	6 %	11 %	6 %	11 %

On the issue of delegation, most agreed that KM can be delegated to other top, middle, and professional managers. A smaller group favored delegation to a central staff group. Very few thought that KM should be delegated to Human Resources, MIS, or to other groups. Some of the executives who favored delegation to other managements ranks, also thought that individual professionals should be responsible for their own KM and that these

responsibilities should be shared throughout the enterprise.

From the responses, it is clear that the CEOs thought KM is very important. The majority considered KM to be "As Important" or "More Important" than R&D, Personnel Management, and Information Management (Table 2-12).

Table 2-12. "How should knowledge management be emphasized relative to other areas?"

	KM is More Important	As Important	KM is Less Important
Vis a vis R&D?	17 %	50 %	22 %
Vis a vis Personnel Management?	28 %	56 %	11 %
Vis a vis Information Management?	33 %	50 %	11 %
"All are important "- 6 %			

We find these responses surprising considering that, to our knowledge, there are no organized functions or institutionalized procedures for broad KM in any of these organizations. However, there still appear to be clear perspectives for how well knowledge is managed in these companies as expressed in Table 2-13.

Table 2-13. "How good is your Knowledge Management?"

How effective is your company's knowledge management?	Very Effective 17 %	Moderately Effective 78 %	Not Effective 6 %
Do you have objectives and strategies for your company's knowledge and its management?	Oear Objectives 11 %	Selected Objectives 78 %	No Objectives 11 %
Are your knowledge strategies consistent with your business objectives and strategies?	Fully Consistent 6 %	Generally Consistent 83 %	Not Very Consistent 1] %
Is your allocation of knowledge management resources consistent with your business strategies?	Fully Consistent 0 %	Generally Consistent 83 %	Not Very Consistent 17 %

A small proportion of the executives thought that their company's management of knowledge is very effective. Some, although fewer, thought they had clear objectives and strategies in this area. Very few thought that their knowledge strategies are fully consistent with the business objectives and strategies. None thought that the actual allocations for KM are fully consistent

with the business strategies. Instead, the feeling was that the situation is much better for selected operational areas and for general correspondence between goals and execution. On the whole, over three quarters of the executives thought that their performance is generally acceptable, presumably given the present state-of-the-art rather than the potential for KM.

Since knowledge and expertise in many instances are directly tied to various areas of technology, we asked the executives if they presently are surveying the technologies that support their business (Table 2-14). The majority responded that their firms regularly survey technologies using either formal or informal methods. Almost half indicated that they also survey characteristics and values of expert knowledge. We did not investigate how this is done and how broad these investigations are. When asked if they would find results from knowledge surveys useful, the great majority responded yes.

Table 2-14. "How active is your company in applying and building expert knowledge?"

Is your company presently surveying the technologies that support your business as a regular activity?	Yes 39 % Using formal methods	Yes 56 % Using informal methods	No 11 %
If not, are you considering perfonning such surveys?	Yes 0 %	No 11 %	
Do you survey characteristics and values of expert knowledge?	Yes 44 %	No 44 %	
Do you, or would you, find results from such surveys to be of value to you?	Perhaps 6 %	Yes 72 %	No 6 %

Some of the executives indicated that they did not know of any meaningful ways of surveying knowledge methodically; others noted that they had no idea of how to conduct such surveys. This attitude is strongly supported by the perspectives expressed by the executives with regard to which KM activities they find to be important. One half felt that "survey critical knowledge areas" is important at this time, while two-thirds felt it is important now to "create plans for strategic use of key knowledge."

These perspectives are detailed further in Table 2-15, which shows that two-thirds of the executives indicated that they would find it valuable to survey knowledge to identify and describe important knowledge factors; 33% were undecided or did not know how this would benefit their organizations.

When asked about KM and its future importance, almost half of the

executives stated that they considered KM important for competitiveness in the 1990s (Table 2-16). This is a lower fraction than we expected based on views of how better KM could improve competitive factors and areas of operations (Figure 2-2 and Table 2-10). One third of the executives indicated that they were familiar with "conventional approaches to managing knowledge," while about one quarter had "a beginning understanding" of how they should manage knowledge. Another quarter indicated that KM was new to them. Several of these executives also indicated that they were "very interested in managing knowledge to secure" their competitiveness. No one felt that they were "familiar with advanced concepts for managing knowledge."

Table 2-15. "If well-tested methodologies for surveying knowledge were available to identify and describe critical and highly valuable and manageable knowledge factors, would your organization benefit from using such methods?"

33 %	Perhaps -- don't know.
33 %	Continually as part of each manager's ongoing business and professional duties.
22 %	Annually as part of technology and strategic planning.
17 %	Annually as part of each manager's personnel management duties.
6 %	Annually in important departments and situations.
0 %	Occasionally in isolated situations when specific needs are perceived.
0 %	No, not at all.

Table 2-16. "What are Knowledge Management trends and future importance?"

44 %	I consider knowledge management to be important for competitiveness in the 1990s.
33 %	I am familiar with conventional approaches to managing knowledge.
28 %	I have a beginning understanding of how we should manage knowledge.
28 %	Knowledge management is new to me.
22 %	I am very interested in managing knowledge to secure our competitiveness.
0 %	I am familiar with advanced concepts for managing knowledge.

We asked about the levels of knowledge awareness and preparedness in their companies, distinguishing between "Promising," "Competitive," and "Standard" knowledge areas as defined in Table 2-17. When asked how well business unit managers know the important knowledge areas of their operations, the executives provided a range of perspectives (Table 2-17a). The majority thought that their managers would know "promising knowledge" only partially, while they are thought to know "competitive knowledge" and

"standard knowledge" quite well. We must conclude that in these companies, knowledge is thought to be well known, particularly after it has become well established ("standard knowledge").

Knowledge may, however, not be so well known for the newer knowledge areas that often are crucial for competitiveness. This may leave companies vulnerable and make their strategies difficult to implement -- or even arbitrary. For example, we do not have insight into how well the knowledge is understood or defined in terms of its detail, who possesses it, and how it compares with their competitors' knowledge. We also do not know about the policies and plans that are referred to by the executives for managing their enterprise's knowledge. Given these uncertainties, it is difficult to judge how well the companies surveyed actually know the important knowledge in their organizations .

Table 2-17. "What is the knowledge awareness in your company?"

Use the following definitions for this table:

"Promising knowledge areas" are in early development stages with demonstrated potentials for changing the basis of competition. *(Some of today's "promising knowledge" becomes torrwrrow's "competitive knowledge.")*

"Competitive knowledge areas" differemiate your company and have the greatest impact on competitive perfonnance.
(Competitive knowledge in time becomes standard knowledge for an industry).

"Standard knowledge areas" are highly essential to your business, and are widely available to all competitors.

a. How well are the important knowledge areas in your firm known to your business unit managers?	Well Known	Partially Known	Relatively Unknown
The promising knowledge areas? .	0 %	56 %	33 %
The competitive knowledge areas?	50 %	39 %	6 %
The standard knowledge areas?	72 %	11 %	6 %

b.Does your firm have established policies and methods for:

In tenns of:	Promising Knowledge	Competitive Knowledge	Standard Knowledge
Preparing for management of knowledge?	0 %	22 %	44 %
Building and producing knowledge?	17 %	33 %	61 %
Using and applying knowledge?	11 %	39 %	56 %
Controlling and safeguarding knowledge?	39 %	50 %	39 %

Observation: The executives were very interested in ways of finding, describing, and evaluating critical knowledge factors throughout their organization. Yet most of them did not know if that can be done in meaningful and practical ways.

When asked if their firms had established policies and methods to deal with knowledge (Table 2-17b), the executives provided more diverse perspectives. The emphasis in most firms were still on the better understood, mature "standard knowledge," hence most firms have procedures for building, producing, and using such knowledge. When it comes to the competitively more important areas of knowledge, the companies were much less prepared, and when it comes to "tomorrow's knowledge" -- the "promising knowledge" areas, they may be characterized as being unprepared.

Organization and Human Resources

Different uses of knowledge, requirements for knowledge in the work place, and options for how to manage knowledge are all expected to have implications for how companies are organized and how human resources are managed. We solicited perspectives from the executives by asking their level of agreement with selected quotes. Almost three-fourths agreed that in many organizations there is a new environment for knowledge and learning, a result the need for knowledge and learning to be "at the heart of productive activity." No one disagreed with this notion (Table 2-18).

Table 2-18. "Will organizations change as a result of new reliance on knowledge?"

"The informated *(sic)* organization is a learning institution, and one of its principal purposes is the expansion of knowledge -- not knowledge for its own sake (as in academic pursuit), but knowledge that comes to reside at the core of what it means to be productive. ... The behaviors that define learning and the behaviors that define being productive are one and the same. Learning is not something that requires time out from being engaged in productive activity; learning is at the heart of productive activity. To put it simply, learning is the new form of labor." (Shoshann Zuboffin the Age of the Smart Machine, Bnsic Books, 1988, p. 395) Agree 72 % Neutral 28 % Disagree 0 %
"Our knowledge of management is (not) complete. ... What we knew about management 40 years ago ... does not necessarily help managers meet the challenges they face today. ... And what has made that knowledge obsolete is, in large measure, its own success in hastening the shift from manual work to knowledge work in business organizations." (Peter Drucker "Management and the World's Work" in Harvard Busine88 Review, September-October 1988, p.69) Agree 61% Neutral 39 % Disagree 0 %

More than half of the executives agreed that they observe a shift from manual to knowledge and that this shift has made management knowledge partly obsolete -- i.e., conventional management practices and knowledge does not apply when one is managing knowledge intensive activities. Again, no one disagreed.

Many companies are changing their operations by flattening organizational structures. Considerable attention has been paid to the difficulties associated with designing the resulting new functional relations, spreading and sharing responsibilities and work tasks, and changing operating practices and procedures. To our knowledge, less attention has been paid to the skill and knowledge transfers required (except for needs for training). We were, therefore, interested in the executives' perspectives on the role of knowledge in this regard. The majority agreed that current ways of managing knowledge hamper changes such as organizational flattening. No one disagreed with this notion, although 39% were neutral. This view was strengthened, since two-thirds of the executives thought it is "Important Now" to rely on automated knowledge (i.e., knowledge-based systems) to "flatten organizations and distribute responsibilities" (Table 2-19).

Table 2-19. Effects of Imowledge requirements on personnel

Organizational "flattening," transfer of responsibili ties, and other types of organizational changes to streamline the com pany are hampered by difficulties in managing the knowledge requi red to suppon such changes.	Agree 61 % Neutral 39 % Disagree 0 %
The investment required to make a new hire productive is greater today than it was ten years ago.	Agree 61 % Neutral 33 % Disagree 6 %
Young people coming into the labor pool are less prepared to perform the increasingly complex work tasks that are required.	Agree 33 % Neutral 28 % Disagree 39 %

Observation: *The majority indicated that KM will have important impacts supporting orga nizational flatteni ng. They also thought that knowledge environment and learning needs will continue to change in significant ways and will receive important support from KM.*

When considering the effects of the new knowledge environments on personnel, more than half of the executives felt that it is more expensive to train new hires now than a decade ago. This may be due to several factors: lower educational levels of new hires, increased workplace requirements, it

may be a combination of the two, or even other factors. Also, as indicated in (Table 2-8), the executives agreed almost unanimously that "the workplace is becoming increasingly complex" and that "there is a need to provide employees with knowledge" to fill the "gap between knowledge required for the job performance and knowledge in the workforce." However, these perspectives seem partially to contradict the perception that young people coming into the labor pool are less prepared than required. Only one third of the executives thought this to be the case, and another third disagreed with that statement.

Knowledge Technology and Knowledge-Based Systems

In the future, advanced KM may in part rely on codification of knowledge and automation of expertise to bring about different and better ways of doing business. During the last decade considerable attention and efforts were devoted to creating capabilities in these areas. Some companies have used sophisticated, technical approaches to improve their competitive situations by considerable margins. We explored the executives' thoughts on these subjects by asking if they agreed with statements that expressed different perspectives. Two-thirds agreed that of expert systems will be routinely used and that technology will help people with judgment and expert knowledge. Less agreement as found with the statement that reliance on expert systems and artificial intelligence will make "the outstanding expert executive of tomorrow." The majority were undecided, one third agreed, but only 6% disagreed with that notion (Table 2-20).

The view that use of expert systems and artificial intelligence is not premature was further reinforced when executives were asked directly about this issue (Table 2-21). No one thought it premature. Also, no one stated that they were holding back to wait for others to show the way. This corresponds with the attitudes toward adopting new technology indicated in Table 2-3. However, it does not agree with the general adoption of KBS applications in any industry. A few executives thought that this technology did not apply to them. Many companies (all from Industry Group C see Figure 2-1) responded that they are not sure how to use AI and expert systems within their firms.

Table 2-20. Perspectives on knowledge aut:omation.

" many companies (will) routinely use expert systems and other artificial intelligence applications. Knowledge bases, in which expertise is stored along with information, will become as commonplace as data bases are today. Technology will increasingly help people perform tasks requiring judgment and expert knowledge."

(Lynda Applegate et al. "Information Technology and Tomorrow's Manager" in Harvard Business Review, November-December 1988, p. 131)

Agree 67% Neutral 33% Disagree 0%

"Those who believe in the partnership of knowledge, understanding, and application (of artificial intelligence) and take these ideas to heart and apply them to their businesses or professions will be the outstanding expert executives of tomorrow."

(David Hertz The Expert Executive, John Wiley & Sons, Inc. 1988, p. 223)

Agree 39% Neutral 55% Disagree 6%

The technology for codifying and automating expert knowledge is too immature for practical use.

Agree 11% Neutral 67% Disagree 22%

It is too expensive to codify and automate knowledge.

Agree 6% Neutral 44% Disagree 50%

Automation leads to gradual loss of human expertise, flexibility, and loss of competitive leadership.

Agree 0% Neutral 17% Disagree 83%

[10]

Table 2-21. "Is your company presently using or planning expert systems or artificial intelligence t:o distribute expertise, t:o capture or preserve knowledge, t:o incorporate knowledge in products or services, or t:o manage knowledge in other ways?"

Industry Group			Number of Executives	
A	B	C	Who Agree	
			0%	No, it is premature to use this technology.
			0%	We first are waiting to see how others benefit from Al.
Few			5%	We are planning to use such tectmology.
	Few	Few	11%	No, this tectmology does not apply to us.
		Many	17%	We are not sure how to use AI and expert systems.
Some	Few		17%	We have such systems under development.
	Many		17%	We have a few systems in trial operation.
Many	Few	Few	28%	We have a few systems in full operation.
		Few	5%	We have many systems in full operation.

These perspectives may be based on misunderstandings of where and how the technology applies, and may change as more companies report their experiences in a wide variety of applications. Understanding the applicability

of these new knowledge technologies will also increase as more organizations report specifically on how they have automated reasoning in a wide variety of functions that previously were performed as intellectual tasks by knowledge workers. On the other hand, the optimism indicated by the executives may be misplaced since many of the firms involved are slow to adopt KBS applications and many of their information systems departments are still characterized by lack of knowledge. To this point, as reported later, most KBS applications implemented in the past have fallen into disuse after two years, primarily due to lack of expertise in the initial implementation.

Two-thirds of the executives indicated that their companies are active in applying expert systems and artificial intelligence. They stated that they have systems under development or in different stages of operation. Industry groups A and B include several companies who are using KBS technology adively, while Industry Group C have only a few active companies, but it is interesting to note that those appear to be farther along with more systems in full operation. This profile corresponds to other surveys and by our own experiences with a number of companies.

Observation: *Two-thirds of the companies were active in knowledge automation. The executives noted that knowledge automation is important and will shortly be a "standard technology." They did not consider automation of knowledge premature or too expensive, nor did they think it will have significant adverse effects. These views, however, may be too optimistic and contrary to their organizations' actual progress.*

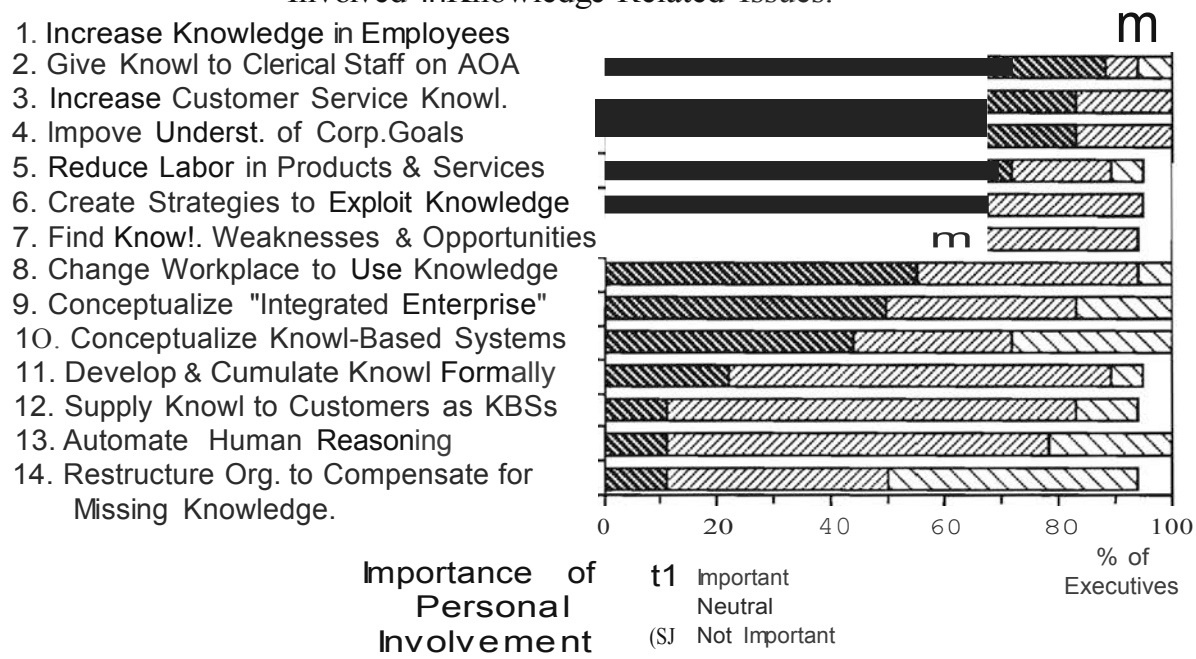
Importance of Knowledge Management Activities

For KM to become practical, the specific activities that make it possible must be mastered and prioritized. On the executive level, the first step is to identify the issues that need CEO attention in their own opinion; that is, exploring which corporate objectives and KM activities executives would consider to improve the important issues. We explored the importance of 14 knowledge-related issues with the executives (Figure 2-3).

The executives agreed that the four highest priorities were associated with improving employees' knowledge levels and understanding of their work. The fifth highest priority involved cost (labor reduction) and was still considered to

be important by over two-thirds of the respondents. Next, and considered important by over one-half of the executives, were the two issues associated with strategic use of knowledge and expertise -- issues number 6 and 7.

Figure 2-3.Executives' Perception of How Important ItIs to BePersonally Involved inKnowledge-Related Issues.



About half of the executives thought it was important for them to be personally concerned with conceptualizing how knowledge should be used and overall integration of operations ("Integrated enterprise") -- issues number 8, 9, and 10. We take that to mean that they wanted to set the general direction and purpose, but not perform the detailed conceptual design.

We inquired about the executives' perspectives on the importance of 30 KM activities, divided into "Conventional Activities" and "New and Advanced Activities." We asked which of them are "Important Now" and which ones will be "Important in 5 years." (Detailed responses to these questions are presented in Appendix C.)

When the executives considered activities to "Prepare for Management of Knowledge," the majority felt that all conventional activities are important now. However, the majority of executives from Industry Group C often held the opposite view, i.e., many conventional activities are not yet important. For

the new and advanced activities, the two activities that were considered important now by the majority included "survey critical knowledge areas" and "create plans for use of key knowledge."

Observation: *Executives overwhelmingly thought that it is important for them to be concerned with knowledge-related issues. They noted that it is particularly important for them to be personally concerned with improving their employees' knowledge levels.*

When the executives considered activities to "build and produce knowledge," the majority felt that all but one of the conventional activities are important now. It is interesting that, again, the majority of executives from Industry Group C often held the opposite view (i.e., many conventional activities are not yet all that important). The activity that most executives felt could be postponed was "write procedures manuals." For the new and advanced activities, one-third responded that these activities are important now, with good agreement between industry groups.

When the executives considered activities to "Use and Apply Knowledge," the majority felt that all the conventional activities are important now. Again, however, the majority of executives from Industry Group C held the opposite view. For the new and advanced activities, the majority noted that all of these activities are important already now. The advanced activity that received the highest level of agreement for immediate importance was "Flatten organization and distribute responsibilities while relying on automated knowledge." This perspective was expressed unanimously by Industry Group B but was opposed by Industry Group C, whose majority also indicated that none of the new and advanced activities were important now.

When the executives considered activities for "Control and Safeguard Knowledge," the majority felt that all the conventional activities are important now. Again, the majority of executives from Industry Group C held the opposite view in the case of ascertaining that appropriate knowledge is used. For the new and advanced activities, more than half felt that control of knowledge is important at this time. Many also thought that to "Examine, validate, and choose appropriate knowledge" also is important now. Most executives from Industry Group C indicated that the new and advanced activities might wait while the executives from Industry Group B thought that these activities may be important at this time.

Observation: *The majority of the executives considered almost all conventional KM activities to be important at this time. This view was not unanimous, however, as one industry group representing pharmaceuticals,*

semicond uctors, manufacturing, and transportation expressed that many conventional activities are not yet important, though they will be important in the future.

Observation: *The majority of the executives considered most advanced KM activities to be important sometimes in the future. This view was not uniform, however, as advanced activities for using and controlling knowledge were considered to be important already now.*

Concerns of Many Executives Related to Knowledge Management

Several of the surveyed executives thought that management of knowledge is too nebulous and broad a subject to be handled meaningfully at this point. They were aware that all kinds of knowledge is used by people everywhere in their organization and in many different functions. These notions are shared by many other executives that we meet. Yet, they could see how it is possible to locate and describe important knowledge situations that require management attention and identify in practical terms the pertinent knowledge and possible management options involved. To these executives, KM is an interesting and potentially promising idea that is not yet relevant."

Not all executives considered KM to be ready for adoption at this time. Many did not think that it is necessary for them to accept the intellectual burden to learn a whole new set of concepts and perspectives that will require a substantial investment of their time. In addition, they were aware that adopting KM will also require investments of time and efforts by their managers and staff, in addition to new systems, procedures, and capital investment projects. Furthermore, as they saw it, the competitive value of all these efforts is unknown until each situation has been investigated and practical experience has been obtained.

Some executives were explicit about their concerns. Their attitudes may be characterized by the example monologue presented in Table 2-22.

This monologue resulted after a discussion of the "Myth of the Communication Gap"[1] The example in Table 2-22 is similar to interactions

1 "The Myth of the Communication Gap" recognizes that what appears as a communication gap between two people or two departments is often a knowledge gap. In these cases, lack of understanding and knowledge prevents correct information or leads to wrong interpretation or use of received information.

with other executives whose priorities clearly are set by other, and quite legitimate, pressures.

Table 2-22. Monologue by a Concerned Executive.

"So we recognize the 'Myth of the Communication Gap.' But what can we do about it?"
"The problem is very complex. There are all kinds of knowledge missing on both sides. And there are a large number of important 'Communication Pairs' to be considered in my organization."
"Where do we start? And what do we do in each situation? We cannot possible make an expert system for each end of each communication pair! Or train important people in all the facets required to build the requ isite knowledge to have a perfect exchange and interpretation and use of infonnation ."
"And many of the communication pairs should be integrated into one function and collapsed anyway -- and we know that already!"
"I think that we should just trust our good people to continue to develop their knowledge and understand ing in the way they are doing it now. They are doing a good job as it is, and our strength is in their knowledge and expertise. So go away and don't bother me with highfalutin' new ideas!"

Several executives wonder why they should be concerned with KM. Some think that they are doing an adequate job already. Others feel that they have more pressing things to do. They are not convinced that KM offers anything of competitive value, or for that matter, anything of personal val ue to them in promoting their own careers. As they see it, their managers and staff have enough to do, and do not need additional tasks to perform. These executives also feel that it is difficult and perhaps of questionable valu e to invest in learning new concepts and perspectives and going through the paradigm shift required to internalize and integrate the new methods and procedures into their daily lives. They would prefer the issue to go away so they could continue business as usual!

Chapter 3

Knowledge Is Needed Everywhere!

Of Course, Knowledge Is Needed!

That we need knowledge to deliver quality work is hardly a debatable issue. **The degree to which knowledge is needed** is another matter, however. Most managers know that the better the knowledge, the better the results. But how much expertise is required and how it should be managed typically receives little thought.

Experience shows that it is vitally important to ascertain that the requisite knowledge is available to deal competently with the challenges of the workplace. Yet, it is argued that to perform a set of simple tasks "adequately" does not require a great deal of knowledge. As a result, we often find that workers are provided with only minimal training and education, usually focused on the mechanistic and routine aspects of the work. Such shortcuts may be appropriate when exceptions and non-standard situations are rare and the quality of work is not particularly questioned. But when we seek competitively viable performance, considerable knowledge is required.

Expertise Is Needed for Quality Work

We are always at the mercy of the expertise that is available to the people we deal with -- our employees and suppliers, even our peers and superiors. The quality of the work they deliver depends on what they know and for our part, we are directly affected by the work products and the help we receive from them. How they deal with us and the quality of the solutions they craft are

functions of how expert they are. Their effectiveness as agents on behalf of the organization that employs them is highly dependent upon how proficient they are within their functional areas. While other factors also influence how well people perform, good knowledge is always required for excellent performance. In fact, people perform knowledge-intensive activities everywhere -- thoughtless work cannot exist when quality is required. As a result, corporate performance, the very existence of corporations, relies upon good knowledge that is well placed and used diligently. Knowledge underlies success everywhere.

"CLERICAL" WORK REQUIRES CONSIDERABLE EXPERTISE

We often assume that "clerical" jobs require little expertise and do not depend upon knowledge-intensive work to any significant degree. That may be true for mediocre performers, but after having analyzed how outstanding performers conduct their work, we have concluded that these assumptions were totally wrong!

In the past, industrial engineers, in some instances, standardized and simplified worker operations to the point that little thought was needed to perform circumscribed repetitive tasks. Such inflexible work is now mostly found only in highly routinized, mature -- or even outdated organizations. By contrast, knowledge workers at all levels must increasingly be prepared to deal with great varieties in the tasks they perform. This is particularly true for organizations that attempt to stay ahead of their competitors -- that strive to provide quality services and products, be responsive, learn, and maintain versatility.

For example, accounting department filing clerks in a marketing company need to understand the principles and organization of the filing system, customers and suppliers, how to categorize anomalies associated with billings and accounts payables, and many other factors. The better the workers' knowledge, the fewer the filing errors. In addition, as their knowledge is expanded, they work faster and can substitute for each other in ways that lead to greater flexibility and capability of the whole department.

Similarly, factory workers in advanced organizations are asked to become knowledgeable about their workplace -- how their tools and machinery works and can be maintained, and how these variables affect the performance of the whole manufacturing process. In addition, they are asked to develop judgments for how to be responsible for keeping their workplace in top

condition and ascertain that top quality work is produced at all times and major breakdowns are avoided to the largest extent possible.

In short, high-quality clerical and other "routine" work is far from routine today, but requires extensive knowledge to be performed with excellence. All such work requires thought and judgment and can be highly rewarding when emphasis is on quality and responsiveness.

THE OUTSTANDING PERFORMER'S MENTAL MODELS

Outstanding performers share several perspectives that are built upon well established mental models -- concept hierarchies and associative nets -- that in many respects are similar across performance areas.[1] Within an organization, these mental models are teachable and may be transferred to relevant personnel. Before that can happen, however, the models must be determined in detail and by groups of outstanding performers. They also have to be validated to ascertain that they represent views and values the company wishes to perpetuate.[2]

Outstanding performers appear to possess and use five central sets of mental models (each set consists of several complex models as evident from the description below). These models are:

Knowledge WHY

- What Are the Customer's Needs and Intents? Outstanding performers without exception cherish in helping external and internal customers. They actually enjoy such tasks and derive great personal satisfaction. They have elaborate models for how to "read" customer intentions and needs and they have developed the ability to understand quickly "where the customers are," "what their needs are," and "what needs to be done to help." They are also proud of what they do.
- How My Actions Benefit My Firm. Top performers have personal mental models that provide a keen understanding of how their actions benefit the firm both in the shorter and the longer terms. They clearly understand "first-order" impacts of how their actions lead to increased asset aggregation and revenues. More importantly, they have sophisticated hypotheses -- even beliefs -- about higher-order impacts such as how their

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1 When we refer to "mental models" here, we refer to complex collections of understandings, associations, beliefs, and above all, concepts. These notions are discussed extensively by Wiig (1993) Knowledge Management Foundations.

2 Complex mental models are readily teachable by using "effective teaching methods" such as those described by Brien & Eastmond (1994) Cognitive Science and Education, and Wiig (1993), op. cit.,pp. 226-228.

contributions to good service lead to better internal operating performance, market acceptance, and increased customer retention with further positive impacts. That is, they are acutely aware that their actions make a difference.

- What Is In It for Me. Outstanding performers are constantly motivated by their understanding of what their actions will do for them -- how they are secure that in the end they will be rewarded by the firm for their work. They have mental models for how the quality of their work will be recognized.

Knowledge HOW

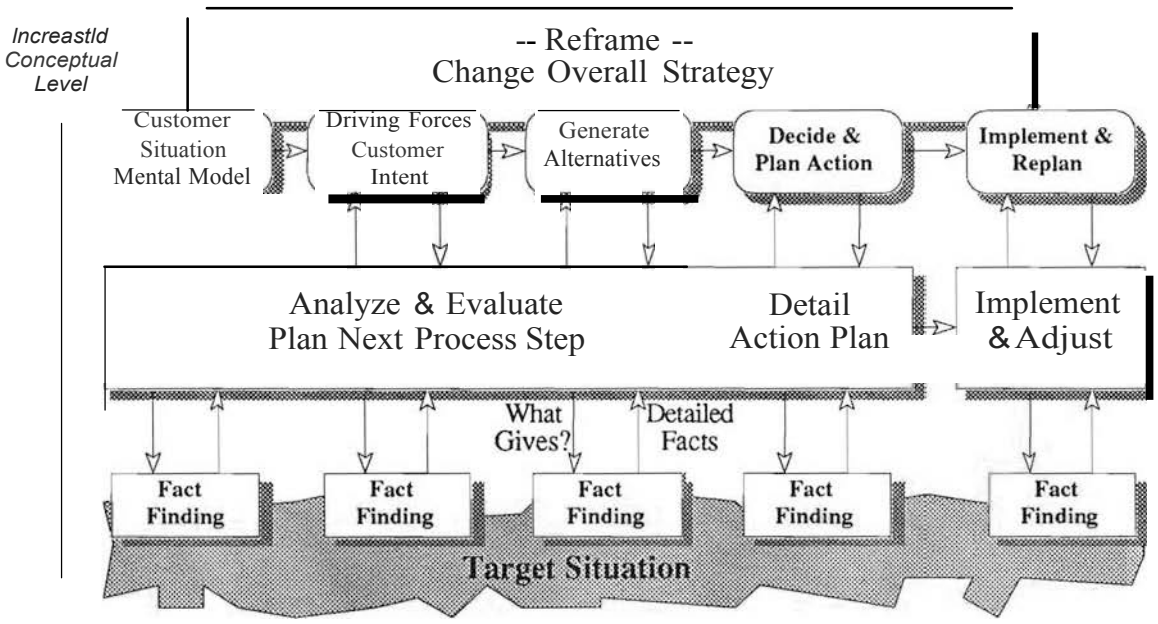
- Dealing with "the Firm and the Outside Agent" System. Top performers have unusually well-developed models for how the internal case handling system works for their area of responsibility, what the neighboring areas are, and how to take advantage of all aspects of the system to facilitate the actions they need to take. Similarly, they have extensive understandings and models of the external world. They know how to navigate all these systems and have personal contacts and relationships that allow them to conduct business efficiently and effectively. Importantly, they have good understandings of the "quarks" of the systems, how to tweak the system to deal with anomalies, and how to catch and solve problems of most kinds. Mostly, however, they know how to initiate actions that will prevent problems.

  These models go far beyond the standard expectations and capabilities to handle process steps (such as how to perform transactions, navigate the information system, etc.) that we often find that the 1to 3 year veteran has mastered with full proficiency.
- The Typical Case and Its Variations. Additionally, the models that exceptional performers have for typical cases -- what their characteristics are, how they can be verified, how they should be handled, etc., are held on three levels: (1) As part of the general schema of cases, (2) As the more concrete script for typical cases, and (3) As routines for the most frequently encountered cases. The scripts and schemas include large repertoires for standard variations and some anomalies.

We find that all proficient knowledge workers pursue knowledge-intensive (K-I) activities on several conceptual levels, often at the same time. For example, the major K-1 activities that an experienced customer service representative engages in are listed in Figure 3-1. On the lowest conceptual level -- the most automatic -- knowledge workers gather information. They engage in fact-finding by conducting conversations, accessing information systems, observing, and in many other ways. On the next conceptual level, as they gather information, they analyze and evaluate it and generally plan what to do next. These activities are often also automatic to some degree. On the

third level, workers start to identify the nature of the situation before them and the driving forces behind the situation (in the customer situation the driving forces are often customer intents). Later they discover the alternatives for dealing with the situation, and lastly they decide which alternative to pursue and how to implement it. The highly expert knowledge worker also considers how the whole situation may be reframed and thought about in a different manner to obtain an even better approach to the situation.[1]

Figure 3-1. Knowledge-Intensive Activities to Determine "What It Means" and Decide What to Do in a Customer Service Situation.



Corporate training programs often emphasize development of the lower conceptual capabilities -- by developing fact-finding skills in some way -- while ignoring the more difficult higher-level knowledge areas. That leads to development of individuals who are skilled at manipulating their work environment (information systems, job aids, etc.), but may be totally unprepared to deal competently with the more demanding aspects of delivering quality work. In most situations, it is the ability to deal with the K-I activities at the higher conceptual levels that separate the good performers

[1] Reframing and its importance in creative problem-solving and decision-making is discussed by Wiig (1993).

from the mediocre ones.

This model has been found to have applicability in other settings as well. In particular, it also describes the K-I script and activities of expert diagnosticians and clinicians.1

THE "DANGER PLATEAU OF UP-AND-COMING KNOWLEDGE WORKERS

As indicated by several researchers, we invite problems when we train individuals in only the mechanistic aspects of their work and let them build their own generalizations from on-the-job observations of factual events.2 In these situations, which are quite common, the knowledge workers develop preliminary and narrow perspectives of what the whole job is about and subsequently start to develop judgments and expectations based on insufficient -- and much too often erroneous -- mental models. These individuals are typically able to perform their basic (and observable) job flawlessly, but tend to have a number of misconceptions that may not come to light until non-standard situations need to be dealt with. Due to their limited understanding of underlying principles, these knowledge workers also tend to deliver work that is not very creative and they often have difficulty identifying the broader meaning of situations with which they are confronted. They may even make totally wrong decisions and are generally on a "danger plateau" of performance.

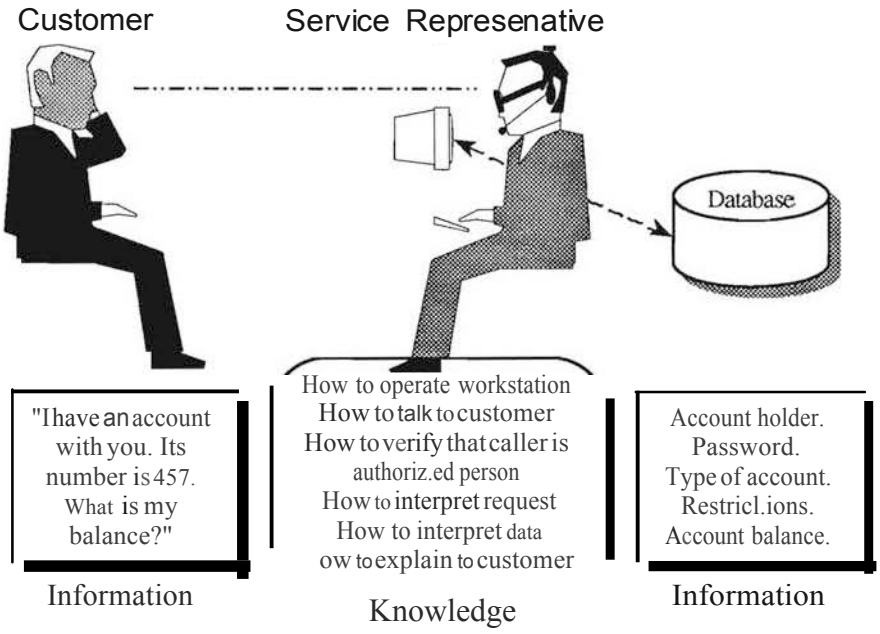
Such situations do not have to develop! It is not difficult to bring these individuals up to a new level of understanding or avoid the danger plateau altogether. However, it does require that modern educational methods be adopted to provide knowledge workers with the conceptual understanding of the scripts and schemas -- the mental models -- required to deliver quality work.3 In addition to more traditional education, the requisite knowledge may be made available to the knowledge workers through a broad educational program that employs several knowledge transfer modes: texts, training, education, reference documents, and KBS applications.

1Reported by Elisabeth Wiig (1994).

2 See, for example, Hubert & Stuart Dreyfus (1986) Mind over Machine, Howard Gardner (1991) The Unschooled Mind, and Diane Halpern (1989) Thought and Knowledge. For additional discussion, see also Wiig (1993) Knowledge Management Foundations.

3 For discussions of development of abstract mental models, scripts and schemas, see Wiig (1993) op. cit.

Figure 3-2. Information Provides the Specifics about the Situation. Knowledge Is Used t.o Work, Interpret, and Manage the Information.



Distinction Between Knowledge and Information Is Not Always Clear

In many situations, both individual managers and organizations can foresee the knowledge required to perform quality work under a variety of conditions. This insight requires that they focus on the nature of quality work to be performed followed up with analyses of resources -- in this context, knowledge -- needed to deliver work with the desired quality. With such insights, knowledge building and transfers can be managed deliberately, thereby enabling the organization to act intelligently in all desired situations.

There still is considerable confusion about what knowledge is and the difference between knowledge and information. This is exemplified by a quote from Business Week where the author equates information and knowledge in the following way:

> "Once the work has been redefined, the new information technology plays a key role. "User-Friendly" software, personal compu ter networks, hand -held wireless terminals, and other gadgets are used to move information to the front lines -- to give

the folks on the factory floor or in the customer service department the knowledge they need to act quickly." Business Week, June 14, 1993 #3323, p. 57.

As illustrated in Figure 3-2 where a customer phones a service representative, there are fundamental differences between knowledge and information. In this illustration, the customer provides **information** about his account and the service representative obtains additional information about the account from the in-house information system. The service representative now holds **knowledge** which allows him to work with the customer. Information, then, is specific and particular to, and defines a given situation, while knowledge is general, held to handle many situations. Besides knowledge may be concrete or abstract and is often semi-permanent.

What Does It Mean? The Struggle to Interpret Information

We often focus on the need to gather sufficient and correct information to support our work. However, we do not always consider what is required to use that information to our best advantage. In particular, we may neglect to ascertain that requisite knowledge is present when we strive to make excellent information available to knowledge workers. We find innumerable examples of how information services departments have labored to bring appropriate information to decision makers and professionals only to learn that the majority of the recipients do not know how to utilize such information correctly. That is, the recipients have not been given the systematic and pragmatic knowledge in the form of concepts, judgments, and methods to deal properly with the information. When we implement a computer-based system to process information, we define in crisp detail how it will be treated within the program. However, we normally only cover relative routine and simple tasks. We often do not consider at all how the information we prepare for knowledge workers will be used by them and therefore cannot identify which knowledge they need to take advantage of the information.

WHAT rs THE MEANING BEHIND THE INFORMATION?

A much more important aspect of the use of information is associated with the question, "what does the information mean?" What does it tell us about the

situation that it pertains to -- given everything else.

Alice Carpenter is the customer service director at Apex Corp. Paul Gantt, the chief engineer of ProPak , one of Apex's medium-sized customers, calls Alice to request assistance in redesigning a part Apex makes for ProPak . Paul is asking for almost immediate action and is also requesting that the design service to be free contrary to Apex's normal practices.

Alice cannot remember precisely what ProPak's records are, and she is hesitant to promise too much for fear ProPak is only on a "fishing expedition" to explore options and may in the end go to a competitor. She queries Paul and discusses the situation with him, accesses the customer service and history files through her workstation. While talking to Paul, she also lets the computer search the marketing and competitive information databases to identify what else may be going on that relates to ProPak and other potential suppliers. Since ProPak is a public company, Alice also has the computer look up and evaluate their recent financial and market situation.

During her discussions with Paul, Alice performs many knowledge-intensive tasks on several conceptual levels. On the lowest conceptual level, she engages in fact finding. On an intermediate level, she processes the information by analyzing what she obtains from her computer and what is communicated by Paul. She evaluates the information for reasonableness and plans the next steps required to obtain additional data.

Alice's purpose in performing these tasks is first to identify what Paul's and ProPak's situation is -- how big and capable are they, is this a reasonable evolution of the relationship, are they in a bind, etc. In other words, she is forming a mental model of ProPak's general situation. Next, she attempts to determine what ProPak's intent is -- ***what Paul's inquiry means given the general, situation.***

What Alice is particularly interested in, is to determine what Paul's inquiry will mean to Apex and to explore in her mind what the potential alternatives are. She holds Paul off while discussing options with Apex's engineers. She calls Paul back to discuss the best alternatives with him and negotiates a mutually satisfying approach that they also agree on how to implement.

Throughout, Alice has continually turned over in her mind how the whole situation with ProPak might be approached from different perspectives to provide a setting with alternatives that are more suitable for both Apex and ProPak and that may provide better overall results as well.

In this example, the knowledge-intensive activities Alice has engaged in are similar to those shown in Figure 3-2. Alice uses her basic skills to obtain the facts she needs to create a mutually satisfactory situation for the two companies. She then uses knowledge of a different kind -- professional knowledge -- to evaluate what the information tells her and to form opinions of

the customer situation, the customer's intent, and what to do about it.

We find that proficient workers use professional knowledge in all situations to interpret the available information in an effort to determine what it means -- to determine what the situation is, what is wanted, and how t.o deal with it. The quality of this determination and the quality of the subsequent work performed, is in almost all cases in direct proportion to the worker's expertise and knowledge.

Recently, I was told how the senior management of a service organization responded to a presentation of the results from a large survey of their customers. The outside consultant brought up a number of significant preferences and dislikes, but did not draw any conclusions. Middle managers familiar with the detailed services were awed at the implications. However, the senior executives who did not possess the same detailed understanding actually thought the whole study was worthless. They did not grasp the meaning of what the findings told -- they could not interpret the information and did not have the knowledge to see how it suggested how they might make highly valuable changes in their services and delivery processes. Most executives did not stay for the follow-up discussion and left quickly. Fortunately, one of the middle managers was later able to summarize findings, implications, and opportunities with the result that many of the important changes were made.

Had the executives possessed the knowledge -- or been provided with interpreta tions of what the information meant -- at the time of the presentation, most of the important changes would probably have been made more quickly to greater advantage for the corporation.

"Agile Manufacturing" Needs Knowledge

During the last few years, progressive manufacturing organizations have adopted the concept of "agile manufacturing" to respond quickly and with low costs and prices to market changes, and design improvements and servicing of individually customized orders. Agile manufacturing is a response to new market demands and highly competent international competition, where to be successful, corporations must meet challenges from strong competitors who have many advantages -- low manpower; idle capacity; excellent facilities, engineering, and technology; and so on. Instead of the old mass production model whose operations are highly tuned to make large numbers of similar

items, agile manufacturing relies on extensive sharing of information and decision-making powers across the organization and alliances with suppliers.

Agile manufacturing also depends extensively on automation and the use of computers and other information technology to support work. It also puts workers -- knowledge workers -- in new roles that place new demands on them to handle new conditions and anomalies, and to exercise judgment based on extensive insights. People drive the process, adjust it to fit new requirements, improve it continually, and watch it to prevent problems. To acquire the versatility that is needed to support the new environments, the workers must be educated in many directions. In the words of Mr. Wass of Ford Motor Company, "Our model is the cheetah. We want to be able to stop on a dime, direct all our energy toward a goal, tum quickly and accelerate rapidly."1

Agile manufacturing also requires extensive knowledge on the part of product designers to (1) Be able to create new products that can be manufactured advantageously by the new facilities and (2) To acquire new design skills that allow them to create individualized designs quickly.

The concepts of agile manufacturing do not apply only to the manufacturing industry. It applies equally to service industries where new environments, customer needs, and competitive pressures require agility to degrees not previously experienced. In all these situations, the organization and its personnel must learn to be light-footed and versatile.

Examples of Practical Approaches to Knowledge Management

Proper management of knowledge is the central and most important activity the modern organization can engage in. Quality of its products and services, acceptance within the marketplace, and overall success are direct functions of how effectively the organization learns and applies its knowledge assets to critical areas.

A few advanced organizations focus on organizing and consolidating their important knowledge-related initiatives into a well-coordinated program -- they manage knowledge proactively. One of their objectives is to ascertain that knowledge-related efforts complement each other, that important

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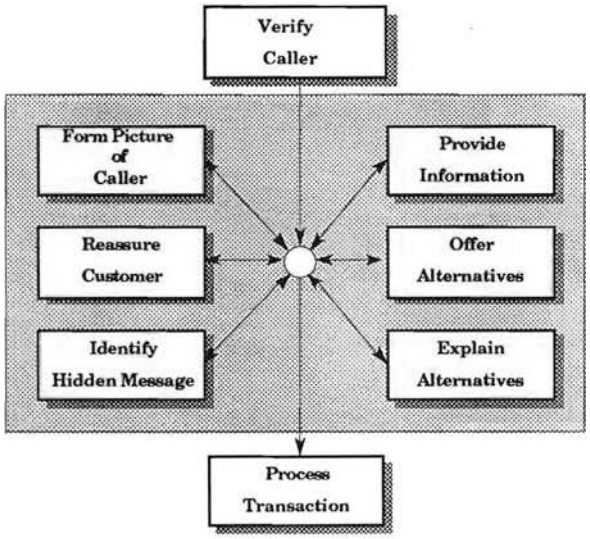
1 See Holusha (1994) "Industry Is Learning t-0 Love Agility," New York Times, May 25, pp. C1&5.

opportunities are not overlooked, that the best approaches are pursued, and that the whole program is made as effective and efficient as possible to take proper advantage of its knowledge assets.

DETAILED ANALYSIS OF KNOWLEDGE-INTENSIVE WORK

One method to identify the knowledge required to deliver quality work is to use knowledge scripting and work function profiling.[1] To accomplish this, knowledge-analysis is performed through interviews, expert and average worker observations, and simulations where novices perform real-life tasks assisted by experts. Scripts of knowledge-intensive steps are identified for specific major tasks and an example is summarized in Figure 3-3.

Figure 3-3. Simplified Script of Knowledge-Intensive Steps[2]



Results of interviews and other materials are analyzed in considerable detail. Knowledge-intensive activities for each step are identified and the knowledge needed to perform them proficiently is made explicit. As part of this work, dominant concept hierarchies (see Figure 3-4) are elicited from the experts to identify the conceptual basis for mental processing and judgments.

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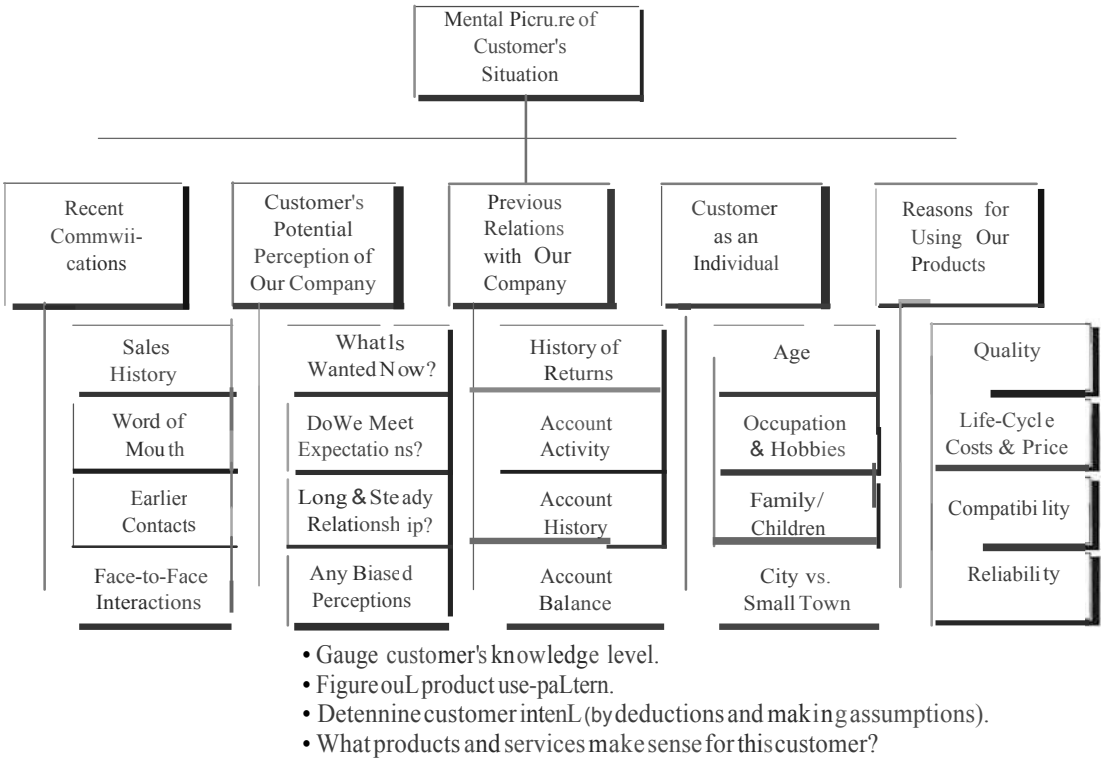
1 See Wiig (1993) op. cit., p. 181.

2 AU steps may not be required for each task, and different tasks may require execution of steps in different sequences depending upon the actual situation and the worker's associations and routines for what to do next.

Figure 3-4. Concept ffierarchy for Developing the Mental Picture of the Customer's Situation.



- Gauge customer's knowledge level.
- FigureouL product use-paLtern.
- Detennine customer intenL (by deductions and making assumptions).
- What products and services make sense for this customer?

Many who have previous experience in "requirements analysis" have observed that most of the knowledge-intensive (K-D activities performed by competent workers are hidden from view, invisible or not observable by the casual onlooker. That is, it requires considerable expertise to discriminate between different aspects of the situation and to identify the K-I activities and determine their content and function. Also, experts almost invariably perform many activities very quickly -- almost automatically -- compared with less competent workers. And, as indicated, the quality of their work is also often much better as a result of comprehensive understanding and judgment and the use of higher-level mental models.

When we deal with in-depth knowledge and understa nding as requirements for performing knowledge-intensive work, we need to distinguish between knowledge at different conceptual levels:1 (1) Goal-setting or Idealistic knowledge; (2) Systematic knowledge; (3) Pragmatic knowledge;

1See Appendix A for an explanation of conceptual knowledge levels.

and (4) Automatic knowledge. These conceptual levels reflect the degree to which we have internalized the knowledge and how we apply it to the situations we face. We often have only intuitive comprehension of goal-setting knowledge but still use it to direct our thinking and activities. We have deeper comprehension of systematic knowledge which we use to understand "how the world works" and to shape our approaches. We use pragmatic knowledge to make conscious decisions. Finally, automatic knowledge has been internalized to the point that we use it without thinking. In addition to these four conceptual levels of knowledge, to characterize the nature and expected use of knowledge, we must also distinguish between knowledge of different types: (1) Factual knowledge; (2) Conceptual knowledge; (3) Expectational (judgmental) knowledge; and (4) Methodological knowledge.[1]

KNOWLEDGE, SKILLS, AND PERSONAL CHARACTERISTICS PROFILES

Scripting and profiling lead to knowledge, skills, and personal characteristics profiles. The profiles are developed in two ways: (1) From the specific knowledge components that are identified as part of the knowledge-analysis; and (2) From in-depth discussions with experts, managers, and others who have professional insights into what is required to deliver quality work in the target function. Profiles for the example scenario are presented in Figure 3-5.[2] They are used to portray the knowledge and skills that are required -- or that individuals might actually acquire. Gaps are readily identified to guide the development of educational programs or determine where individuals or groups may benefit from knowledge transfer.

The knowledge profile specifies the different areas of in-depth "professional" knowledge and understanding needed to deliver quality work. Knowledge consists of deeper understandings required for the knowledge worker to perform knowledge-intensive tasks -- routine and non-standard -- with desired quality and can be developed through education or other modes of knowledge transfer that facilitate deep learning. It is often possible to distinguish between different manners in which the knowledge is primarily possessed -- it may be possessed as Idealistic, Systematic, or Pragmatic knowledge. Automatic knowledge normally needs to be internalized to the extent that it becomes a skill, although elements of all the knowledge areas

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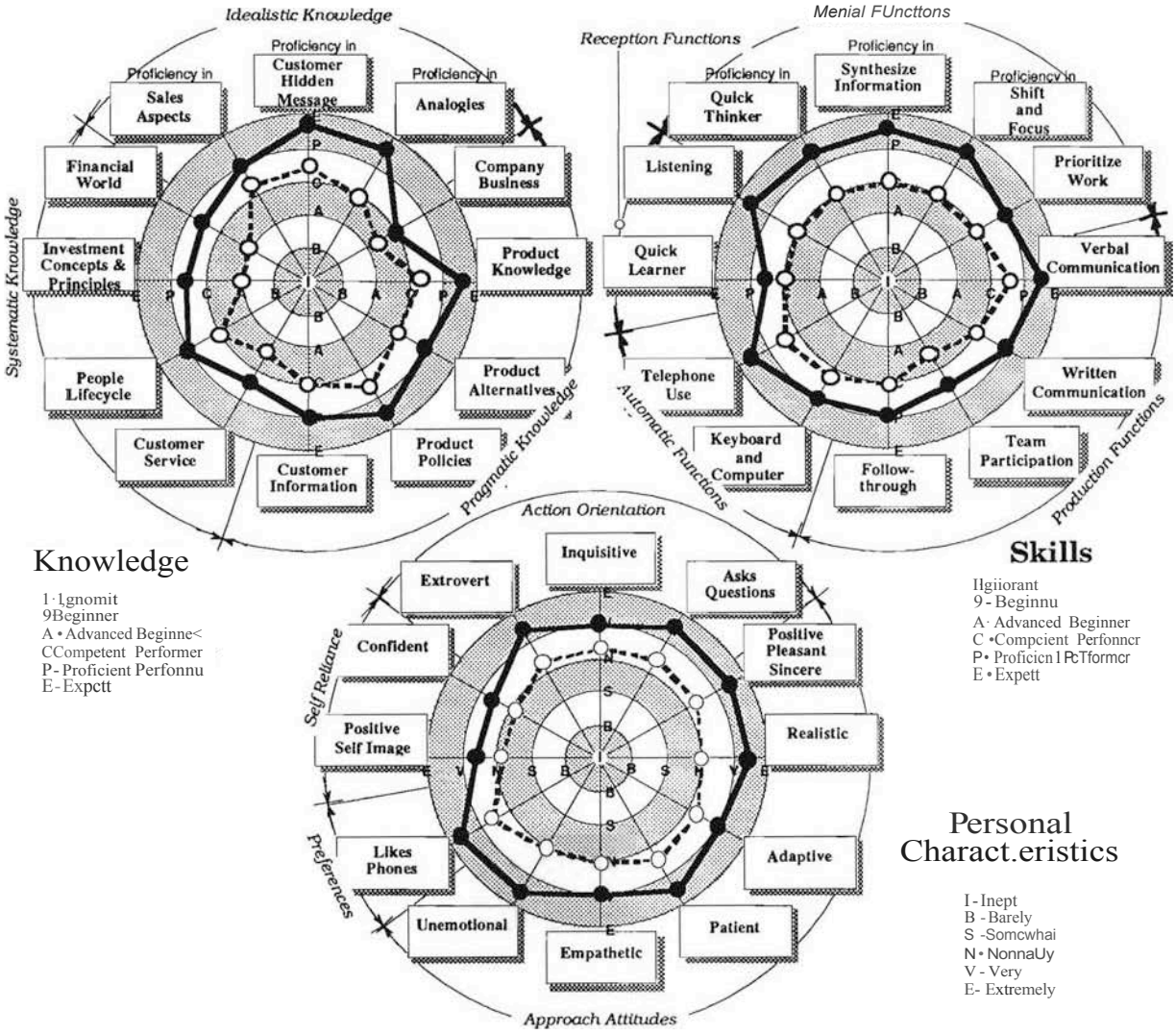
1 See Appendix A for an explanation of knowledge types.

2 This figure is explained further in Knowledge Management Foundations (Wiig, 1993).

shown are automatically also available to the knowledge workers.

Figure 3-5. Example of the Knowledge, Skills, and Personal Charact.eristics Desirable for a Particu1ar Cust.omer Service Knowledge Worker.



The skills profile specifies basic proficiencies that individuals need to be able to work competently. Skills cover routine capabilities used more or less automatically; these are typically acquired and improved by training. For some highly expert individuals, parts of their professional knowledge may be so well internalized that they in fact have become automatic skills.

The personal characteristics profile specifies the requisite personal qualities. They often cannot be easily changed. Personal characteristics are similar to "competencies" as identified through "competency modeling" and cover basic human traits needed for good performance in a particular position. These are difficult to change quickly.

TEACH CONCEPTS TO BUILD KNOWLEDGE, RATHER THAN MERELY TRAINING TO TRANSFER FACTS AND CREATE SKILLS

Concept hierarchies are central to identifying the details of knowledge required for competent work. In customer service situations, for example, there are several top-level concepts such as "Mental Picture of Customer Situation" and "Customer's Intent." Given these, a third concept is "The Best Way of Helping Customers," as indicated in Figure 3-1. (An example of a concept hierarchy was illustrated in Figure 3-4.)

In forming top-level concepts, workers build abstract, often qualitative, mental models. They assess the state of the concept by using discrete qualitative brackets such as: "The customer's situation is not serious but competent technical help is required to correct the problem." To form broad concepts, they "chunk" lower-level concepts to combine simpler concepts into more comprehensive mental models. Chunking often varies between individuals and may reflect misunderstandings or different associations.[1]

It has been found to be relatively easy to teach concepts to people at all ages. Strong foundations can be provided that enable learners to build understandings and judgments quickly and accurately. That is, teaching workers the foundations of underlying concepts minimizes the need for providing much of the detailed factual knowledge that has often been the traditionally been taught. Instead of teaching details for all products, therefore, it is possible to educate workers in the conceptual principles, accompanied by representative details showing how the abstract schemas and scripts translate into concrete conditions. Most details can then be provided via such modes as computer-based support systems. Models exist for effectively teaching broad concepts and schemas while connecting them firmly to concrete and detailed examples. Such models suggest frequent switching between concrete cases and the underlying concepts and theory. Transfer of knowledge is quicker, can be performed with fewer errors and misconceptions,

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1 See Wiig (1993) op. cit., pp. 113-115.

and provides greater insights and flexibility when it focuses on transferring the underlying concepts populated with samples of representative factual knowledge.I

When people are taught only concrete facts and details, they tend to develop their own mental models and schemas based on the sum of their prior experiences. These will differ considerably from person to person and, therefore, their resulting mental models will be different -- and in most cases incorrect. Thus, it is important to teach the underlying theory alongside the factual details.

WHAT CAN THE COMPUTER KNOW AND WHAT MUST THE HUMAN KNOW?

Most knowledge workers, as an example those who provide customer service, often find themselves in time-critical situations requiring that they "think on their feet." For example, they engage in customer dialogs and verbal problem-solving involving subject matter that may span large domains.

As a result, these individuals need to possess knowledge and a work environment that allow them at all times to: (1) Understand the situations they encounter; (2) Plan where they wish to direct the situations; and (3) Feel confident that they will be able to obtain whatever additional knowledge, facts, or information they will need to proceed.

It is generally impossible for these individuals to possess all the factual, conceptual, judgmenta;I, and methodological knowledge they need to be able to perform their routine and non-routine tasks. In most situations, the amount of knowledge -- particularly factual knowledge -- required exceeds the mental capacity of the average knowledge worker. However, as indicated above, it is quite manageable to provide the workers with selected conceptual knowledge that allows them to function competently without possessing all details. In these situations, we often provide knowledge workers with powerful computer-based support systems. When this is an option, however, we are immediately faced with the question, "What can the computer know and what must the human know?"

One solution is for the computer to possess all factual knowledge as well as much methodological, conceptual, and judgmental knowledge as is practical. Such knowledge may be represented in an active reasoning system or, less

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1See Wiig & Freedman (1993) and Wiig (1993) op. cit.

desirably, in a sophisticated but passive query system such as based on hypermedia technology. Knowledge workers, in turn, should be provided with as much conceptual knowledge as possible to understand all general principles that underlie the situations they are expected to deal with. In addition, they must know how the factual knowledge relates to the concepts and how to apply all methods. The particulars of the methods can be obtained from the support system when required. Particulars of judgment and other specifics may also be obtained from the support system as needed. It must be recognized that some of this knowledge may be volatile and needs to be changed quickly.

This division of knowledge offers many advantages: Educational requirements can be reduced. Workers can be more versatile and flexible and can change jobs as required. And volatile knowledge may be incorporated inexpensively into the support system whenever it changes and distributed to points-of-action for direct use.

Chapter 4

Ainerican Knowledge Gaps

Knowledge Gaps Come in Different Forms

There are many kinds of "knowledge gaps." Some are caused by gaps between available knowledge and knowledge required to deal with the situations at hand. Others are caused by relationships between different parties such as one party having superior knowledge while others have less. We find knowledge gaps between nations when people in one nation are better educated than in another or when the technology base of one is better than in the other. Further, we find a broad knowledge gap between two parties when one knows more than the other. We find a specialized knowledge gap when one company has some particular knowledge that gives it a competitive advantage over another. We find a knowledge gap between a knowledge worker and a job when the job requires a specific proficiency that the worker does not possess.

Other knowledge gaps are caused by parties possessing different kinds of knowledge with different understandings and beliefs. In these situations, the knowledge gaps may be manifested by misunderstandings, an inability to communicate, and various kinds of incompatibilities. We find such knowledge gaps between well-educated people in different fields; for example, between technologists and humanists and between management and production workers. We frequently find such knowledge gaps between highly specialized departments within the same organization and can observe the results when otherwise well-meaning professionals seem to work at cross-purposes.

WHY DO KNOWLEDGE GAPS MATTER?

Knowledge gaps are very important, particularly because of the deleterious effects they often cause. As a result, we need to work hard to reduce such gaps

or minimize their effects by other means. The existence of knowledge gaps between two parties invariably leads to significant problems regardless of whether the parties compete, collaborate, or just need to coexist. One such problem stems from the job-requirement knowledge gap, when the knowledge to perform the required work is insufficient. These serious and unproductive situations often occur when novices -- or improperly prepared professionals -- are asked to perform knowledge-intensive tasks that may range from allocating consolidated invoices to dealing correctly with difficult customer problems, or planning for new information system capabilities. Other gaps include interdisciplinary knowledge gaps, knowledgeable vs. ignorant parties gaps, and teacher-student knowledge gaps.

The American Knowledge Gap Is Two-Sided

It is frequently argued that the United States lag behind other developed nations in terms of the knowledge our workers possess. To some extent this argument is appropriate since the average job entrant's command of the "Three Rs" is below that of people with similar backgrounds in many of our competitors in Europe and Pacific Rim countries. In addition, within the U.S. we frequently find knowledge gaps between the expertise job seekers possess and that required for many positions.

This situation is not that one-sided, however. Upon examination, we find that the American knowledge gap has two sides -- one positive, the other negative. On the positive side we find that no country or economy has progressed as far or as broadly towards being a knowledge society as America. Specifically, we may have the largest proportion of knowledge-intensive companies and knowledge-based industries, the greatest export of knowledge, technology, and information, the best universities, and overall, the most sophisticated workforce in the world. We repeatedly develop the most advanced and sophisticated new technology solutions in many areas and have the best educated market for high-technology products. In this sense there is a knowledge gap between the United States and other countries. We also have greater knowledge assets in total and per capita than any other nation and, to a large extent, we have organized our knowledge assets better than our competitors.1

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1 Some people argue that this view is incorrect, maintaining that other, but smaller, countries have progressed as far, or perhaps farther than the U.S. has. They mention Singapore, the

On the negative side, it is argued with some justification that the U.S. has the least prepared workforce entrants, the most inadequate school systems, a larger proportion of functional illiterates, and a greater effectiv.e gap between job requirements and workforce capabilities than any other highly developed nation. We perceive that we are behind the Japanese and many European countries in general education and world understanding in the population at large. The same appears true for widespread technical knowledge in many industries and businesses.

It is also argued that we have the poorest educated management workforce of any industrialized nation, having the least understanding of, and interest in, knowledge areas outside narrow technical and business subjects. This has resulted in a management knowledge gap that has translated into a management crisis. Managers are accused of being unwilling to take risks, unwilling to consider comprehensive solutions that require vigilant decision-making and collaboration with others, and tending to pursue short-term solutions with particular emphasis on personal gain rather than long-term solutions of a more egalitarian nature. In larger companies, managers are further accused of demonstrating a herd mentality, of working to perpetuate the *status quo* -- of not being willing to learn, change, or redefine problems to fit new conditions and paradigms. We suggest that these traits -- to the extent that they exist -- inhibit creativity and vigilance. They make intelligent-acting behavior very difficult.

If these characteristics in fact are representative of actual conditions, we need to develop a knowledge culture and a knowledge delivery system that is far more powerful and supportive of intelligent behavior than what we have today. We also need to develop managers who are more knowledgeable and curious, have broader perspectives, are eager to reframe problems and be creative, and work smarter, not harder.

The United States has a dismal record of being able to maintain leadership in producing and marketing the high-technology products that we invent and develop. As these new and advanced products gain in acceptance, other nations repeatedly win the race by improving technical features, reducing production costs, and providing features that make the products more appealing to buyers. This has been demonstrated repeatedly with the loss in market leadership in videorecording, computer displays, xerography, and

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Scandinavian countries, and Holland where literacy, sophistication of the work place, and sdence have come very far.

many other areas. Instead of prospering by manufacturing these products for the rest of the world, we lose the market and our initial lead and become poor by buying them from the outside.

The American knowledge gap manifests itself in additional ways as well. It is not the purpose here to analyze the reasons behind these gaps. We will, however, point to some situations where we can expect to find organizational knowledge gaps that can benefit from managerial attention. We will also deal with selected opportunities for reducing some gaps with the help of active KM.

Some Knowledge Gap Examples

BUDGET CUTTING MAY LEAD TO DETRIMENTAL KNOWLEDGE GAPS

In the 1970s, a Silicone Valley semiconductor company had perfected its production of 4k dynamic random access memory (DRAM) chips to the point that yield s were good and prod q,ction costs were low. The plant ran with few operating problems: Operators and technicians were able to run prod uction and maintenance with little or no help from engineers and prod uct designers. The company made good money and looked forward to a long and profitable prod uct life span. However, price competition was strong and management decided to improve profits by cutting back costly R&D and engineering staffs. As a result, most engineers and scientists were laid off or resigned leaving only a skeleton professional staff

A year later, the new generation of 16k DRAM chips were introduced and the demand for 4k chips started to fall. Due to its R&D cutbacks, the company did not have a competitive 16k design of its own, and it was too late to create one. Management also discovered that without a strong engineeri ng staff, it did not possess the knowledge to adapt its prod uction line to the more demanding technology required to prod uce 16k chips, should it decide to buy someone else's design. To make matters worse, competitors had invested in R&D to improve their 4k chips to be faster, more reliable, and have lower power consumption to serve the shrinking market better. The company gradually lost sales and within another nine months, it ran into red and was liquidated by the bankruptcy court shortly thereafter. The only assets left were real estate, machinery, and some raw materials. It had no intellectual property, knowledge assets, or market recognition and was essentially an empty, worthless shell.

We are not suggesting that this will happen to American industry when C•Ompanies decide to cut budgets by reducing its staff of experts. It is, however, an illustrative example of what can happen when a company stops supporting the knowledge base that underlies its products and production technology. The

model relates to the present debate, which emphasizes the deteriorating competitive situation of American companies in many vital industries where we have lower R&D funding than our international competitors and have reduced investments in new products.

It seems we frequently lose our leadership position when we reduce investments in R&D and neglect to maintain and update the very knowledge base and expertise that was the basis for our initial lead. This is not only the case in some areas of consumer electronics and other high-technology industries, but also in some basic industries like steel and even ocean fisheries. By not managing our knowledge for future gains, we lose out.

DO NOT TRANSFER WORK TO THE FIELD WITHOUT THE ACCOMPANYING KNOWLEDGE!

A large chemical firm decided that its salespeople needed greater autonomy in matters relating to negotiating terms of new contracts. The firm had lost considerable business which it judged as stemming from its rigorous and bureaucratic internal procedures for preparing and reviewing quotations and contracts.

It was assumed that the salespeople had sufficient understanding of the deliberations that needed to be taken into account to close a contract. A brief document was created and distributed to outline the new policies that increased decision rights and specified basic terms and the room for negotiation. Based on the feedback of a few sales managers, it was judged that the new procedures were simple enough to be competently handled by all.

A few weeks after the new program was initiated several dozen new short- and long-term contracts had been negotiated and forwarded to the VP of Sales for review. It was found that most of them violated the terms of the new policy, giving customers prices and delivery conditions beyond what had been intended as the outer limits, although those were not clearly delineated since they depended upon several conditions. After interviewing the "offending" salespeople it was found that they had never understood how to take into account the need to balance regional product slates, calculate overhead allowances, the internal system's needs for advance notice, and so on.

It had been thought that the sales force was better educated. The VP of Sales had indicated: "Everybody knows these things and I learned the first month on the job!" The present situation was intolerable and the VP of Sales decided that instead of centralizing decisions, it would be better to support the new policies by a quick and intensive educational program supported by videos and interactive CBT programs. A knowledge-analysis

was performed to delineate the knowledge gap and the programs were implemented with the desired results.[1]

AUTOMATING WITHOUT ADDING KNOWLEDGE CAN BE COSTLY

Many American companies have embarked on massive automation projects but have not received the intended benefits. An example:

A large producer of consumer goods had high production costs which it determined were due, to a large extent, to inefficient use of its workforce. The number of work hours per product unit was one of the highest in the U.S. and significantly higher than its more efficient international competitors. Many overseas competitors had automated their plants extensively, and this was generally accepted a major factor in their success. As a result, the company decided to embark on an aggressive automation program.

The company created specialized engineering teams that studied automation opportunities throughout its operations. Massive changes were made in layouts of the production processes, the production line was streamlined significantly and new plants were built to facilitate automated production. After several years of planning and engineering, the new automated processes started to operate. The usual start-up problems occurred, but they were expected to be easy to iron out.

Unfortunately, many operating problems that appeared at start-up persisted. For example, the automated lines had frequent production stops and long downtimes. When the lines did work, the quality of the products were less than satisfactory, and the scrap rate was unacceptably high. It had also been expected that transition of products from one line to another would be "seamless." Instead, significant manual adjustments were often required for intermediate products to be acceptable downstream. As a result there was considerable rework, in-process inventory was much higher than expected, and schedules were constantly delayed.

What was wrong? In retrospect nearly two years later, the company discovered that they had made two major management errors, both of them knowledge-related:

1. The workers had not been educated. Those who operated the new automated systems had only received instructions and training in how to run the equipment under normal circumstances. If something went wrong with the automated equipment they were to report it to specially

[1] When the VP of Sales started as a junior salesman 15 years earlier, the field had great autonomy. However, as the firm grew, many unprofitable decisions were made and pricing and contract decisions were later centralized. The reasons for this move had been erased from the corporate memory; hence, the errors repeated themselves.

trained mechanics who would make repairs. Quite often this would lead to shutting down the line while mechanics were summoned to fix the problem. Also, all too frequently, the workers did not spot problems early enough, thereby aggravating the equipment failures resulting in costlier and longer repairs.

The workers had not been given knowledge to diagnose their equipment and perform simple maintenance and adjustments on-the-fly as these were needed. In contrast, overseas workers in the same industries with equal levels of automation were considered knowledge workers, having received considerable education in the theory and technology of the automated equipment. They had also received general education in basic physics and electronics and in the more conceptual areas of diagnostics and trouble shooting.

Overseas workers in similar situations were expected to be sufficiently knowledgeable to understand how their equipment functioned and to participate in the process of improving the operations. The American workers were not expected to understand, nor were they expected or encouraged to participate in making improvements in the line operation.

2. It was assumed that the new production lines initially would continue to make the old products. The product design engineers had not been educated in the operations and capabilities (and lack of capabilities) of the new automated production equipment. As a result, they did not have sufficient knowledge of its strengths and weaknesses and, therefore, did not know how to design products that could be manufactured optimally on the new production lines.

As a result, many of the parts had to be completely redesigned to make it possible to manufacture them. It took almost a year to realize that and longer to accept it. In the meantime, older part designs were manufactured with difficulty, and the shapes and tolerances of many parts and assemblies had features that created aligning and machining problems in the automated line.

Only after the design engineers had been thoroughly educated in automation design capabilities and principles were they able to generate workable designs.

DANGERS OF TECHNOLOGY TRANSFER WITHOUT UNDERLYING KNOWLEDGE

A large technology company manufactured high-quality industrial equipment with great success. A competitor had developed a complementary line of equipment but wanted to concentrate on other areas and, therefore, was willing to sell rights to its new prod ucts. The company bought all rights, drawings, prod uct and material specifications, and manufacturing and tooling directions. However, it did not acquire any of

the marketing, engineering, and R&D knowledge that was the basis for the new product line.

With all the technical information it had obtained, the company was able to produce and market the new equipment in record time and make high-quality products at a very competitive price. After they had produced the products for about a year, they needed to improve the equipment models to enhance their capacity and efficiency. Initially, they were able to make small improvements very smoothly and foresaw no problems.

However, after a short time attempts to implement further improvements became problematic. Materials started to break, overheating occurred in unexpected places, and other physical limitations that had not been predicted started to appear. The engineering and research staffs worked on crash projects to reverse-engineer the products at great expense. Improvements became less than promised and some were delayed nine months before they could be shipped.

In the end, the company's management evaluated the situation and found that it would have been cheaper and faster to develop the new product lines in-house instead of buying them. They also determined that if they had acquired only part of the underlying product knowledge -- in the form of transferring or borrowing personnel -- they could largely have avoided the costs, time delays and market embarrassment.

THE MYTH OF THE "COMMUNICATION GAP"

A knowledge gap often appears as a communication gap between people, teams, departments, or organizational entities. Symptoms may initially indicate that insufficient or wrong information is being provided by one party to another who has a "need to know." Or it may appear that the receiving party is paying insufficient attention to the importance of the information received. Often identified as communication problems, these situations are typically much more fundamental than problems associated with exchanges of information. In reality, they may be caused by disparities in the knowledge available to the different parties -- often by interdisciplinary knowledge gaps.

In a knowledge gap situation of this kind, knowledge disparity may result from three modes of faulty information exchanges:

1. Direct information transfer where the transfer is in one direction from a sender to a receiver (example: superior to subordinate).
2. Dialog where two parties alternate between being sender and receiver and carry on an exchange of messages.
3. Multiparty communication with one sender and multiple receivers

(example: speaker with audience), multiple senders and multiple receivers *(example:* committee at work), or multiple senders and one receiver *(example:* manager receives information from subordinates.)

A special multiparty communication gap occurs in collaborative work teams where team members have insufficient shared knowledge of each other's perspectives, backgrounds and strengths.

Whenever information is transferred or exchanged, knowledge about the nature and content of the information and its use is required by both sender and receiver. The sender needs to know how the information is to be used to *select* and *format* the information. The receiver needs know about the origin of the information to *analy ze* the communication, *interpret the relevance and meaning* of the received information and *decide how it is to be handled* and used. An apparent communication gap appears when there are mismatches between the information being communicated and its intended use or when there are errors in the selection, interpretation, or timing of when the information is forwarded.

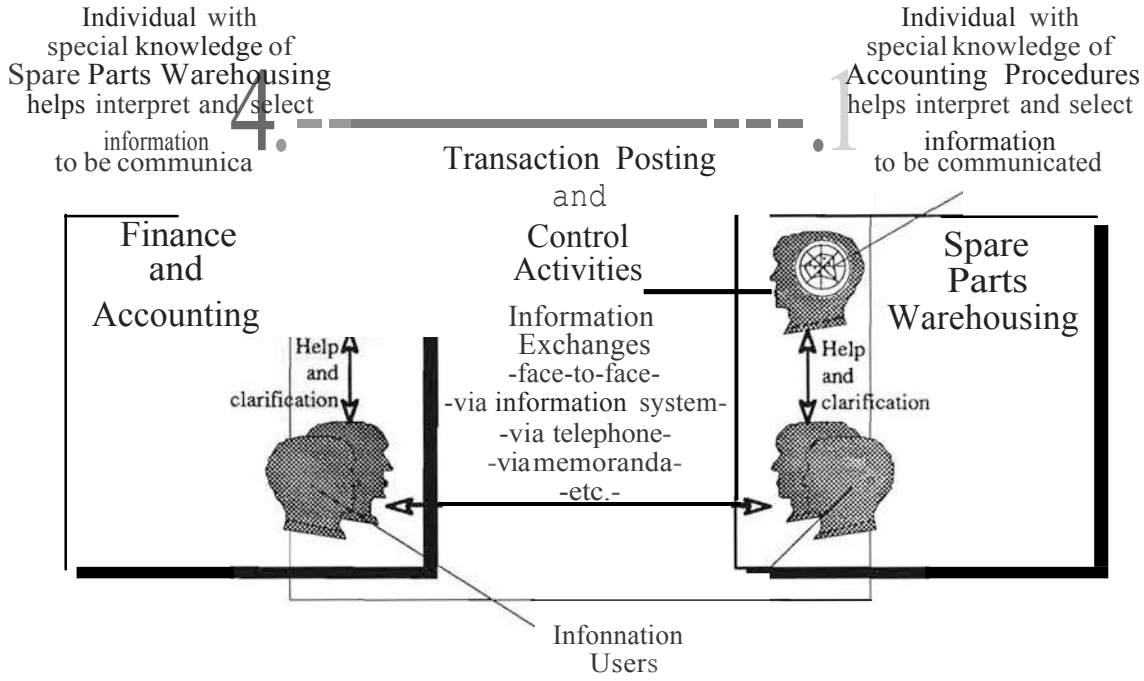
An example of a situation that often leads to apparent communications gaps is indicated in Figure 4-1 where information is exchanged between the accounting department and the spare parts warehouse regarding how the accounting department should post multiple-order invoices. Quite frequently, the accounting department has insufficient knowledge about the precise work practices in the warehouse department. Similarly, the warehouse staff may have insufficient knowledge of the accounting practices and relevant line items of the chart of accounts and cost center assignments. As a result of these knowledge gaps, a number of errors may be made when invoices and other transactions are posted by the two departments.

Most information users do not have enough knowledge to fully interpret the meaning of the information they receive. As a result, individuals with special knowledge are often placed in user departments to interpret and clarify information that is exchanged between departments. In some important situations, we are starting to see expert systems introduced to help out the information users.

As part of "systems studies" we often analyze in some depth information exchanges between business functions and the related information needs and availabilities. However, we rarely look at the knowledge required to generate and communicate the information in the best manner possible. Nor do we look at the knowledge required to interpret and understand the information once it has been received. Consequently, we often are surprised and misunderstand

what is happening when what we think is "correct" information is being exchanged but not used correctly in the receiving business function.

Figure 4-1.IDustration of Information Exchange Between Accounting and Spare Parts Warehousing for Transaction Posting and Control



It is quite simple to identify and chart the knowledge areas that need to be available to individuals who perform important information exchanges and other communication functions. Knowledge-analysis accompanied by scripting and work -function profiling can be used for this purpose.

ARE AMERICAN KNOWLEDGE GAPS LONG-TERM OR TEMPORARY?

It appears that we will continue to experience knowledge gap problems for a while. Japan, with half our population, invests twice the number of dollars every year in R&D as we do. At the same time, they are generating more patents per capita than us. The overseas R&D efforts are initiatives to build and expand corporate and national knowledge assets. The cumulative effects of these efforts are to widen, or at least maintain, the lead -- the knowledge gap -- in such industries as electronics, automotive, and consumer products. Per capita, that is four times our investment.

We continue to see examples of knowledge gaps as a result of budget cuts in personnel to downsize and flatten organizations. During the "industrial era," personnel costs typically were the major cost elements in manufacturing firms. This is changing! With increased automation and extensive subcontracting, personnel costs have now been reduced so that they are often much lower than other costs. Yet managers still use perspectives and judgments that were developed when personnel was the major variable cost. As some authorities suggest, cutting personnel for budget reasons in engineering, R&D, and other knowledge worker areas often reflect outdated perspectives and may undermine the future health of the organization. Such moves are extremely shortsighted as attested by many companies that formerly were healthy independents and now have been absorbed as smaller divisions of larger firms.

In addition, the reduced headcount that results often cannot operate the organization as effectively as market and competitive conditions require. Consequently, the companies that cut costs by cutting personnel often end up being operated less effectively and drive up unit operating costs.

One reason for these secondary problems is that the reduced staff needs to take on added responsibilities for which it does not have the appropriate expertise. When staff is reduced "across the line" by five or ten percent, a number of knowledge gaps are created. In most cases, prior to cutting back personnel, management has not examined the knowledge required to deliver services or products with the desired effectiveness and quality. Consequently, managers are caught by surprise when the seriousness of the resulting knowledge gaps become apparent. By then, unfortunately, it is usually too late.

There is no reason to accept the continuation of these knowledge gaps as a *fait accompli.* By reviewing the reality of our knowledge situations and focusing on the knowledge processes, we can channel our resources to narrow -- or in many instances, prevent -- these gaps.

Education and Knowledge Preparedness in the U.S. and Other Countries

Comparatively speaking, the condition of the knowledge base of American entrants into the job market is a disgrace. Over 80% of American youths graduate from high schools, yet 14% of all job entrants are considered to be

functionally illiterate. The total public school budgets in the 50 states amount to about 150 billion dollars per year. Yet U.S. industry and business spend over 25 billion dollars each year for **remedial education** of new entrants to teach them the rudiments of the "Three Rs" and other basic skills that they did not learn in school but were expected to. That means that the private remedial education budget is one sixth of the public school budget -- a hidden tax of large proportions! Not to mention the waste of minds that do not reach their potentials because of lack of education. The associated additional hidden costs for social services and loss of competent workers at all levels are enormous. Some suggest that they may be in the hundreds of billions of dollars per year.

There is a significantly lower demand on the American student to learn than on students in other developed countries. For example, by the time American students graduate with Masters Degrees in Business Administration, they have finally received as many classroom instruction hours as the average Japanese high school graduate! European students also receive considerably more quality classroom hours and more extensive coverage in subjects like mathematics, languages, history and geography than their American counterparts.

As a result of these disparities, the American manager is faced with a considerable challenge when having to prepare new entrants to do knowledge intensive work. Most manufacturing and office technology developed and used in the United States is engineered and geared to worldclass standards -- to produce worldclass quality products and services and to compete in the international marketplace. The standards and expectations for sophistication in some areas have been increasing to meet demands in the competitive and more sophisticated markets. As a result, some work environments in the U. S. are "uncomfortably sophisticated." In other instances, managers and designers are choosing simpler solutions that may be less competitive, but that match their own lack of sophistication and the deficiencies in their personnel.

These problems are not new. I recently met an American executive who had moved to the U.S. from Europe as a teenager thirty years ago. He had completed his *Gymnasium* education but that was not recognized by the school board in his new town. Due to his young age, he was told to enter high school as a junior and was also told to take normal-track mathematics. Shortly thereafter when the class was given a simultaneous equation problem the student indicated after a few minutes that he had the solution. The teacher was amazed but verified that the answer was correct and asked the student to show the class how he did it. He showed how he solved the problem with

determinants but the math teacher did not understand these operations and had to obtain help from the department head.[1]

This example of not providing our students with "modern" math methods -- or in-depth knowledge in other fields -- is not an isolated case. We frequently find that our curricula are shallow, our textbooks are watered down, and our teachers are not prepared to teach up-to-date physics, mathematics, social sciences, geography, history, and almost any subject we care to mention. Our educational resources are sadly lacking and not up to the task we require as a nation to maintain our position as a world leader.

According to several recent surveys, the great majority of executives are convinced that the U.S. educational system does not prepare graduates adequately for entering the job market. Other surveys have found that our high school graduates often do not know how to write. (A 1994 survey found t'hat, on the average, students spend two hours per week writing and more than four hours per day watching television!)

Knowledge Gap Between Workers and Workplace Requirements

Our industry leaders have an acute awareness of the significance of the knowledge gap. In the CEO survey[2] reported above, 83 % of the respondents agreed that there is a gap between knowledge required for job pe:rformance and knowledge in the workforce. The advanced American workplace is "worldclass." In most industries and businesses, the workplace is as highly automated, supported with computers, and "informatized" or "informated" as any sophisticated workplace anywhere else in the world.[3] To operate competently and perform even the basic work tasks effectively in this

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1 Determinants have been known for a long time and have been a standard and straightforward method for solving simultaneous equations. Leibnitz investigated determinants in 1683 and Kowa (in Japan) some 10 years earlier. There is no excuse for not teaching determinants early in regular high school math today.

2 Wiig (1987) op. cit.

3 Harlan Cleveland in The Knowledge Executive (1989) uses the concept *"informatization of society"* adapted from the French to describe the increased generation and spreading of information and insights about any aspect of our environment. Shoshana Zuboff in In the Age of the Smart Machine (1988), uses the word *"informate"* to describe the ability of information technology to "generate information about the underlying productive and administrative processes..." to provide "a deeper level of transparency to activities that had been either partially or completely opaque."

environment requires considerable sophistication and broad knowledge. Since these advanced, modern workplaces are relatively recent, considerable training is still required to enable the workers to use them properly and obtain the expected benefits and returns. In our survey, every participating executive agreed that there is a need to provide employees with additional knowledge to interpret and use all relevant and available information. Additionally, more education is required to develop appropriate mental models -- concepts, schemas, scripts -- necessary if the knowledge worker is to deliver high-quality work.

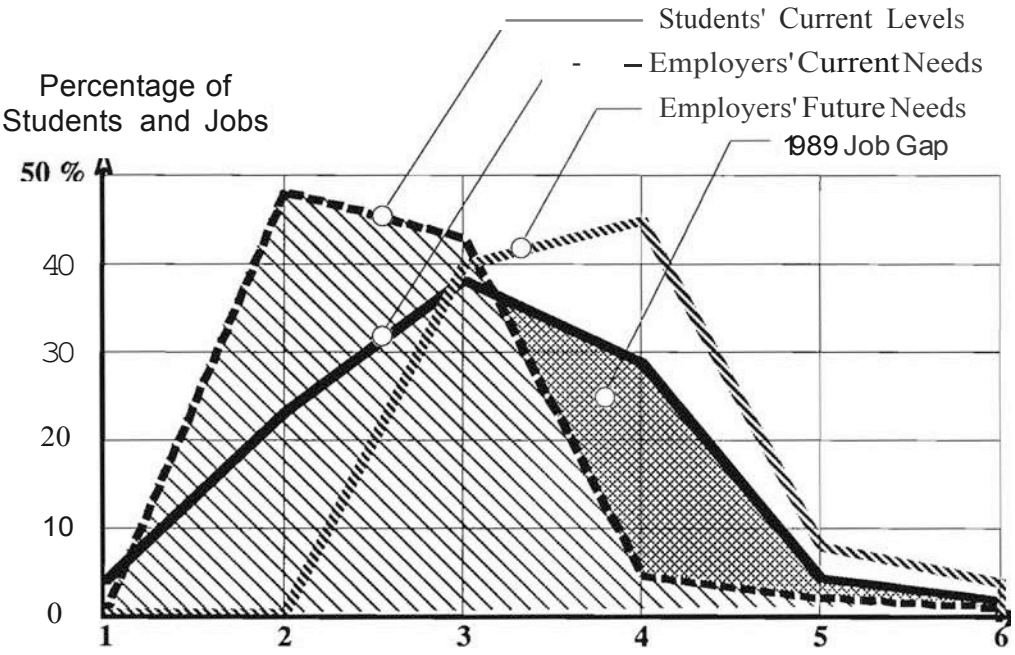
Other issues are associated with working in these new environments. For example, the new work settings are constantly changing. New technology is being developed, and new or upgraded systems are regularly installed to improve the performance of the work tasks and, quite frequently, make the knowledge worker's job more manageable. These changes require an adaptability and flexibility in the workforce that only can come from a strong and secure understanding of the work to be done -- the work tasks and the related support systems and technology. In other words, the workforce needs to be knowledgeable to be capable of changing.

Unfortunately, average knowledge workers at all levels of the organization are not able to keep up with the knowledge requirements of today's workplace, resulting in a knowledge gap unless appropriate education is provided. That is, most knowledge workers find it difficult to possess adequate knowledge to do their work. Also, when undereducated, they are not capable of accepting changes easily. As they often note: "How can we do a top-quality job now when we are asked to do tasks that we don't fully understand? And how can they expect us to do a better job in a more complicated environment that we know even less about?"

An example of the present and future American knowledge gap, was reported in 1989 by the U.S. Department of Labor.1 The proficiency and knowledge of the job entrants can be measured by their language skill levels as indicated in the lower part of Figure 4-2. In this figure, the proficiency of the present job entrants is indicated by the vertically stippled area. The current and future requirements for language skills in job entrants for all jobs are also indicated.

1The U.S. Department of Labor (1989) Workforce 2000: Work and Workers for the 21st Century.

Figure 4-2. Job Skill - The Gap Is Widening.



Language Skill Levels by Department of Labor definitions:
1 - Rudimentary communication skills required in manual jobs.
3 - Typical language skiUs for retail sales people and construction workers.
6 - Language skills required to read and apply technical journals.

Source: The New York Times, September 25, 1989

As can be seen, properly prepared job entrants were in short supply in 1989, and according to recent reports, these shortages still persist. If we do not improve the proficiency of graduating students, the gap will be even greater in a few years. Today, our schools supply approximately 10% of job entrants with language skills at level 4 or above (5% with proficiency level of 4.) Yet, our employers require that almost 30% perform at least at skill level 4. In a few years, the complexity and competitiveness of the workplace will increase this requirement to about 45% -- a demand that we will have difficulty meeting.

The effects of the knowledge gap in job seekers is already apparent in employment statistics.1 Average unemployment for workers with college degrees is 3% now, and it has been steady for 20 years. At the same time, unemployment among high school dropouts is 12% and rising. The steady, low unemployment rate for degree holders, according to economists, is an

1 These viewpoints are adopted from Robert Reich (1994) "The Fracturing of the Middle Class."

indication of the shortage of highly trained workers. This trend is also evidenced by earning powers. In 1992, males with college degrees earned on the average 83% more than those with only high school diplomas. This gap had increased from 49% in 1979 -- only 13 years earlier.

To remedy the American knowledge gap, the increasing role of "technicians" -- often workers with two-year community college associates degrees -- is eyident in all sectors. Technicians perform functions with targeted skills that often involve additional tasks of communicating with sophisticated computer applications to perform the job. The need for computer literacy is evident. Two-thirds of college graduates use computers in their work while only one in ten of high school dropouts use them.

Are the Knowledge Gaps Changing?

Unfortunately, the gaps between knowledge worker competence and workplace requirements are widening in many companies. Advances in office and workplace support technology continue to move ahead. More important are the changes that are occurring in many organizations towards integrated operations and participative management, as well as moves to push decisions downwards in the organization, closer to customers and other points-of-actions. These changes require a command of new knowledge at the point-of-action to a much larger extent than earlier when systems and procedures were simpler and when a larger proportion of decisions were "kicked upstairs" for resolution.

A second factor is accelerating the change towards relatively more demanding workplaces and, therefore, a wider knowledge gap. This factor stems from the gradual demise of less sophisticated companies. Fewer of the simpler, less demanding workplaces that existed in these companies are now available for less knowledgeable workers. As outdated companies and industries are shut down, low-skill jobs are gradually disappearing. Even worse, as these companies close their doors, their laid-off workers are forced into a more sophisticated job market, for which they have generally been inadequately trained. Due to an already existing surplus of job seekers with lower-than-required-skills, most are forced to compete for more sophisticated jobs for which they are not fully competent, thus increasing the knowledge gap on the average.

Several institutions have changed their operations and procedures

drastically to cope with these situations and to make good use of workers with less skills. For example, the fast food industry has developed highly routinized operations and even created cash registers with picture symbols to allow operation by semi-literate staff. Other organizations have modified their organizational structures and their systems and procedures to support less knowledgeable workers with supervisors and resource people who possess the "missing" knowledge. In all instances, organizations (including the U.S. Armed Forces) are continuing, and even stepping up, their training programs to provide additional knowledge to an inadequately prepared workforce.

WORKPLACE SOPHISTICATION CONTINUES TO INCREASE!

To some extent, the sophistication of the workplace is made possible by the continued increase in computer capabilities at the-point-of-action-opportunity. Thus, we see the installation of personal computers in typical office work settings where the computer power can be measured in several million instructions per second (MIPS). Within two or three years, it is expected that personal workstations with speeds of over 100 MIPS will be generally available to all knowledge workers in many companies. These devices offer very powerful support capabilities for knowledge workers at all levels with potentials for greatly increasing work effectiveness. While the new capabilities provide richer and more timely information, they also provide complex analysis tools and other supports based on artificial intelligence, natural language understanding, image processing, and other technologies. Consequently, extensive knowledge is required to understand and to use these capabilities effectively.

As the sophistication of the support facilities increases. so does the knowledge required to perform the jobs. This additional knowledge requirement is only to a small extent associated with using the support systems. As has been the case in the past decade, considerable new knowledge is required to perform more demanding jobs as responsibilities widen, decisions are pushed downwards (to "where the information about the situation is"), and to generate higher value-added services by each worker as our real salaries and productivity increase.

In the U.S. we are required to continue to increase our sophistication to compete. We repeatedly are informed about overseas organizations like banks, high-technology companies, and basic industry companies that are implementing very sophisticated infrastructures and support systems, at

times based on sophisticated personal workstations, to deliver better service and products in the international marketplace. As an example, in December of 1989, an Italian banking company bought more than one thousand personal computers with "Reduced Instruction Set Computers" (RISC machines) that were much more capable than what their competitors used. These systems permitted the bank to implement a very powerful, broadly available work environment with higher competitive performance. That move tightened the competitive screw another revolution, forcing other financial firms to improve their operating environments to stay competitive. The same trend is seen in almost all industries. And as in this example, the competitive screws are tightened both by organizations outside the U.S. and within our country. Not surprisingly, these new and powerful operating environments will require more and different knowledge to allow the users to take full advantage of them.

What Can Be Done about the Knowledge Gaps?

Before discussing what we can do about the knowledge gaps, it is important to identify what a person needs to know to be a valuable employee. For a technical company, in addition to basic skills, we identified 10 general knowledge areas as important for a well-rounded, valuable employee. These general knowledge areas, listed in Table 4-1, were applicable to technical as well as staff and administrative personnel.

When a person has good proficiencies in most of these general knowledge areas, these proficiencies make up a strong, balanced, and valuable background. They also cover a very diverse and broad range. However, when there are important knowledge gaps in these areas, quite different approaches may be needed for improvement. But as the examples in the first part of this chapter indicated, other knowledge gaps also are of great importance.

A different approach to characterizing the repertoire of capabilities that a knowledge worker should possess consists of identifying the ("professional") knowledge, skills, and personal characteristics that are relevant for a particular position. An example of the characteristics desired for a particular customer service knowledge worker was shown in Figure 3-5.

Table 4-2 provides a few examples of how one might manage the knowledge gaps once their nature and extent have been established. In most cases, some effort needs to be aimed at determining the precise nature of the knowledge gap, the best options for managing it, and then implement the options in terms

of training, reassignment of people, building support systems, and so on.[1]

Japan's "Meta-Cognitive" Firms[2] and U.S. Enterprises

In Japan we find a number of firms that may be denoted as "Meta-Cognitive." That is, firms that are organized and operated according to the "Meta-Cognitive Organization Theory" as summarized below. This management theory provides an organized and integrated philosophy for a number of perspectives that are considered unusual -- even "far out" -- according to common U. S. management perspectives. This may be where some of the reasons for our deficiencies and gaps relative to the Japanese and, in part, the Europeans lie.

From our perspective , the Meta-Cognitive management philosophy emphasizes use of knowledge and expertise. The emphasis on knowledge is to ensure that individuals are able to "work smart" and that teams can take on additional responsibilities, operate relatively independently, and be responsible for their own enterprise and activities -- including the quality of their work. The philosophy embraces five operational styles of importance. They are:

1. Participat.ory self-management of psychological protocols at work. The work groups design and manage their work and create the social work environment with priorities, leadership, and organization.
2. Job "plurification." People are cross-trained to be able to provide additional insights into, and understanding of, each other's work function, flexibility in staffing and work capacity, and versatility in capabilities.
3. Participat.ory generation of expertise. Team members and outside knowledge sources collaborate to increase their individual and collective understanding of the work process, the possibilities for improving work within the present process and the process itself.
4. Cust.omer-designed companies. The enterprise itself and all its people -- including executive management -- are prepared to cater to the customer's needs and requirements. This may not be the most profitable short-term strategy. It is, however, considered to be very beneficial in the long-term, since it strengthens the market position of industrial customers -- their sales increase; in turn, they will buy more.

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1 Some of these aspects are discussed from more practical perspectives in A Knowledge Management Methods, Wiig (1995).

2 The concept of "Meta-Cognitivity" in Japan is discussed by Greene (1990, pp. 19-28)

Table 4-1. Knowledge Expected in a Well-Rounded, Valuable Employee.

0. Basic skills. Knowledge of reading, writing, basic mathematics, physics, and areas such as history, social science, and geography.	5. World matters and broad perspectives. Knowledge of general social and economic issues, geography and world conditions, business and market forces, hobbies and leisure activities, literature, arts, religion, philosophy, physical, mental, social health, personal and social behaviors, and viewing situations from many sides.
1. Application of professional knowledge. Knowledge of the practicality of solutions provided, innovativeness of solutions provided, seeing "What does not work," recognizing "What is needed to make it work," what customer "should want," know-how to satisfy customer, expertise -- trouble shooting, and ability to deliver on time.	6. Conceptualizing and abstracting. Knowledge of how to abstract complex operations, systematize operations, apply good judgment, see opportunities for new ways, generate visionary perspectives, cognitive and knowledge sciences, systems science, and knowledge and its organization.
2. Primary professional area. Knowledge of primary professional area in terms of theory, analysis methodologies, synthesis methods, standard professional solutions, theoretical limits and constraints, achieving peer acceptance, and delivering what is expected.	7. Leadership and facilitation. Knowledge of leading meetings, general leadership, motivating people, explaining what is required, administration and management, planning, cooperation with organization's objectives, persevering, and how to achieve closure.
3. Adjacent and supporting professional areas. Knowledge of practical and theoretical aspects of adjacent professional areas, sources of adjacent experts, integrating areas with primary, use of support tools and functions and their nature, sources of support assistance, and the universe of adjacent areas.	8. Entrepreneurship, negotiations, and sales. Knowledge of generating innovative solutions, seeing and explaining benefits, seeing situations from "the other side," promoting positive dialog under adversity, operating under uncertainty, persuasion, mustering personal energy, and self-starting.
4. Job function and company matters. Knowledge of job requirements, how job fits with other functions, company products, customers and suppliers, company's business, company practices and procedures, company personnel and networking, and company traditions and history.	9. Communication and human skills. Knowledge of easy and clear communications, group communication and control, "what is required," how to teach and transfer skills, ethical conduct, befriending and creating trust, easing relations between people, presenting positive attitude.

5. Educative workplaces. The emphasis on increased knowledge and understanding, on knowledge flows from all possible sources to workplace operation, reorganization, and redesign and for product modification, translates into continued motivation to learn at every opportunity.

Although authors like Greene associate Meta-Cognitive Organization Theory with Japan, it is not solely Japanese. Part of its origins lies in Scandinavian management theories, which promoted autonomous work

groups, learning networks, contextual designs, socio-technical systems, self-study groups, and heavy use of work aids such as robotics. It is also based on American management theories, which emphasized pragmatic managers, efficient problem-solving methods, industrial research, formal market research, and heavy use of information systems.

Table 4-2. Examples of Approaches to Managing Knowledge Gaps.

KNOWLEDGE GAP AREAS	POTENTIAL KNOWLEDGE MANAGEMENT ACTIONS
Lack of Personal Preparedness	
Basic Skills *Theory and Practice*	Remedial education in lieu of grammar and high schools Regular brush-up courses during/after work Self-study programs
Technical Product & Production Knowledge *User Skill and Know-How*	Brief-to-long training courses Self-study programs On-the-job training KBS applications
Technical Product & Production Knowledge *Underlying Theory*	Educational programs and courses Self-study programs Brief, targeted courses Expert networks
Knowledge of Services Provided *Practical Hands-on Know-How*	Brief training courses On-the-job training KBS applications
Knowledge of Services Provided *Underlying Theory*	Longer training courses Education in theory Self-study programs
Broad knowledge background	Training courses in special topics Self-study programs Excursions, domestically and abroad Regular educational programs in universities
Organization or Assignment Problem Gaps	
Work teams have insufficient understanding of other team members' expertise, capacities, and perspectives	Numerous "get-acquainted" occasions Formal group meetings with training Joint education sessions
"Communications gap" between departments	Education of knowledge workers in all departments Knowledge-based systems for guidance
Lack of knowledge at point-of-action	Quick and established access to experts Education or training of knowledge workers at point-of-action Knowledge-based systems at point-of-action

Some of the Scandinavian and American theories, in turn, have their roots in social and economic research that started in the 1920s. These management theories joined to spin off new management approaches tha t later were incorporated into the Japanese management approach. A large portion of the Meta-Cognitive Organization Theory comes from the Japanese management theories that emphasized such perspectives as integrated operations, working with the customer, quality circles, and "Protestant work ethics." A significant amount of Japan's recent management philosophy also comes from the impacts of the rebuilding of the Japanese economy and the teachings of Dr. Deming. Their business leaders and professionals have shown a remarkable willingness to learn from any source and to refrain from engaging in the Not-Invented-Here (NIH) syndrome behavior.

In the modern "Meta-Cognitive" firm, the emphasis is on collaboration between all levels of the organization. This includes participative -- and hence informed and implementable -- decision-making. As a result, the Japanese firms in manufacturing, marketing, finance, and service industries like travel and hotel operations, have become very strong and dominant throughout the world. A few years ago, of the world's 10 largest financial institutions, for example, eight were Japanese (America's largest bank, Citicorp was number 11). Of the largest 20 industrial firms, four are Japanese while nine are U.S.-owned and six are European. We tend to try to explain this fact by pointing to Japan's low cost of capital and to real or imaginary trade embargoes. Over the years, we have tried to wish the problem away, hoping that we would not have to change our ways. As individual managers, we have not been willing to admit that our management methods are outdated and are leading us to destruction.

Only recently have we in the United States been willing to start changing our management perspectives and attitudes. These changes have been very traumatic. They have involved difficult realizations that management and labor need to cooperate -- even collaborate -- and have often come only after plant closings after loss of market share in many industries -- steel, consumer electronics, automotive, just to name a few.

As recently as at the end of October 1990, a group of business leaders from U.S. automotive suppliers were told by Toyota's managers that the quality of their products were unacceptable. The average defect rate from U.S. suppliers was 1,000 per million shipped whereas the Japanese suppliers were able to

provide 10 defects in a shipment of one million![1] A different, but quite typical, problem was encountered by a U.S. firm which after polite requests from the customer decided that it was unnecessary to change the materials it used in a part supplied to Toyota. Because of their outdated attitude and lack of flexibility and versatility, the firm lost the account and the prospect of a long, profitable relationship .

Another interesting insight gathered at the Toyota meeting is that U.S. auto suppliers are given a grace period at the start of a new contract and model year to bring their products into quality and specification compliance. Normally, Japanese customers expect the quality problem to be solved prior to the first delivery. To eliminate this difference in performance requires fast and knowledgeable response by workers at all levels in addition to changes in corporate attitudes and a willingness to make up-front investments. "Agile manufacturing" is sorely needed!

As we in the U.S. adopt Total Quality Management (TQM) methods in the form of Quality Function Deployment (QFD) or in other forms, and as we change the culture within our companies correspondingly, we will emerge stronger. However, it will not be easy. We need to be willing to work smarter -- not only on the part of the knowledge workers, but more importantly, on the part of managers. It will also be necessary for managers to take into account broader perspectives and integrate their actions when they make decisions and solve problems. Such change will come as a blow to the ingrained American independence attitude and will remain a tough psychological hurdle for many. Independent behavior was a significant strength in the frontier days but in modern, integrated business, that inheritance signifies a social gap that is a liability. It is also a major contribution to the Not-Invented-Here (NIH) syndrome.

However, the ingrained American independence attitude is not only a liability, but also a major strength. In many well-documented situations, it has been the force behind new, independent developments in scientific areas, technical and consumer product areas, and in new management practices. Many of the major innovations that have emerged from U.S. organizations and garages (the personal computer, for example), are due to this stubborn attitude.

KM approaches will help make this transition easier, we believe. When we have had the opportunity to apply detailed knowledge-analysis and

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[1] "U.S. Suppliers Get a Toyota Lecture," The New York Times, November 1, 1990, pp. C1 & 5.

characterization methods, we have found that managers and knowledge workers alike see much clearer the merits of collaborating, building knowledge, and reasoning together. We have discovered that when we can delineate the knowledge aspects in considerable detail, most of the objections voiced before disappear.

Chapter 5

Business Approaches to Kno'Wledge Managentent

Why Companies Decide to Pursue Knowledge Management

KNOWLEDGE MANAGEMENT IS APPROACHED FROM MANY PERSPECTIVES

Managers are motivated to become actively concerned about knowledge and how it is managed for several reasons. These reasons may originate from opportunities or problems or from management initiatives that initially had a different focus. Typically, as pursuit of management initiatives such as business process redesign (reengineering) or organizational flattening becomes more in-depth, the need for a more comprehensive approach becomes evident. This often leads to analysis of underlying factors, in particular knowledge, and how it is managed on a broader scale. Examples of initial foci and the changes in perspectives in such situations include:

- *Knowledge Transfer Mode Perspective. The initial focus of this large personal service company was on transferring knowledge to critical points-of-action when it was discovered that knowledge workers in the field needed additional expertise to deliver work of the desired quality. As the transfer program progressed, it became evident that attention also needed to be directed to the knowledge sources -- experts, outside resources, R&D programs, etc. -- to improve the quality of the knowledge involved. Further, attention needed to be given to approaches to capturing and organizing knowledge -- the acquisition process -- into knowledge repositories (the formal "corporate memory") from which it could be transferred to points-of-action. Later, a broader approach was developed to manage the whole process including all knowledge resources and assets.*
- *Knowledge Asset Building Perspective. The early concerns in this medium-sized manufacturing firm were associated with creating and collecting competitively and operationally valuable knowledge. It soon*

became clear that an additional and major issue was the need to categorize and represent the assembled knowledge so it could be accessed, validated, maintained, and made available to those who needed it. The training department found that its functions needed to be changed to assist with the transfer of the new knowledge resources to points-of-action using new technology that piggy-backed on an expanded information system infrastructure.

- *Knowledge Asset Management Perspective. In a large engineering firm the beginning emphasis was on making managers responsible for building, maintaining, and exploiting the knowledge assets under their control. This quickly led to realizations that other areas also needed attention to make it possible to transfer the responsibility to individual managers. Better knowledge-analysis methods were implemented to identify which knowledge was already present and where additional knowledge was needed. Knowledge sharing between experts and users and departments was found to have hindered effective corporate use and, therefore, was revised. Personal incentives to educate and help others were instituted, and after some time a comprehensive KM approach was implemented under top-executive management control.*
- *Intelligent-Acting Operation Perspective. The management's initial objective in a small process company was for its employees to act more intelligently to make operations effective and serve the customers better. After the new initiative was communicated, it was discovered that most employees lacked critical knowledge of the process, customer needs, and the company's real goals and objectives. Therefore, they could not immediately follow the intended directions. Consequently, a comprehensive educational program was started which in turn, led to a comprehensive, yet low-effort, program for acquisition and collection of expertise. Later, a broader KM program was created to support the initial intelligent-acting initiative.*
- *Reengineering Perspective. A medium-sized transportation firm decided that its operations had become too unwieldy and did not reflect actual needs. Operating costs were higher than industry averages; besides, delays and other unwarranted problems caused management to start a reengineering effort. From process, information f/,ow, and job-function analyses it was found that workers had not been properly prepared -- they lacked crucial knowledge. In addition to defining many reengineering opportunities, the task force identified an important need to strengthen the expertise of the workforce. A subsequent knowledge transfer program required a new emphasis on capturing lessons learned, organizing knowledge, and methods for deploying it to those who needed it. In addition, managers were for the first time made responsible for managing the knowledge assets under their purviews through personnel reviews.*
- *Learning Organization Perspective. The management's focus in a large marketing company was at first that it needed to become a learning organization in order to succeed. That meant that everyone had to learn*

from customers and monitor competitors. After an ad-hoc *version of the initiative had been implemented for some time, it became clear that the collected intelligence needed to be structured and assembled into well-organized knowledge bases. It also became clear that effective mechanisms were needed to make the new knowledge available to all who needed it. Further experience indicated that additional capabilities were necessary. As a result, incentive programs to promote learning, use of superior knowledge, and an information technology infrastructure were implemented.*

- *Total Quality Perspective. A medium-sized school system decided that its immediate approach to improving education was to adopt TQM methods. After much deliberation, they defined what constituted quality work and then discovered that the teachers often did not have the requisite knowledge to deliver the appropriate services to students. To alleviate the knowledge gaps in the short-term, the district adopted team teaching and other professional teaming approaches while waiting for the staff to upgrade its content knowledge.*
- *Core Competence Perspective. An advertising firm identified the key knowledge that distinguished it from its competitors. At the same time, it discovered that this knowledge was held by only a few individuals. One of them felt unappreciated, was generally unhappy and, therefore, was a potential liability if she would leave for a competitor. Management changed the incentive system to reward key individuals, broadened the transfer of core knowledge to be possessed by all who needed it, and started to upgrade the knowledge of all its employees.*
- *Knowledge Culture Perspective. The CEO of a medium-sized process firm believed that the best way to excel would be for all its employees to be as knowledgeable as possible. From the start, it was decided that all employees should be salaried, that all should receive in-depth education in the fundamental sciences of the processes used, as well as in finance and operational micro economics. In addition, all should be allowed to search for operational changes and would receive feedback on the efficacy of their suggestions once they were explored. After a few very successful years, additional steps were taken to redesign the plant and to embed considerable knowledge into automation and systems and procedures. The company is now a world leader.*

As these examples illustrate, KM can be initiated from many different starting points. After the focus shifts to consider knowledge explicitly from a given perspective, it soon becomes evident that a number of activities and functions are intimately related and that most, if not all, of them need to be considered in order to make knowledge play its important function in the organization. The KM approached that are pursued will often be different and will emphasize areas and activities specific to the organization, its business, its priorities, and its capabilities.

KNOWLEDGE MANAGEMENT Focus rs DRIVEN BY NEEDS

Most companies pursue KM to satisfy very real needs. Initially, they may have been led to consider broad KM approaches in order to solve practical and pressing problems. Later they often find that the associated perspectives and methods have wider merit and applicability. A few companies have initiated KM after concluding from visionary and idealistic considerations that it is a useful and powerful competitive weapon. However, in a number of instances management teams with broad and long-range perspectives identified knowledge and expertise as fundamental strengths of their organizations, and consequently decided that KM approaches were appropriate to deal with their operational problems.

Examples of problems that led to adoption of KM approaches on a broader scale include the following:

- *A service company discovered that: "we are letting millions of dollars of expertise walk out the door after each retirement party. We had no way to replace this knowledge in the short-term and had to start learning many things all over again!" as one senior manager phrased it. They decided to look at the knowledge that remaining senior employees possessed as a crucial resource and corporate asset.*

  As a consequence, they set up a program to motivate employees with critical knowledge to postpone retirement, and to capture the expertise of those who were leaving. Expertise was captured by several methods, ranging from letting relatively senior people become apprentices to the experts, to eliciting and codifying the expert knowledge to document and preserve it in knowledge repositories of different kinds. In a few instances, knowledge-based systems were built. It is expected that this solution will become more frequent in the future as the company expands its capabilities in this area. The company has now instituted a broad program to organize and operate its "knowledge-bank" as an active and ongoing activity.

- *A high-technology company discovered that a key individual provided an important interface between their sales and manufacturing departments. He translated equipment orders as expressed by the sales department into manufacturing documents which then became the basis for producing the equipment. Only one individual had this expertise and the work load was becoming so large that a knowledge bottleneck (critical knowledge function or CKFJ emerged.*

  Management immediately started to remedy the situation. In addition, having been sensitized by this type of problem, they also started a program to locate other CKFs that needed management attention. A regular activity is now in place whereby managers at all levels help find, investigate, and manage CKFs.

- *A **heavy equipment manufacturer** discovered during its long-range planning process that the number of new product candidates in its development pipeline was insufficient to meet competitive challenges. Further, additional investigations revealed that the company did not have sufficient in-house expertise to develop all the products they needed. They also discovered that they were missing experts in areas judged to be crucial for future products.*

  The company immediately embarked on an impressive and costly "knowledge acquisition" program. They hired a number of experts and started several new development and research projects to create the missing expertise and the desired products. They now have in place a considerable R&D program and are regularly assessing its direction from perspectives on technology and with particular emphasis on the knowledge that underlies the technology. The knowledge perspective has spread throughout the company to include considerations of knowledge required for many engineering functions, make I buy decisions, personnel reviews and staffing of operations and sales.

- *A **financial company** had implemented and put into production a number of knowledge-based systems over a period of four years. Senior management decided to evaluate the efficacy of this activity with the objective that if the systems were as good as projected, more should be built and used. The evaluation indicated that about half of the systems were useful. However, to their surprise they found that many of the implemented systems had been selected without much forethought and that the work functions they supported had not been modernized or redesigned to the degree desirable if a broader view of the operations had been taken.*

  As a result, senior management instituted a permanent program to coordinate planning for knowledge-based systems with a broader activity to rethink the way business was being performed and to include considerations of knowledge flows and intellectual tasks to ascertain that the new capabilities would serve the organization in the best possible way. Different priorities for the knowledge-based systems development program also resulted from the new program.

In all of these examples, the company management initiatives led to broader -- yet relatively narrow -- KM approaches. It is interesting to note that all these organizations now pursue still broader KM programs that enable them to gain overall perspectives and strategies that lead to better results.

As indicated elsewhere in this book, many other companies pursue active KM to some extent. As the acceptance of this management focus widens, and as its methodologies become more accessible, we can expect to see companies adopt KM directly as a required management method and as a necessary building block in their business strategy.

It appears that managers look for basic factors when they consider adopting KM. They look for better use of, and ways to exploit, the knowledge that is available within their company; they look for improved knowledge building -- i.e., organizational learning and retention of what has been learned; and they look for better overviews of where their management attention should be focused so they can direct the organization's efforts to improve the attainment of the organization's goals -- for profitability, longevity, competitive position, and also for their own success.

Managerial Motivations for Initiating Strategic Changes

When senior managers consider changing the strategic approach to their internal operations, they look for compelling reasons and considerable improvements in many areas to justify the costs and pains involved in the change. From a macro perspective, they look for such changes as increased profitability, improved competitiveness, and higher degrees of survival security. To achieve that, they may look for opportunities that will lead to improvements in intermediate success factors. In this way, they have a more detailed perspective while focusing on more immediate effects from associated changes, such as:

- Versatility - to have the resources and capability to deliver proficiently a broad spectrum of services and products in response to individual customer requests, competition, changes in the marketplace, business practices, and technologies, and be able to respond to new strategic opportunities and directions.
- Flexibility - to change easily and quickly between different customized products and, on a broader scale, services and to change to new operational and tactical requirements.
- Quality - to deliver services and products that perform well and with features customers will appreciate, find valuable, and will continue to demand.
- Efficiency - to operate and produce services and products that require as few resources and elapsed time as possible to be able to deliver quality at reasonable prices and still remain highly profitable.
- Environmental Desirability - to provide internal physical and social environments that are desirable to employees at all levels. It also concerns creating and maintaining desirable external environments -- physical, economic, social, and so on.

- Ability to Innovate, Be Informed, Learn, and Change - to ensure viability and leadership and to understand where the rest of the world is headed and which opportunities and threats are associated with new developments and conditions. This includes the capability and willingness to seek out and learn from "Best of Breed" and other sources of excellence.

Close examination of these six success factors reveals that they can all be improved by increasing proficiency and applying better knowledge at all organizational levels. They can also be improved by increased exploitation of knowledge that already is available in the organization. It is the conviction of managers who pursue KM, as well as our own belief, that approaches and practices that provide better knowledge lead to significant improvements in most of the elements that are considered important for corporate success.

EXECUTIVE MANAGERS MUST BE PROVIDED WITH UNDERSTANDING AND CONVICTION

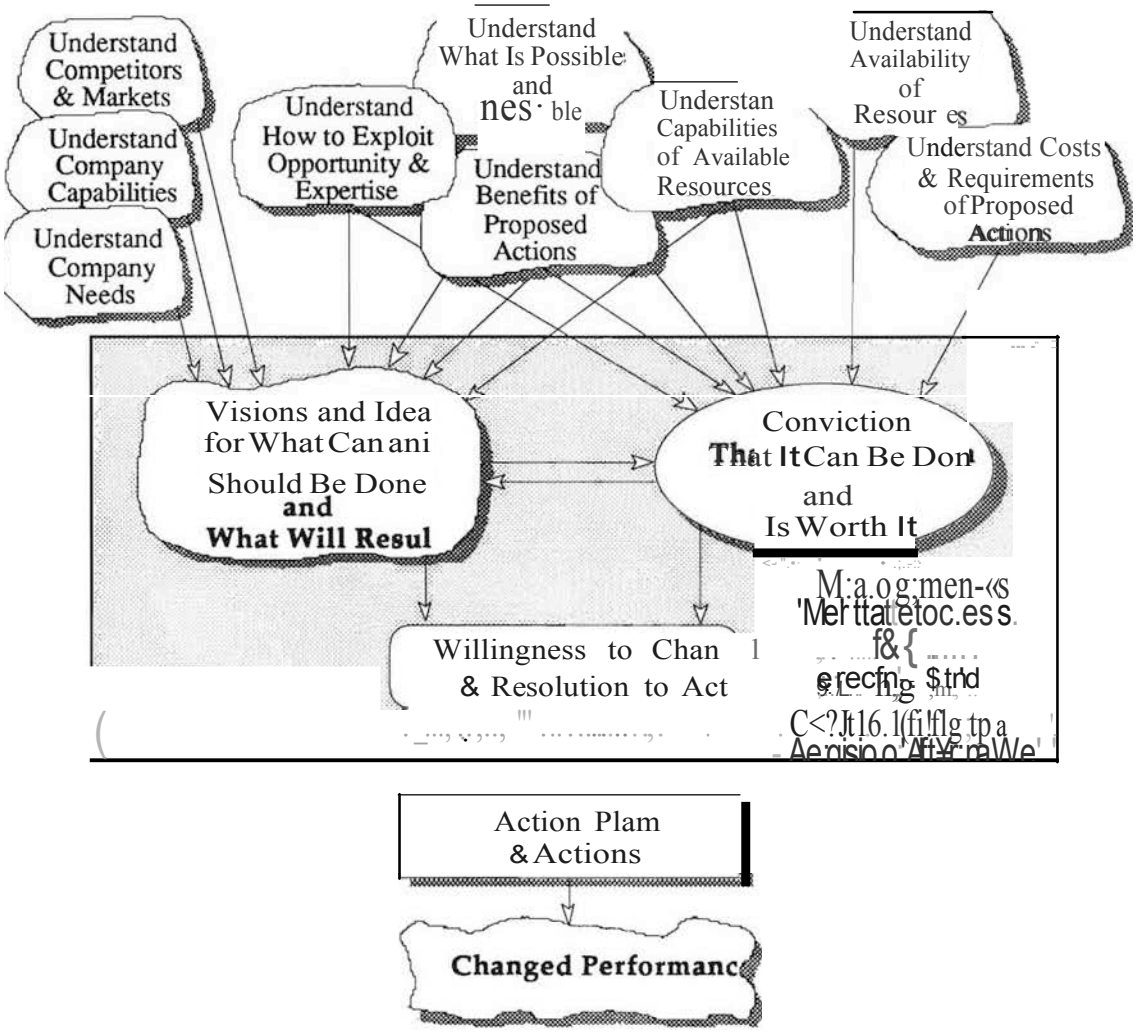
To assist their companies in developing a broad and integrated KM approach, executive managers must be convinced that the methods and approaches to knowledge management are practical, can be performed by their staff, and are worthwhile. In other words, as indicated in Figure 5-1, executive managers must be provided with the understanding and assurance that knowledge management is beneficial and can be handled by the organization. Such insights must be built up and substantiated by professionals and middle management from many areas.

At the same time, the executive managers must develop their own visions and ideas of what can and should be done based on their knowledge of the company's needs and capabilities and on what they see elsewhere. Only when these perspectives have been created and integrated with other priorities and plans, can a willingness to change and a resolution to act and allocate resources be expected. This process may take considerable time -- often several years. Thus, it has taken considerable background work and effort by managers and professionals on all levels to place the need for active management of knowledge on the corporate agenda in those companies that now are pursuing it.

In Figure 5-1, the transfer of understanding to managers points to needs for considerable learning. First, support-professionals need to learn about KM and related areas. Then senior managers must gain understanding of all knowledge areas and factors such as those indicated in Figure 5-1. Only after

senior managers have obtained relevant understanding about requirements, capabilities, and business advantages, are they in a position to act.

Figure 5-1. Conditions Must Be Met Before Management Can Act with Confidence.



Knowledge Management -- State-of-the-Art

Companies in many industries are starting to incorporate approaches to managing knowledge into their visions, plans, and action programs. With the general agreement that "knowledge is our company's most important asset," it

is also understood that knowledge must be managed somehow. However, as indicated, most executives feel that they do not know how to manage knowledge adequately. They do not have the framework, methods, or effective role models to tell them where their attention should be directed. Further, they do not have a good overview of which tools and approaches are available to help them. In fact, many individual efforts towards managing knowledge at this time may be characterized as somewhat unguided or arbitrary, and in discussions many executives point out their concern about this situation.

In a few companies, a more integrated and comprehensive perspective of KM has emerged. Some of these companies have arrived at this position after many years of applying knowledge-based system (KBS) technology to automate knowledge and expertise. Many of them have also implemented and deployed computer-based training (CBT) systems to transfer knowledge to points-of-action with good results. They have found that management of these activities must be well integrated with all other company activities, some of which can take on a greater short-term urgency. The knowledge assets and their management must also be considered from several points of view, particularly from financial, organizational, management, information flow, work flow, knowledge content, knowledge network, and human resource perspectives.

A few companies, in collaboration with outside professionals, have developed wide-ranging, yet detailed, methodologies and approaches to managing knowledge in practical situations. As a result of this work, practical and field-tested approaches to managing knowledge are now available. Many of these methods, though, have not been explicitly identified as KM methods. Therefore, to be useful they must be integrated into a broader framework.

KM is now being pursued by companies both in the United States and abroad. Presently, the state-of-the-art of application of KM can be summarized as shown in Table 5-1. Four steps of KM illustrate the approaches that different kinds of companies have pursued during the initial "experimentation stage" as discussed in the next section. The following stages will also consist of several steps, although we do not yet know what typical evolutions will look like.

The standard approach is to start by pointing out the possibilities, nature, and potential benefits of KM to top executives, middle managers, professionals, and knowledge workers. In progressive organizations where managers are ready to pursue KM, the next step is to plan how to introduce the management approach. Frequently, the introduction is oriented around several pilot

projects that are started with multidisciplinary teams, with the responsibility lying with the operational areas in which the projects are located.

Table 5-1. State-of-the-Art Application of Knowledge Management.

Step 1 • Awareness Raising.

A number of companies are increasing their management and staff's awareness of the needs and approaches to managing knowledge. This may initially be achieved through seminars, work meetings, and discussion groups ranging from board of directors to mid-level managers. In some instances, it also includes internal surveys of managers and senior professionals to find out what their insights and preferences are and to alert them to the issues associated with managing knowledge. A later stage has involved the broad creation of awareness, particularly on the knowledge worker level.

Step 2 - Planning for Knowledge Management.

Some companies are planning for implementation of KM throughout their organization. Planning may involve the creation of small, two- to four-person task forces whose full-time focus is to determine the procedures and approaches to KM to be adopted and applied to the organization. In most instances, it appears that KM is coordinated with other companywide operations improvement programs, such as TQM or business process redesign (BPR). Responsibility for planning for a KM program may lie within the human resources or the information system functions of the organization.

Step 3 • Preliminary Knowledge Surveys.

Several companies have started to perform knowledge surveys with limited scope to identify important and high-priority critical knowledge functions (CKFs) within their operations and in their relations with suppliers, customers, and the economic, social, and regulatory environments. In some situations, the motivation for surveys come from the realization that candidates for KM projects (training, personnel reassignment, re-organization, or creaion of expert systems, and so on) were previously selected arbitrarily and at better overviews of needs and opportunities are required. These overviews are obtained through several kinds of knowledge surveys.

Step 4 • Implementation of Knowledge Management Program.

few co!11pnies are in the process of implementing a KM program for larger areas of thrr.orgamzaon. Most known efforts are still in the early stages, but are considered high pnonty by their executive management and are strongly supported by all other levels of management and by the employees in general. The principal model for KM program progression through implementation appears to be:

1. Raise awareness of executive and senior managements
2. Survey KM perspectives and opportunities.
3. Hold middle management working meetings.
4. Investigate selected situations in-depth.
5. Improve important situations with better KM solutions.
6. Design and conduct *KM* roll-out program.
7. Institutionalize KM at all levels of the organization.

The state-of-the-art of KM should also be considered from the perspective of which evolution phase the maturity of management approach is in. Presently, KM is an advanced management approach that may be about to emerge from the experimental phase. After some time, it may pass into the promising phase, and within a decade or more, into the competitive edge phase. ▮

Dynamics of Introducing Knowledge Management

When new management approaches or basic technologies first appear promising great improvements in profitability and competitiveness as result of fundamental changes, companies often listen with skepticism before gradually adopting the new approaches. The changes that companies go through seem to proceed through four stages over a considerable period of time. This pattern has been illustrated in many areas, ranging from adoption of strategic management of technology, TQM methods to reliance on information technology and computer-integrated management. We think this pattern will apply to the adoption of KM as well and that the length of the adoption period will be similar to that of other revolutionary management approaches. With that in mind, we may expect that it will take three to four decades for KM to become a "standard management approach" -- when a majority of organization have successfully adopted it.

The four stages that we may expect for adoption of KM can be described as:

Stage 1. Experimentation. Simple KM methods are used as tools for isolated

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1 The evolution phase categorization provides a measure of maturity from a life-cycle perspective. It is given in terms of an evolutionary progression of new approaches and technologies. The phases are:

1. The Experimental phase where the approaches and technologies still are under development. Their usefulness and applications are largely unknown and most potential users are unaware of their existence.
2. The Promising phase denotes the period when experience and acceptance accumulate and the approaches or technology are partially developed and prove themselves in practical use.
3. The Competitive Edge phase is the period where sophisticated and advanced companies derive considerable advantage while further development continues and adoption increases to involve more companies.
4. The Standard phase is the major period where most companies use the approaches and technologies, with little or no competitive advantage to its use. However, there is competitive *disadvantage* associated with non-use.
5. The Outdated phase concludes the lifecycle and denotes the era when the approach or technology has been mainly replaced by new developments.

knowledge projects to improve work and effective support of work tasks. Early adapters become proficient in the use of selected KM technology methods. Some critical knowledge functions (CKFs) are automated to improve work productivity. Strategic goals and long-term benefits are typically not considered. Instead, individual professionals and small technical teams test the concepts and methods to verify how applicable and beneficial they are. Top managers take a "wait-and-see" attitude. Most KM activities occur as isolated projects. Financial returns of the projects are low -- perhaps around 10%.

Stage 2. Knowledge Management Introduction. KM methodologies are gradually accepted as advanced management practices suitable for supporting improved functions and conventional management methods in all areas. KM approaches are starting to be built into conventional management practices and systems to provide integrated capabilities in support of long-term goals and to assist changes from "business as usual." Top managers start planning on future KM capabilities. Most KM activities are still in the form of projects, only a small portion are in the form of integrated programs. Financial returns may be significant (ROI: above 15% with some much higher), but most are long-term.

Stage 3. Broad Knowledge Management Adoption. KM methods are considered as companion management approaches to assist managers at all organization levels. This is the first stage of business transformation. There is general agreement that: "Knowledge underlies the whole success of our organization," and that it must be managed actively and creatively. Managers at all levels are increasingly adopting KM approaches as part of their daily work and are integrating them with other advanced management methods like TQM. Financial returns are becoming large and are often indirect and long-term. Explicit focus may be on management of knowledge assets.

Stage 4. Organizationwide Reliance on Knowledge Management. KM becomes a central management approach that continually supports strategic management and operation of the organization. Managers, professionals, and knowledge workers at all levels consider the knowledge and expertise implications of their work, in addition to, and in the same way, as financial considerations were treated in the past. Developments that will lead to this state include changes to:

-- Integrate KM practices with human resource management, all professional operations, R&D, business planning, and other functions.

-- Manage knowledge assets as a basic responsibility.

-- Provide a common knowledge organization and framework in the form of an organizationwide "knowledge architecture."

-- Build explicit knowledge bases as repositories for the organization's critical knowledge.

-- Change products, services, customer support, and markets to embed knowledge where possible and to exploit unique and competitive knowledge.

-- Integrate with TQM philosophy.
-- Push knowledge and operating responsibilities downwards in the organization to the point-of-action to be available at time-of-maximum-advantage.
-- Flatten the organization by reducing unneeded middle management functions.
-- Automate knowledge-based functions as knowledge-based systems to obtain greater leverage and efficiency.

The last stage includes full support of business transformations where KM is considered a fundamental support of the way of doing business. Economic benefits are reported to be very large, but credits are not due to KM by itself. Instead, benefits are also functions of many changes in operating and management practices and trade-offs.

The time schedules that different groups of companies will pursue in adopting KM within their organizations are expected to vary widely. For some company groups, the adoption is relatively swift -- within a decade or two -- for others it is quite slow.

"Early Adapters" may adopt KM fully within 20 years or less after having adopted the first stage within two-to-five years after the methodology emerged. "Cautious Sophisticates" are a little slower. "Proactive Professionals" slower still. Then follow "Reactive Followers," "Laggards," and lastly "Losers." The four adoption stages that we may expect for KM for these six groups of companies are illustrated in Figure 5-2.

When a new framework like KM emerges, it is important to distinguish between theory and visions on one hand, and actual state-of-the-art practical experiences on the other. At this time, practical KM is not implemented in all its facets by any company known to us. However, since the concepts of KM have grown from practical experience with a number of approaches and methods, most of the individual elements of KM have been implemented successfully in different companies over the last five years.

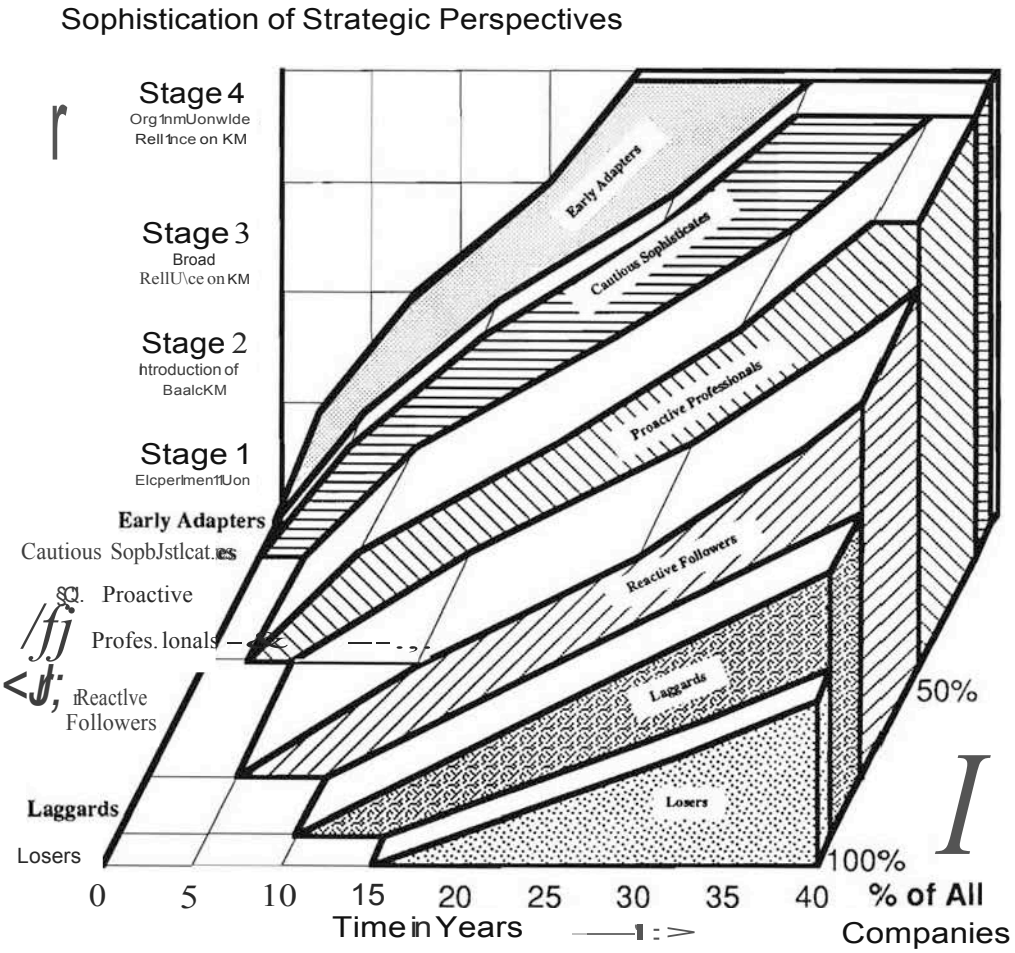
Many students of business present perspectives and examples of what we recognize as KM strategies, although they have been focused on concrete aspects of technical implementations or have been quite abstract and general. Nevertheless, business advisors and practitioners have started to identify need for methods to deal with knowledge to fill what clearly is a strategic void.2

1To differentiate between sophisticated and aggressive companies and companies that follow after the mainstream has passed, we use six groupings of companies. The six groupings are:

1. Early Adapters 2. Cautious Sophisticates 3. Proactive Professionals
4. Reactive Followers 5. Laggards 6. Losers

2 Drucker (1989 and 1993), Hertz (1988), Feigenbaum et al. (1988), Senge (1990), and Peters (1992) discuss initial company strategies for managing knowledge. Others have illustrated

Figure 5-2. Potential Transitions of Six Company Groups from Experimentation t.o Organ.izationwide Reliance on KnowledgeManagement



ADOPTION OF KNOWLEDGE MANAGEMENT WILL BE SLOW

Considering how quickly (or slowly) other management approaches have been adopted, it will be several decades before KM becomes a standard management approach to the extent that companies will be at a competitive disadvantage if they refrain from using active KM (See Figure 5-2).

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the needs for considering knowledge explicitly in operating successful organiizations. Of particular interest are Post-Capitalistic Society by Drucker (1993), Managing KNOWHOW by Sveiby & Lloyd (1987), The Knowledge Executive by Cleveland (1989), and The Knowledge Society by Bohme & Stehr (1986).

The evolutionary phases of a management approach and the adoption stages that companies go through as they use the approach more and more are closely related. As KM methods are developed and evolve, they will be adopted more readily and by more companies. The approximate relationship between the evolution phases and adoption stages that we can expect to see over the next decades is indicated in Table 5-2.

Table 5-2. Types of Organizations That Can Be Expected at Various Knowledge Management Adoption Stages and Evolutionary Phases.

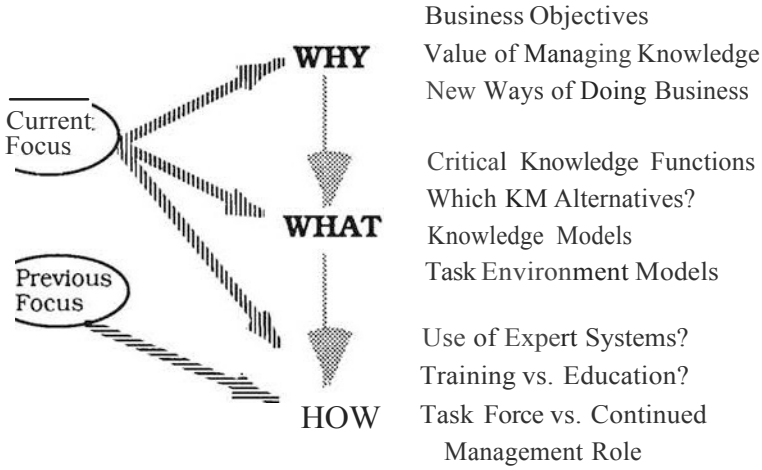
PHASES	Stage 1 Experimentation	Stage 2 Introduction of basic KM	Stage 3 Broad reliance on KM	Stage 4 Organizationwide reliance on KM
Experimental Initial methods being	A few Early Adapters try the approach	None	None	None
Promising Methods are proven in practice	Early Adapters; Cautious Sophisticates	Early Adapters; a few Cautious Sophisticates	None	None
Competitive Edge Mature methods	Proactive Professionals; Reactive Followers	Cautious Sophisticates	Early Adapters; some Cautious Sophisticates	Early Adapters
Standard Mature methods	Laggards and Losers	Proactive Professionals; Reactive Followers	Cautious Sophisticates; Proactive Profs.	Cautious Sophisticates

Managers in several companies feel that they already have good experience with many KM activities but that an integrated KM framework with unified perspectives has been missing. This void prevents the creation of a general understanding of the roles, opportunities, and values of the KM approaches with which they already have experience. With the various KM frameworks that are emerging, many realize that the development and adoption of the new approaches may be further along and more mature than expected.

As experience with knowledge technology and management has increased, the emphasis in advanced companies has started to change from a technology push to a demand pull as shown in Figure 5-3. On the executive level, new directions emphasize WHY KM should be undertaken and outline particular business objectives to be observed. On the middle management level, the new direction focuses on WHAT the related priorities should be on critical knowledge functions that need management attention. Previously, the focus

was often technical or procedural and advanced by professionals on the lower organization levels who emphasized HOW to perform the implementation of particular KM activities in a "technology push" manner. The conventional focus was on separate activities such as training programs, knowledge-based systems, and the like and were often initiated without much explicit support from senior management -- who certainly were not integrated or considered to be part of a common knowledge transfer program. There was also limited understanding of how many of these activities supported or integrated with the overall operation of the organization.

Figure 5-3. Change in Knowledge Management Focus from Technical Approach to Strategic, Business, and Operational *Aspects.*



When a company approaches a new initiative like KM strategy, it is often desirable to create a full program plan with the help of a good development approach for. What is needed, we have been told, is a "tall" KM approach that spans the required activities from the top to the bottom of the company. The program development approach must outline the different steps and activities that managers and knowledge workers have to undertake.

As indicated schematically in Figure 5-4, such an approach highlights areas of responsibilities and the nature of actions required for executive management, middle management, and professiona ls and knowledge workers. We have provided a few examples of the actions and items that need to be prepared at the different levels. We have indicated three different areas for each of the three major levels of the organization: the driving forces that are the motivating factors (i.e., visions, objectives, and guidelines); the actions

to be taken at the organization level (i.e., policy generation, strategy setting, or detailed activities); and the results of the actions (i.e., the goals, tactics, and work products).

STRATEGIC ASPECTS OF INTRODUCING KNOWLEDGE MANAGEMENT

Several knowledge-related, strategic aspects are central to the success of the company when introducing KM. These aspects need to be considered in some detail to ascertain that the planned actions will have the desired impacts and to ensure that the priorities and sequencing of the activities are the most beneficial. Other strategic aspects will also be affected and are, therefore, important. Some are concerned with the organization's financial position, its internal environment, and so forth. But since those aspects are not directly related to knowledge and its management, we suggest that they be treated indirectly. The three major knowledge-related aspects are:

- Competitive Advantages of Knowledge and Its Management
- Build Knowledge for the Future
- Build and Distribute Knowledge for Improved Internal Operations

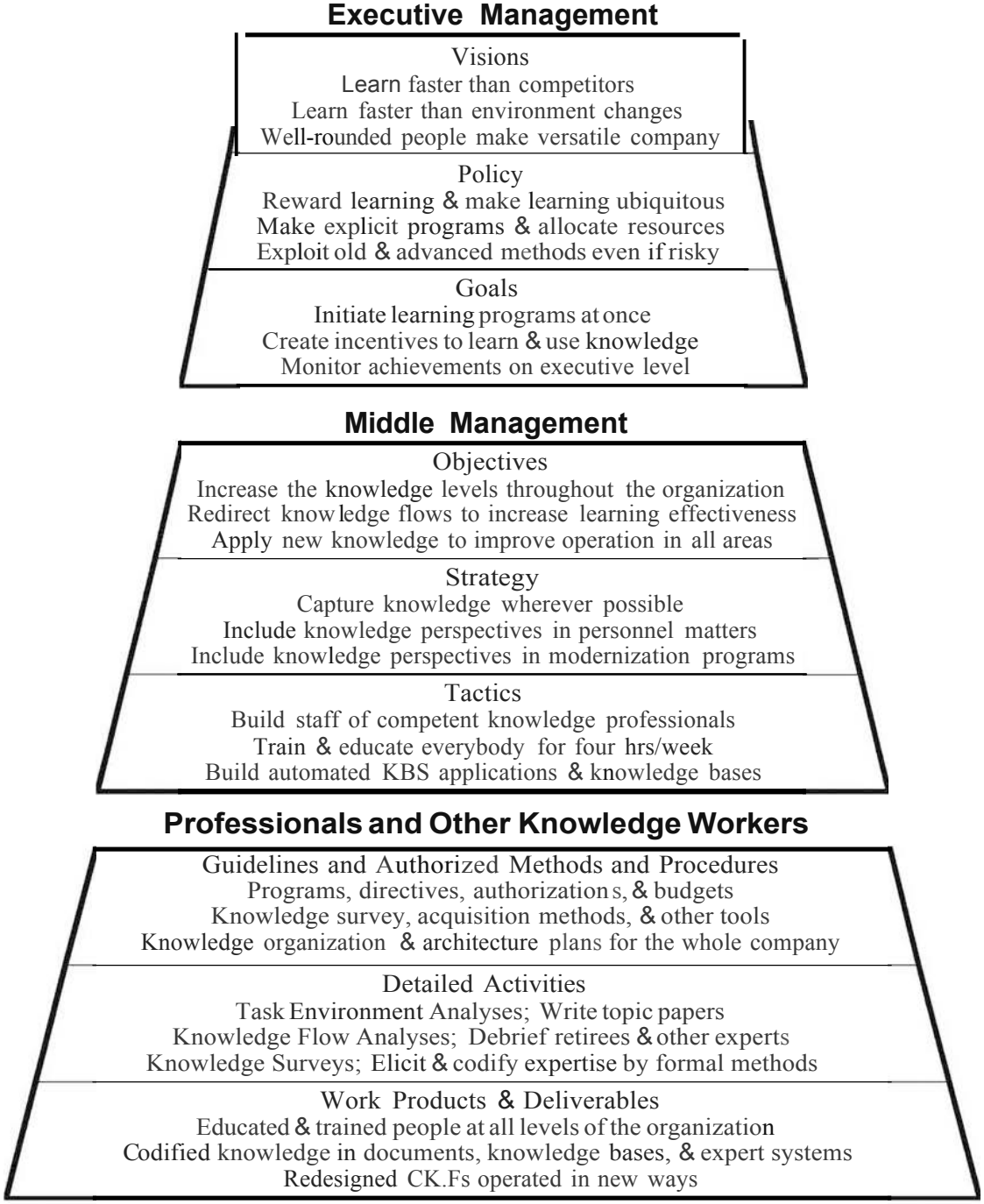
When a company considers introducing KM, it is frequently helpful to generate explicit expectations for the impacts that are envisioned for the major management areas under consideration. Since many of these impacts will be long-range and indirect, rather than short-term and direct, they will generally be strategic rather than operational in nature.

The strategic impacts of the individual knowledge-related management activities should clearly be considered. However, the major impacts may come from the integrated, synergistic, combined effects of the full complement of KM activities to be undertaken. In particular, the companies that have advanced furthest in adopting KM indicate that the most important strategic value of the management approach appears to come from such integrated effocts. Some of these synergistic benefits are discussed in the next chapter.

Competitive Advantages of Know'ledge and Its Management

Significant strategic advantages derive from effective management of knowledge as a function of the increased ability of more intelligent-acting behavior on both the individual and the organizational level. A few of the possible advantages include:

Figure 5-4. A "Tall" Approach t.o Knowledge Management Development.



- Increased market acceptance due to broadly increased quality of products and services
- Increased profitability due to lower costs resulting from more effective operations
- Better employee relations and organizational climate due to greater job satisfaction

This list appears very optimistic and is clearly a function of how well the management of knowledge is performed -- that is, how good the knowledge that is made available is and how well it is put to use.

Several companies claim significant competitive advantages from having introduced active KM. Most indicate -- probably as a result of their initial focus -- that the primary advantages of improved knowledge building and the opportunities of distributing knowledge to the point-of-action are associated with being able to provide better customer responsiveness and service. Improved handling of customers, in turn, leads to closer relations, greater reliance by customers on the company, and in the end, larger orders, increased market penetration, and improved profitability.

Build Krwwledge for the Future

Most sophisticated companies take a long-term perspective on their competitive situation. They are deeply concerned with how well they will perform several years from now and how strong their financial, product and service, and competitive positions will be at that time. These companies are interested in building knowledge, that is, learning and retaining everything they can in their corporate memories, in order to prevent unnecessary relearning and to act with insight when they meet new situations. In considering the strategic aspects of knowledge building, several companies work with a combined top-down and bottom-up approach.

For the top-down part of the approach, they develop different scenarios of what the future might bring. From these, they take stock of their in-house knowledge through skills inventories, knowledge analyses of key functional areas, or other specialized surveys to evaluate the nature and extents of the strengths and weaknesses of their knowledge position. Based on these findings, companies explore how managers would like to govern their areas, which knowledge areas need to be strengthened to bring the company to the desired position, and so on. These analyses typically provide new research agendas to develop missing knowledge, realistic time plans for activities to

bring knowledge to where it is needed, and a good understanding of what the bottom-up approach needs to achieve.

In the bottom-up part of the approach, the companies develop tactics and general guidelines for priorities and methods for more detailed activities to implement the individual parts of the overall program. Guidelines cover areas like opportunistic knowledge acquisition (when experts retire or are promoted), identifying, selecting, and implementing knowledge-related projects for CKFs, and knowledge flow analyses in support of corporate improvement programs and business process redesign (BPR), TQM, etc.

There are other strategic approaches to building knowledge for the future. Some focus on particular product or marketing strategies, such as building capabilities in a particular technology area in which management plans for the company to dominate. When this kind of goal drives the strategy, the knowledge areas that need to be built are relatively well defined, hence highly targeted programs can be developed.

Other approaches are associated with broad policies when the top management strongly believes that "well-rounded and knowledgeable people make a strong and versatile company." In these situations, the company attempts to build knowledge on all fronts in the belief that improved understanding and breadth in a number of knowledge areas will lead to a competitive advantage and to high success and long life expectancy.

One area of some interest for knowledge building relates to building product and service knowledge in personnel who are in contact with customers. For technical companies, this may mean knowledge in terms of technology and market understanding; for financial services companies, knowledge in terms of the nature of the products, but particularly the expected performance of the products, and so on. Another important area that is shared by everyone is the building of knowledge for how to perform internal operations more effectively.

Build *and Distribute Krww'ledgefo r Improved Internal Operations*

As implied above, considerable potential strategic impacts of active KM can be expected. Perhaps the most important areas deals with improving knowledge of how to conduct internal operations effectively. There are several aspects of internal operations knowledge. Some of this knowledge consists of how well the knowledge workers understand their function and are capable of performing their tasks. This knowledge can be developed in the staff through training and education or made available through expert networks or KBS

applications. However, first the requisite knowledge must be assembled, organized, codified, and at times created as result of research and development.

In order to continually improve the internal operations of the company, another kind of knowledge building must also take place. The enterprise must continually improve its understanding of how to operate and, more importantly, change and redesign, the work processes and work environment to make them better suited to support the company's functions. As a company learns more about how to provide its services and produce its products, and as the products and services change to serve the marketplace better, the company often needs to improve its organizational structures and the designs of its internal processes. Such changes are intended to make operations more efficient and quicker, to produce fewer errors, consume fewer resources, and so on. Through incremental or more comprehensively (even revolutionary) changes, these innovations and discoveries constitute a most valuable knowledge-building activity or organizational learning that companies must exploit effectively.

Embed Knowkdge in the Infrastructure!

Other kinds of knowledge are embedded in the organization's structure, its systems and procedures, the work place organization and tools, the working traditions and practices, the management style and philosophy, and in the decision-making, planning, and control procedures. As all of these areas are modified and improved to serve the organization better, we actually embed, that is, build in, better knowledge of how the organization should be operated. Unfortunately, quite often when we change and "improve" these capabilities, we structure them to serve a particular set of conditions quite well, but leave them inflexible and less suited for other operating conditions and management approaches that may obtain as the world around us changes. As an example, reduction of manufacturing costs by longer production runs of standardized operations fall into this category.

This kind of situation presents a considerable strategic challenge for knowledge professionals. We must be able to clearly u nderstand the knowledge-related features that are embedded in the work environments. Given that understanding , we also must understand how we can build versatile and flexible environments that we can modify without destroying the embedded knowledge that will remain valuable under the new conditions.

Frequently, when we redesign business processes, we discard carefully fashioned aspects of the work environments that reflect the embedded knowledge. As a result, we unwittingly may start from square one again. Unless we are explicitly aware of past considerations, we, to a large extent, risk destroying the cumulated knowledge that has been embedded in the organizational structure, division of responsibilities, and work flows. That is, we destroy part of the corporate memory!

Other Strategic Perspectives

Opportunities for creating, building, organizing, deploying, exploiting, and controlling -- that is, *managing* knowledge -- are evident in many areas of today's business and technical environments. In the past, we did not assemble collected overviews of the opportunities that existed in different situations to manage knowledge explicitly. With our current experiences, our understanding of how to deal practically with knowledge is improving rapidly. As a result, we are in a much better position to assemble overviews that can support business perspectives of how to take advantage of these insights.

OPPORTUNITIES FOR MANAGING KNOWLEDGE

Good business strategy demands that opportunities for managing knowledge be assessed in light of the value-added contributions that particular knowledge segments[1] will produce when exploited. In general, the value of knowledge within an organization can lie in a large number of areas and can be used in different situations that provide implicit, intermediate, and bottom-line values of knowledge. However, the actual value of knowledge is a direct function of how, in a particular situation, the organization exploits the knowledge to fulfill its objectives. As a result, it is essential from a strategic perspective to identify where crucial knowledge resides in an organization, how it can be put to better use, and what end values should be expected when the knowledge is actively managed. It is clear that not all knowledge possessed by an organization has the same strategic value. In order to identify the opportunities for managing knowledge, therefore, we must identify the

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1We use a scale of terms to denote the size of a knowledge area. The scale (Appendix A) from large to small and detailed is: Domain, Region, Section, Segment, Element, Fragment, Atom.

critical knowledge functions that contribute most significantly to the success factors of the business and devise activities to exploit that knowledge.

A major opportunity for knowledge management often lies in supporting highly leveraged professional work functions with powerful new capabilities. Many kinds of support can be based on knowledge provided by experts for use by the knowledge workers who perform these functions. In insurance companies, for example, work functions that are supported in this way include underwriting, claims adjudication, and financial planning. In financial service institutions, we find that investor service, equity and arbitrage trading, portfolio management, and commercial loan evaluation represent functions. Similarly, in manufacturing, marketing, sales, shop floor scheduling, and engineering design are good candidates. In fact, across firms, almost any professional function may be a strategic and worthwhile candidate for active management of knowledge. Typically, in order to bring the requisite knowledge to the appropriate points-of-action, multimodal knowledge transfer programs must be used as discussed below.

In some instances, a sophisticated, automated knowledge-based system provides a desirable solution to making the additional knowledge available to the point-of-action. In other instances, the proper support may be provided through apprenticeship programs, supported by an initial round of knowledge elicitation, analysis, and codification, without creating automated reasoning systems. In still other situations, the best solutions may be the creation of an "expert network," a referral support system of professionals or experts in other areas, or a change in reporting relationships.

As indicated earlier, an organization typically starts introducing KM with a Stage 1 (Experimentation) perspective. As time passes and the staff and management gain experience with KM approaches, the perspectives and reliance on the approach shift, first to Stage 2 (Introduction of Basic Knowledge Management), then, gradually, to Stage 3 (Broad Reliance on Knowledge Management), and after some time, to Stage 4 (Organizationwide Reliance on Knowledge Management). Based on emerging and beneficial experience with KM approaches that currently can be observed in a few companies, senior managers in other progressive organizations now may have the confidence and internal expertise to go directly to Stage 2.

Three basic strategies for introducing KM approaches into business:

1. The first strategy is to grow slowly into the use of KM and to use it gradually in applications where there seems to be a natural fit and where the personnel involved have a high level of interest. This strategy makes it

possible for firms with limited resources and urgency to build KM capabilities, as a follower. It is a low-risk low-reward strategy for companies with low resources.

2. The second strategy is to adopt KM approaches with "cautious deliberation," first in situations where there seem to be a natural fit, and later in a broader set of applications as other needs emerge. Each effort is chosen to support an integrated and carefully prepared general plan. This strategy makes it possible for firms with normal resources and some urgency to build KM capabilities, without being the first to apply the management approach. The strategy is relatively low risk and allows companies to use the approach for competitive gains.
3. The third strategy is in support of advanced and proactive perspectives, and is part of a broad, general effort to rejuvenate and strengthen the firm by forwardlooking and innovative management. The use of KM methods is considered an allied approach to that effort. This strategy has until now been pursued only by a few firms that are "early adapters" since it takes considerable commitment, foresight, and resources to bring about both quick and lasting competitive advantages. It is a medium-risk high-reward strategy for ambitious companies.

Farsighted managers in sophisticated and progressive firms generally adhere to two critical operational and strategic philosophies that set them apart from their competition and make them more successful:

1. They make sure that their customers are well served with quality services and products.
2. They continually innovate to change their operations, their products and services, their relations to customers and suppliers -- all in order to maintain their leadership position.

Similarly, managers and knowledge workers approach their mental tasks differently from their less successful counterparts. They appear to "reframe" the issues before them with very powerful methods to gain different perspectives and to obtain "taller" views of the situations as they proceed to analyze them and create solutions to them.[1]

MANY MANAGERS CHOOSE THE EASY WAY OUT!

When presented with a new situation they need to handle, many managers choose to focus their attention only on the problem areas that they are familiar with or on those issues that most recently have been brought to their attention.

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[1] A "tall" view denotes a perspective that simultaneously considers the broad strategic aspects and detailed approaches for how to implement them with consideration of all requirements in between.

This is quite natural and is the least stressful approach -- issues are relatively clear, the managers know how to deal with them, and they can act relatively swiftly and decisively. However, frequently this is not a very good approach. It is shortsighted and makes a number of often invalid assumptions about the general situation. For example, when a manager is presented with an operating problem that results from a malfunctioning machine, and is already familiar with how that machine can be repaired and quickly be brought back into production, tends to focus only on marshaling the resources needed for its repair. Thus, an average manager rarely considers the basic reasons for why the machine has failed -- again -- until the problem becomes a major issue. For example, s/he does not consider if the operators have sufficient knowledge to prevent failures or diagnose the problems early so they can be treated as part of preventive maintenance or perhaps fixed "on the fly." Some of the limiting assumptions that narrow-minded managers make include:

- The problem at hand is the core problem, not a symptom of an underlying problem that should be handled differently. Therefore, it can be attacked directly with no need to waste time to look at broader or deeper issues.
- The other areas of the situation are good enough "as is," and are not in need of change. They can, therefore, be ignored.
- The other areas are well managed and are operating with acceptable performance. They will take care of themselves and need not be disturbed.
- The other areas will not be affected by the changes that are introduced by handling the focal situation.
- There is no opportunity to create an integrated solution that will provide a stronger and more beneficial result.

In reality, all neighboring areas that are affected need to be managed concurrently. Most importantly, the underlying asset -- knowledge -- needs to be managed in harmony with the other changes.

KNOWLEDGE-RELATED COSTS OF FIRING AND REHIRING: LACK OF KNOWLEDGE MANAGEMENT CAN BE COSTLY

For a variety of reasons many companies lay off part of their workforce during downturns -- even though they are still making a profit -- only to rehire when business picks up again. This has been common practice in many industries under the somewhat outdated assumption that personnel is a variable cost. Large engineering firms, construction firms, aerospace firms, automotive firms, even high-technology firms practice this approach to "peak

shaving." The knowledge-related costs to these companies and to the nation are enormous.

A conservative estimate is that during an economic downturn in the U.S. over two million workers are laid off in this manner and a similar number, mostly different individuals, are hired a year or two later when the business picks up again. The new hires need to receive formal or on-the-job training and, professionals in particular, must learn the organization's products, work practices, and networking. Let us assume optimistically that on the average it takes over six months before all these new hires are up to full speed as if they were old employees and that they during that period they have contributed only two months' worth of fully productive work (four months were invested in nonproductive education and training). If a person year on the average costs $100,000, the total out-of-pocket cost for the nation is (2,000,000*10-0,000*(6-2)/12) = $66.7 billion!1

According to some estimates, these figures are much too low since they neglect two important factors: (1) The cost of lost and irreplaceable expertise among those who were let go or left; and (2) The cost to each firm of letting competitively valuable knowledge out on the street to be available for hire by competitors. The expertise typically takes years to rebuild as does the well-oiled work teams that have been disrupted.

The practice of laying off people during downturns has several other side effects. It leads to a need for unemployment compensation and other welfare supports. It also leads to societal knowledge attrition -- a loss of valuable knowledge in individuals as well as societally valuable how-to expertise -- from idling the knowledgeable individuals. By retaining and maintaining such knowledge, it could have been used to deliver better products and services with higher value to society and provide higher value-add ed deliverables that command higher revenues and salaries. The social costs in terms of lost tax revenues and increased social services have also been neglected in this scenario. These are also estimated to be on the order of tens of billion dollars.

1Indications suggest that it takes between three to five years before workers at any level become fully productive as "proficient performers" experts require longer time. (See Appendix A for brief definitions of proficiency categories.)

Chapter 6

Benefits fro1n Active Kno\Vledge Manage1nent

Benefits May Be Substantial!

KM yields a number of benefits to the organizations that apply it actively. Immediate benefits often include better access to knowledge by people who need it in their work or to strengthen the organization's knowledge assets in areas of operational and strategic importance. The end-value benefits are typically improved economic returns and competitive position and other contributions to improved attainment of the organization's "bottom-line" objectives. Improved management of knowledge, however, often occurs parallel with other advanced and comprehensive management approaches such as TQM and BPR that seek to improve the organization's operation and overall effectiveness or its organizational or business process redesign. As a result, it is at times difficult to isolate the effects of active KM on organizational improvement.

KM provides us with approaches, perspectives, and visions for putting the knowledge we have to better use by finding out where it is needed, how we can access and leverage it better, and how we can control its atrophication. It also allows us to decide where, how, and when to build, create, and cumulate new knowledge.

In particular, companies that have advanced furthest in adopting KM indicate that the most important strategic value of the management approach appears to come from such integrated effects as:

- Decisions are made quicker at lower levels with less personnel resources -- and decisions are often better and more informed than when they were made higher up in the organization.
- Decisions are implemented better since less interpretation is needed and shorter communication chains are shorter.

- Employees tend to become more knowledgeable about their own and adjacent work functions. As a result, they are able to propose better improvements, learn new operational procedures faster and more willingly, and help improve -- rationalize the whole operational process in a more informed and rational manner.
- People are much more conscious of, and better informed about, the operational process, the content and nature of the products and services, customer requirements, and corporate policies and procedures. As a result, they are able to provide much better quality work and tend to correct things that go wrong without supervisory intervention or the need for quality control.
- People are able to collaborate better: they have a better understanding of how to rely upon each other and complement each other's knowledge and to understand what other people mean.
- People tend to be much more aware of what is happening in the workplace and in the organization and seem to understand and tolerate much better most of what happens. Employee morale and cooperation are improved, absenteeism and turnover are reduced, and the workplace overall becomes much more positive.
- Employees, on the average, tend to seek ways to work smarter. As morale improves, they also tend to work harder, although in most cases, working harder does not seem to be a major factor.

All benefits of this kind are implicit - even intangible -- and are more evident and believable after the fact. Thus, it is often difficult, or even impossible, for professionals or lower level managers to justify proposed activities such as introduction of KM based on synergistic, indirect, and long-term benefits of the types indicated above. Most often, can be done only by senior management who will need to rely upon their own judgment to decide that KM is a required focus.

COMPETITIVE ADVANTAGES OF KNOWLEDGE AND ITS MANAGEMENT

Several companies claim significant competitive advantages from having introduced active KM. The primary advantages of building and deploying knowledge to the point-of-action, they indicate, are associated with the ability to satisfy customers better through higher quality products, services, and responsiveness. Improved handling of customers has led to closer relations, greater reliance by customers on their companies. In the end, this leads to larger orders, increased market penetration, and improved profitability -- both

KM, it is interesting to note that their expectations corresponded quite closely to the actual experiences reported by the companies who have implemented at least some KM approaches. The only difference was associated with the effect of KM on the price of goods and services. Experience shows that active management of knowledge improves internal operations which, in turn, leads to reduced costs.

Table **SI.** Knowledge Management Improvements of Key Competitive Factors.
(Ranked according to general importance from Boston University study.)1

	Improvements possible with active Knowledge Management
1. Consistent Product Quality and Conformance to Specifications	High
2. Dependable Delivery of Products and Services	High
3. Product Features -- High Performance Products	Moderate
4. Fast and Reliable Deliveries	Very High
5. Low Prices of Goods and Services	Moderate
6. Flexibility -- New Product Introduction	High
7. Flexibility -- Quick Design Changes by Customer Request	Very High
8. Broad Product Line	Low
9. After Sales Service	High
10. Broad Distribution	High
11. Rapid Volume Changes (Support of Just-in-time, etc.)	Very High
12. Effective Promotion and Advertising	Moderate

Economics Aspects of Knowledge2

From long-term economic and societal perspectives, knowledge and its diligent use is the engine that drives the process that makes it possible for us to earn our living, maintain our lifestyle, and increase our GNP per capita, that is, our quality of life. In other words, it is the fundamental basis for mankind's ability to maintain and improve its lot. All other resources, raw materials, economic wealth, and so on, are only of value when we apply our

1 Adapted from Boston University 1987 North American Manufacturing Futures Survey.

2 We owe a number of perspectives to Kenneth Boulding's Richard T. Ely Lecture, "The Economics of Knowledge and the Knowledge of Economics," American Economic Review, May 1966, pp. 1-13.

knowledge to create valuables from them.

From these perspectives, knowledge is of the utmost importance in many different ways. It is important for our own organization's operation and competitive stance. It is important for our self-improvement. And it is important for our continued survival. Knowledge, arguably, is the basic economic good.

THE BROADER PERSPECTIVE

"Possession of property is exclusive; possession of knowledge is not exclusive, for the knowledge which one man has may also be the possession of another." This insightful statement was made by Major Wesley Powell to a congressional committee more than one hundred years ago. It is a pertinent perspective when we consider the economics of knowledge -- how knowledge is created, made available, traded, and exchanged.[1]

The aspects of the economics of knowledge that particularly interest us are those that help us understand how to asses the value of knowledge as corporate assets and the different KM activities that we may implement. We are interested in issues such as how a particular knowledge segment[2] can be used, what it is worth when used in the proposed manner, how the knowledge of interest can be obtained and what its cost will be, and what the values of the alternatives are. These considerations lead to analyses of supply sources for knowledge, mechanisms of knowledge transfer and exchange, and the costs and benefits of these activities. They also lead to analyses of how effectively we can exploit the knowledge that is available to us.

When considering its economics, we may define knowledge as consisting of facts, known causalities, perspectives, concepts, judgments, and approaches or strategies that are remembered or held in memory, to be applied to handle particular situations.[3] From this definition knowledge can be "internalized" in a person's mind or it may be "externalized" when we codify it in procedures,

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1 Statement by Major John Wesley Powell to a congressional committee in 1886. Quoted in Don K Price (1966), The Scientific Estate, Belknap-Harvard, p. 248, footnote 36, and referred to by Kenneth Boulding (1966), op. cit.

2 We use a scale denote the size of a knowledge area. It is: Domain, Region, Section, Segment, Element, Fragment, and Atom where domain is largest and atom is smallest (see Appendix A).

3 We distinguish between Factual, Conceptual, Expectational, and Methodological knowledge types (see Appendix A).

documents, knowledge bases, automated KBS applications, or embed it in technology or products and even in company traditions. For particular situations, the knowledge under consideration may be a combination of internalized and externalized knowledge such as when a person pools his or her knowledge by consulting with experts or referring to books and other dlocuments that provide knowledge pertinent to the work task.

One major problem with knowledge is that it generally cannot be readily identified, described, or quantified and, therefore, may not be readily measurable. That makes it difficult to establish its economic value. However, practical approaches have been established that enable us to characterize knowledge in terms of its type, general proficiency level, and the extent and coverage of a particular knowledge segment. Such characterizations are normally only valid for specific and well defined situations where the application of knowledge to a process or product can be described in some detail.[1]

As hinted by Major Powell, knowledge is an unusual commodity. It is nonexclusive and can be shared between many individuals without much loss of content. Further, when used to create products and services., knowledge is not depleted in the same way as other resources. On the contrary, use of knowledge typically leads to better insights and creation of new knowledge with greater value. When knowledge is used, it is expanded through the development of learnings from additional experience. In other words, knowledge is not a depleatable resource -- it *increases in value when used*. Conversely, knowledge tends to *decay when not being used*. Normally, knowledge that is not used is gradually forgotten ultimately to disappear unless codified in a repository, which is made readily accessible.

There is a special relation between knowledge and an organization's products and services delivered to its customers. The products and services can be considered vehicles for the economic realization of the worth of the knowledge assets that are used to create them. This is almost self-evident, but leads to the explicit notion that it is of utmost importance to assemble the complement of knowledge that will yield the highest economic return when the products and services are sold in the marketplace.

1For further information on these issues, see Wiig (1993) Knowledge Management Foundations and Wiig (1994) A Knowledge Management Framework.

SMARTLY APPLIED KNOWLEDGE MAKES OUR LIFESTYLE POSSIBLE WITHOUT EXPLOITING THE LESS FORTUNATE!

In the U.S. and other "developed" nations, most of us are accustomed to a very comfortable standard of living. We have obtained these riches in several ways. Many economists and social scientists point out that in part, we, have obtained them by exploiting less developed nations. For example, we are importing low-cost, labor-intensive goods manufactured by people who earn a pittance -- a fraction of what we would accept in terms of moneys or purchasing power.

However, exploitation is not the full story of how well we have been able to increase our standard of living. Whereas that assessment may be correct, it does not explain the effects of vastly improved productivity that continually leads to increasingly greater value-added contributions for each of our own working hours. Increased effectiveness of automation and computerization has led enormous productivity gains. Increased sophistication of the work we perform has led to greater value of our services. Increased understanding of what is important and how our businesses function has made it possible to change our focus to concentrate on what has greatest relevance. Our increased understanding -- knowledge -- has given us the ability to deal with complexity and exceptions resulting in much greater effectiveness in our work.

Due to our own improvements, we find that we can maintain and improve our standard of living -- our per capita output -- by increasing our productivity or value-added contributions by leveraging our knowledge in all areas to work more intelligently. While we have seen examples of our capability to increase productivity in many areas, our advancements in agriculture are perhaps one of the best examples. By leveraging technology, agricultural sciences, and our food-related industrial complex, we can now produce enough food to feed ourselves and a large part of the rest of the world. We find numerous other examples of how we have improved productivity by leveraging understanding and knowledge in all industries and businesses. Chaparral Steel discussed above is but one of these. Nevertheless, we also find many examples of how we still can improve productivity significantly. In reality, in most organizations we have not managed knowledge extensively and explicitly and, therefore, still have the potential for significant improvements.

SUPPLY AND DEMAND OF KNOWLEDGE -- VALUE OF SCARCE KNOWLEDGE

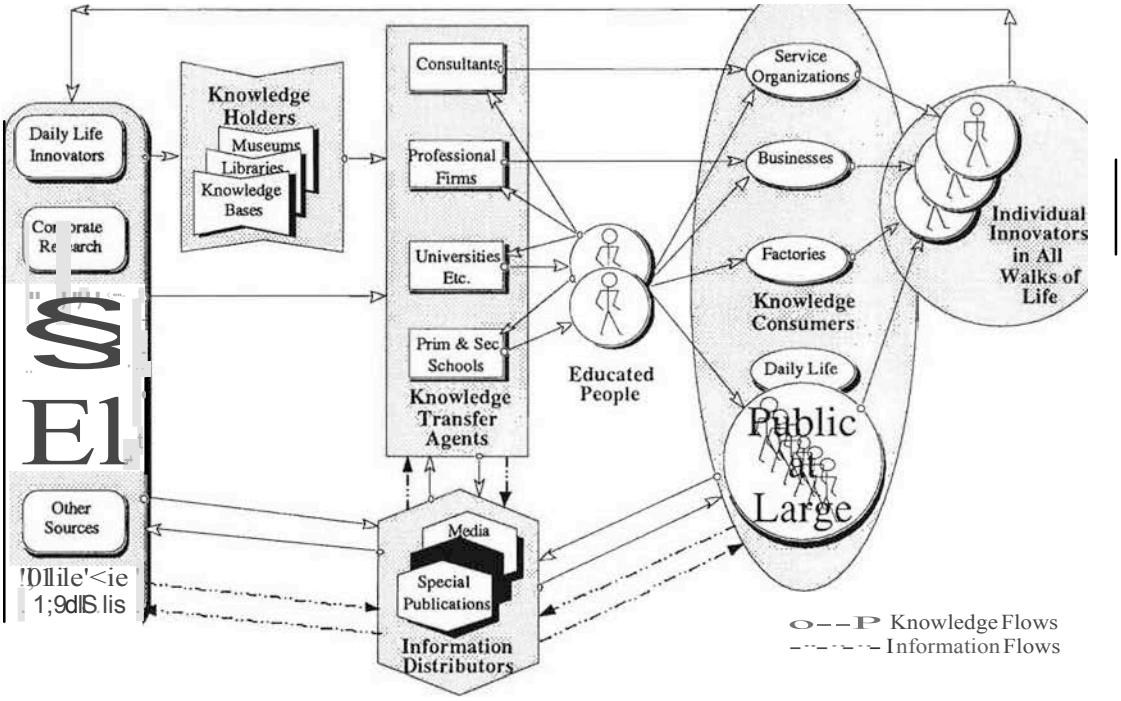
Societal,Krwwkdge Fwws

When considering the economics of knowledge, we are interested in what happens when knowledge is bought, sold, exchanged, developed, or put to a purposeful use, that is, when it takes on market value. We are also interested in the economics of the supply and demand of knowledge. We may illustrate some of the macroscopic societal flows of knowledge as depicted in Figure 6-1. A number of entities are involved in various forms of k nowledge transformations. Not surprisingly: the most important of these are people. We also find that several types of institutions play important roles, but on closer examinations it is always the individual innovator and knowledge worker who creates new knowledge, is key in transferring knowledge between parties -- as the knowledge source, the knowledge transfer facilitator, or the learner. It is important to also note that in many instances knowledge is transferred by actually transferring individuals from one institution to another.

Examination of societal knowledge flows does not yield much information about the microeconomic aspects of knowledge as it concerns most organizations. In our societal knowledge flow analysis we can include the number of activities, the number of people who flow between institutions and their levels of proficiency, investments made to create and to buy and sell knowledge. When we go to this length, the societal knowledge flows can, on an aggregated scale, indicate the general nature of knowledge flows and the potentials for knowledge bottlenecks, surplus, and shortages. In addition, it may provide a model for investigating the potentials for improving the situation.

At the end of the 1980s, approximately 30% of U.S. engineers worked in defense industries. That constituted a large effort on what basically is a nonproductive activity from a societal perspective. For us to improve the general welfare for people everywhere, it appears that we need to promote a significant knowledge flow from this sector of the economy to nondefense related sectors by transferring knowledge directly, or by transferring people. That, we now are learning, is very difficult.

Figure 6-1. Societal Knowledge Flows Between Knowledge Creat.ors (Sources) Knowledge Users (Sinks) and Knowledge Transfer Agents.



Value of Knowkdge

In the competitive world, the market value of knowledge may be a function of its exclusivity. For example, when we apply closely held knowledge to generate a product or service, we can obtain a competitive edge in the marke tplace. The knowledge provides us with the capability to be in the forefront, and it becomes highly valuable. If such knowledge is broa dly shared, the competitive advan tage disappears, and its value is reduced. However, the situation is not always that simple because once a knowledge area becomes "standard knowledge"1 and is used by many competitors, its

1 Working definitions for "promisi ng knowledge," "competitive knowledge," and "standard knowledge" are:

"Promisi ng k nowledge areas" are in early development stages with demonstrated poten tials for changi ng the basis of competition.

(Some of today's p romising kriowledge becomes tomorrow's competitive knowledge).

"Competitive knowledge areas" differen tiate your company and have the greatest impact on competitive performance.

marginal value may remain high since omitting its use can have disastrous effects unless other alternatives can be found.

The market value of a particular knowledge segment is a function of its availability. In a "perfect" market, the market value is low when the knowledge is readily available. That may be the case when the knowledge becomes a commodity, for example through seminars and educational programs, in trained professionals who can be easily hired; or when it is embedded in broadly available machines, technology, books, methods, or computer-based systems, including knowledge-based systems -- all of which may be replicated and sold.

Closely held knowledge can be controlled to retain its value, either by selling it directly to the marketplace on a selective basis, or by selling products and services that are based on it. Most higher-echelon service organizations sell proprietary and closely held embedded knowledge through their services. They may also sell their knowledge in the form of patents or licensing agreements. In some instances, companies sell off, or spin off, whole departments or operations because of the special knowledge these units have. Most product companies sell proprietary knowledge as part of their products, either directly when embedded in the design or content of the product, or indirectly when applied to the production or delivery process to achieve reduced cost, improved quality, increased service, and so on. In all these situations, the organizations seek competitive edge through leveraging of their proprietary knowledge assets.

The value of knowledge is a function of several factors. It is primarily dominated by the demand for the particu lar kind of knowledge under consideration or the demands for the results that obtain from applying it. And the demand for that knowledge in turn, is determined by the demand for the goods, services, or strategic purposes for which it is needed.

If we manufacture blown crystal, and the marketplace is willing to pay highly for quality blown crystal products, then the value of the knowledge of how to blow crystal is high. That may not determine that we need to pay highly for this kind of expertise, though. What we will pay is determined by the market value of crystal-blowing expertise, which is also a function of the supply of people who have this specialized knowledge at the location it is needed. If availability of knowledge is the constraining factor, we may have to

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(Competitive knowledge in time becomes standard knowledge for an industry).
"Standard knowledge areas" are highly essential to your business, and are widely available to all competitors.

pay the marginal value for the expertise we need. The marginal price is then determined by the market demand for the our product. If, on the other hand, our ability to use the knowledge is the constraining factor, that is, if more expert crystal blowers are available than we can use, we may only need to pay what the competing knowledge holders demand for their services if that price is below the demand generated value.

ECONOMICS OF KNOWLEDGE TRANSFER

The economics of knowledge is also affected by the mechanisms available for transferring knowledge from one knowledge holder to another. From a practical perspective, an organization that employs a k nowledgeable individual may be considered a holder of that individual's knowledge. In such cases, transfer of knowledge from one organization to another may take place by transferring the individual. However, this only works perfectly when the individual is free to apply his or her knowledge directly and on a personal basis in the new organization without being bound by limiting employment contracts, "Not-Invented-Here" syndromes, or other personal or social constraints.

Transferring knowledge between persons is more complex and needs to be considered quite differently from information transfer. It requires time, effort, and cooperation and also requires learning on the part of the person who receives the knowledge. In addition, it involves the persons' levels of proficiency in the knowledge to be transferred (that is, awareness, skill, and so on) as well as the nature of the transfer mechanism (self-study, seminars, formal educational program, apprenticeship, etc.)

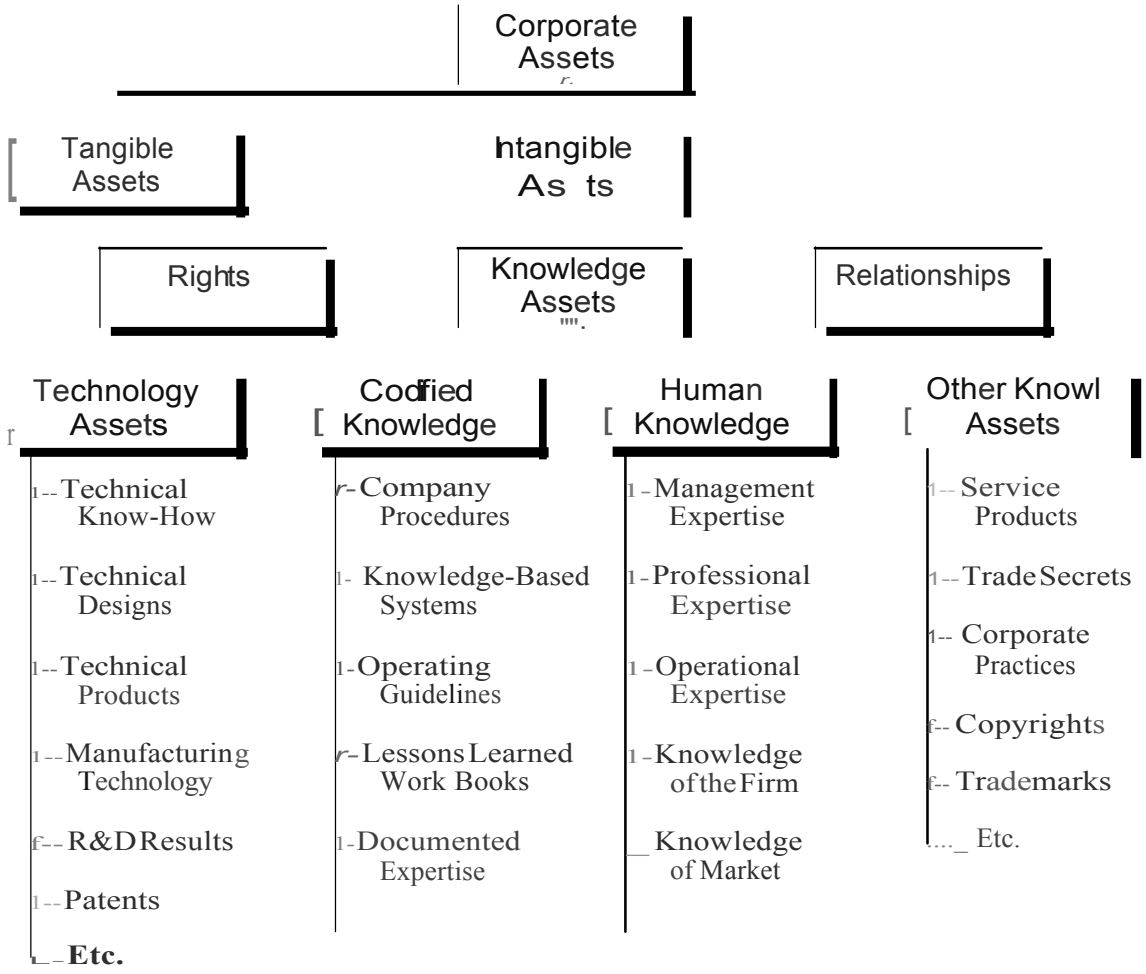
The economics of knowledge transfer is primarily a function of the cost of completing the transfer to an acceptable degree, the price charged for the knowledge (if any) by the knowledge source, and the value of the knowledge to the recipient.

Knowledge Assets Are Not on the Balance Sheet! They Are Not Managed and Often Wasted!

Some of the most valuable assets of any company are kept hidden and are invisible to owners, managers, and all other stakeholders. These are the organization's knowledge assets, which also include its technology assets.

Different types of such assets are shown in Figure 6-2. According to the CEO survey mentioned earlier, all respondents agree that knowledge assets are the organization's most important assets -- yet they do not appear on any balance sheet. Every year considerable investments are made to create these assets, yet such investments are typically not capitalized or kept track of, just expensed, without any accounting value, that is, they are not managed as assets.

Figure 6-2. Knowledge Assets Are Vital Intangible Assets!



Because knowledge assets are not capitalized, they are not included when Return on Assets (ROA) are considered. As a result, management is not rewarded for creating these assets or using them effectively, nor are they

penalized for wasting them. Knowledge assets are created through R&D and engineering efforts, and internal improvement programs and training; and are acquired through licenses, acquisitions, joint developments, and hiring of people with exceptional knowledge.

If measured, the value of knowledge assets would likely be high. So would the returns on these assets. In the U.S., industry and government invest approximately $140 billion annually on R&D. But companies do not normally account for the profitability of these investments, nor do they monitor in detail how well R&D investments contribute to revenues, improved operating costs, and net incomes. Similarly, investments in education, training and other knowledge-building and transfer activities are also not capitalized or monitored from an asset point of view.

As a result of the tendency to write off knowledge-improvement investments as operating expenses, managers are not held responsible for how effectively they build, maintain, and utilize knowledge. There is no accountability regarding knowledge in most organizations. There are no incentives to ascertain that knowledge assets are leveraged or that they generate acceptable returns. Consequently, many mangers invest in knowledge without giving much thought to how such investments may benefit them. They let knowledge assets deteriorate without being called to task for such waste. In short, often not much attention is paid to knowledge, its fundamental value to the organization, and its gradual cumulation that allows the organization to "ascend the knowledge spiral."

Benefits from Using Knowledge

It is often necessary to assess the economic value of changing the content of knowledge in the work functions we are responsible for. For this purpose, we need to understand how knowledge affects our operations. First, the way we use knowledge is to make decisions. Most of the decisions we make are minute, automatic, and part of our regular knowledge-intensive work. In fact, they are often nonconscious -- we are not aware of having made a decision, "we just did it that way." However, these decisions are directly related to the knowledge we have. As we improve our knowledge and become more proficient, therefore, both our automatic and our conscious decisions change. That is, we handle situations differently and more competently.

The benefits of using knowledge and its value depend on several factors beyond the quality and extent of the knowledge itself. From an overall perspective, the nature of a task and the quality of the way it is handled in each knowledge-intensive step are functions of: (1) The proficiency in the knowledge that will be used; (2) The diligence of the knowledge workers; (3) The motivation to use available knowledge; (4) The availability of resources; and (5) The overall structure and organization of the work process. The value of what happens in the work step -- the handling that takes place -- is, therefore, a composite of several factors of which knowledge is only one. To consider what the (additional) value of using or improving knowledge is, we need to account for variations in the other factors as well. Normally, we can assume that the other factors will remain constant -- or at least that they will not change adversely -- which simplifies the assessment.

When we consider the potential benefits of the way we manage knowledge, we repeatedly struggle with questions like: "Should I bring in a new person with greater expertise to perform Joe's job, or should I let him continue to do it? Should I replace him or should I get another person to work with him? Should I let him take advanced courses, or should I invest in the new multi-media expert system to assist him?"

Many difficult issues are hidden in this dilemma. One is associated with the fact that if I bring in a person who is better at performing the work task itself, that person may not possess all the other positive attributes that Joe has. Joe knows the customers and the company products, and its traditions, and whom to network with. He makes occasional errors and is slow at times, but otherwise he is a very valuable person that a number of people can rely on. That aspect, although very important, is not the major issue at this point, however. Yet, along with other aspects, it must be considered when the overall analysis is performed to determine what the appropriate course of action should be. Here, we are interested in assessing the value of different ways of improving the available expertise to perform the work task.

MARGINAL ECONOMICS OF KNOWLEDGE

When we consider improving the knowledge that is available at the point-of-action of a work task, we can ask a number of questions. For example, "Will it cut costs?" "Will it improve quality?" "Will it reduce errors?" "Will it be done in a shorter time?" "Will making the expertise available to Mary free up Janet so she can do other tasks that are more valuable in the long run?" "Can we do

new things with the additional expertise that we cannot do now?" We also need to ask questions to determine how much additional expertise of precisely what kind is required to obtain the potential improvements we would like to achieve.

We Apply Knowledge to Work Objects

We use knowledge by applying it to the "work object" -- the focus of our task which we invariably will change by our actions. The concept of work object is broad. In automobile service, when a mechanic repairs a transmission, the work object is the transmission, all its part, and perhaps the car itself. Similarly, when a service representative talks to a customer, the work object is the customer, the customer's situation and needs, and what the organization can do to help. In the latter case, the service representative applies his or her knowledge on the minute level by making decisions on which questions to ask and which diagnostic avenues to explore, and also by making decisions on how to conduct the dialog, which speech acts to use, that is, how to phrase the sentences, which tone of voice to use, and so on -- all in time-critical situations.

When we consider the value of using a particular knowledge segment to perform an operation on a work object in support of a specific business situation, we are considering the marginal economic benefit of the knowledge segment in question when it is used as planned. To be able to assess the value of added knowledge -- or the costs associated with removing knowledge -- we need to describe the direct and indirect changes that we expect as a result. We need to define the nature and extent of the impacts that we envision will take place and subsequently translate these impacts into anticipated changes in the degree to which the end-value objectives will be attained. The value of a particular body of knowledge made available to a point-of-action is typically incremental. The knowledge provides value-added benefits -- an increase in benefits beyond what is possible without it.[1]

Paul Heinz runs the men's department in a large department store. The department has increased in size and handles more lines than before. As a result, the store has insufficient buyer expertise. The workload is too large for Joe, the expert buyer, to handle and he also is not sufficiently familiar with some of the new lines. Therefore, Paul is considering hiring an expert buyer in men's clothing in addition to Joe, or perhaps instead of Joe if the new person is exceptionally good and fast.

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[1] In many respects, the added-value contributions of knowledge is identical to the "shadow price" concept of mathematical programming.

As a result of bringing in the new expert, Paul expects direct changes and improvements in the quality of the men's wear that they buy, greater confidence that they are buying the right lines and, therefore, risking buying larger quantities, being able to get better buys, obtaining quicker turnover, and so on. Paul expects that all of these changes will impact the "bottom-line" in some way, that is, they will affect the annual sales volume, the department's profit, and so forth. In addition, other impacts that also are of interest. Since the salespeople are commissioned, their income may be impacted and if it increases as a result of greater sales volume, the salespeople may be more satisfied, give better customer service and remain longer with the store. At the same time, if the store has better quality goods and gives better service the customers may be more loyal and, in turn, buy more, and so on.

So, what is the incremental value of complementing Joe with an expert? And what would the impacts be if they replaced Joe? What are the costs or negative impacts of bringing in a new person, particularly if they let a very seasoned, company-knowledgeable and well-liked person like Joe go?

We will take a second look at how we may explore answers to these questions in the next sections.

Knowledge and Noneconomic Objectives

Top managers are increasingly recognizing, and operating their organizations accordingly, basic objectives that are noneconomic in nature. Some of these objectives may have economic impacts in the end whereas others do not. Typical noneconomic objectives observed by organizations include:

- Improve working conditions for workers at all levels so they will be happier and, thus, remain with us longer and be more effective.
- Preserve and improve the physical environment to prevent deteriorating living conditions for ourselves, our neighbors, and our children.
- Preserve and improve the social environment so we can coexist better.
- Preserve and improve the economic environment so we can enjoy our earnings in the future.
- Be a good neighbor and support our local community to create and maintain excellent relations.

Noneconomic objectives do not conform to convenient metrics for measuring the degree to which they are attained. However, all these objectives can be fulfilled to a greater degree when better and broader knowledge is available to the people who make decisions. For example, knowledge workers

need better knowledge of how their actions affect the realization of the important end-goals. Better knowledge is also needed for the knowledge workers to assess how they can change their activities to obtain better results. The organization needs to develop and make such knowledge available to those who make decisions that impact the important objectives.

Economic objectives are less questionable. For the most part, these objectives reflect measurable aspects of the operation and its market position. They often may be proxies for variables that are difficult to measure, such as corporate viability, general market image and market acceptance. Frequently, however, these objectives are based on thorough studies and management theories that link their attainments with corporate success. A few examples of such objectives include:

- Attain as high a quality and constancy as possible in all products and services to improve market acceptance and market image.
- Improve employee morale and work conditions to reduce personnel turnover to decrease hiring and training costs and increase retention of expertise.
- Improve relations with suppliers by working closely with them to develop higher reliability and versatility and better quality in all purchased supplies, products, and services.

Quite often, we neglect to take the noneconomic objectives explicitly into account when we decide what to do. We may omit considering how our proposed actions can realize these objectives when we justify our projects. For example, when redesigning the office environment, we may focus only on cost-related objectives and omit considerations of how the new environment will affect employee satisfaction and, therefore, productivity. And we may neglect to include important aspects of our projects that will affect the questionable objectives positively or adversely.

We fall back on this behavior for two reasons. First, we do not feel that we have sufficient knowledge of how important these objectives are in the eyes of the organization's decision makers who will rule on our proposals. Second, we may feel that we do not understand or are able to explain to others what the effect of our proposed actions will be. We do not have clear knowledge about the cause-and-effect relationships between our actions and the objectives. As a result, we consider the potential benefits (or negative results) to ibe **intangible** and, therefore, tend to ignore them and omit considering them.

TANGIBLE AND INTANGIBLE BENEFITS

The observable effects and benefits of using some particular knowledge to a specific work object may often be direct in the manner in which they affect the department of the operating unit. At the same time, they may be indirect in the manner in which they affect the overall organization's objectives and bottom-line values. The manner in which the direct and immediate effects translate into bottom-line benefits may also be obscure, dispu ted, and questionable. In addition, to make it more complex, we have been accustomed to separating the tangible benefits from the intangible benefits, often omitting considering the intangible benefits from our assessments.

The problems associated with long-term, vague, or implied objectives have led many managers to consider many of the possible benefits to be **intangible** in the sense that they may not be real, are not considered to be appraisable at an actual or even approximate value and, since their precise nature cannot be identified, are not defendable. As a result, managers and professionals have often discounted a number of such benefits as being too vague to consider. That, unfortunately has led to many situations where when proposed activities with poten tials for considerable long-term, "chained" benefits are implemented, the activities are designed to only address the more direct and tangible benefits. In these situations, which are quite common, the features required to make it possible to realize the "intangible" longer-term benefits are excluded and as a result those benefits have not been realized.

When considering the benefits of potential KM activities, we need to determine very specifically which benefits should be expected in the particular situation, and how we may apply methods and approaches to characterize and evaluate those benefits. We need to apply a perspective of the economics of knowledge as it pertains to broad development and use of knowledge in purposeful organizations. We also need to develop an understanding of the marginal economics of knowledge when it is used in specific work steps and applied to a work object for a particular purpose.

Evaluating the Benefits from Active Knowledge Management

Appraising benefits -- or adverse effects -- that may result from planned or proposed actions is often problematic. The difficulty arises from a number of

sources, including uncertainty about what will happen. Other problems stem from the fact that it frequently is difficult to establish precisely which objectives -- end-values -- are of importance to the decision makers. Often the decision makers, that is, the senior managers of the organization, are not themselves clear about which objectives should be considered important and what relative weights they might carry. A few objectives are often quite clear, however. They are often economic objectives with relatively short-term horizons. Some examples of these objectives include:

- Increase the profitability (net after taxes) for this quarter.
- Improve this calendar year's financial statement.
- The economic return of any new project or activity should provide at least an 15% Internal Rate of Return (IRR or ROI) -- or at times stated as: New projects must generate a positive Net Present Value (NPV) evaluated at 15% interest rate.

As we discussed above, other objectives are noneconomic, are more tenuous, and may not have been considered explicitly or communicated downward by senior management. Many of the longer-term objectives, however, are of vital strategic importance to the organization. At times, these objectives are considered desirable, but only after the monetary objectives have been fulfilled. Unfortunately, as indicated above, most managers and analysts have tended to disregard these "intangible" objectives since no good methods have been available to treat them. As a result, many important projects have been shelved and never implemented although they might have been able to rescue good organizations from demise.

DIRECT AND INDIRECT BENEFITS

When operations are changed to improve future gains qr to *"do things better"* and not necessarily cheaper, when improved quality is a prime motivator, many of the benefits that are sought are long-term, which will be realized through chains of events that have to take place before the end benefits are finally obtained. A further complication is that some of the foreseen benefits may not be realized. And if they are realized, it is not certain to which degree they will be realized. Other benefits, on the other hand, may be realized to a larger extent than their expected value. As a result, appraising the value of a proposed knowledge-related activity is fraught by uncertainty of the impacts that may be expected. Methods are available to evaluate the impact of

KM activities on longer-term, non-economic objectives, however.[1]

To improve this situation, we can sketch out the possible benefit streams in the form of event chains.[2] Initially, this is done by charting the likely links in the benefit (and cost) chains without estimating value expectations or likelihoods for the different conditions that may obtain. Later, with the collaboration of managers and senior professionals from the affected operating areas, examinations of the benefit chains will reveal other links, which of them will be important and which of them can be omitted -- and particularly, which will play significant roles in, and be of support to, new ways of doing business.

In the men's department case, some of the benefits -- and costs -- are shown in Figure 6-3 in the form of an event chain diagram.[3] The relations between the different effects, benefits, costs, and some end-values are indicated with arrows. For simplicity, this diagram does not include the longer-term effects of increased customer loyalty and salespeople satisfaction. We have found the use of event diagrams of this kind to be very effective in helping managers identify and take position to the direct, indirect, tangible, and intangible benefits that are likely to obtain from alternative activities.[4]

KNOWLEDGE FLOWS

The use of knowledge in a particular operating situation typically occurs in discrete steps; that is, knowledge from multiple sources (such as people) is brought together and pooled to be applied to the work object. Typically, knowledge is added sequentially in several separate work steps to create the final products or deliverables. For example, an automobile service organization may divide its work process into five major steps: Intake Diagnosis, Full Diagnosis, Repair, Test and Quality Control, and Document and Bill. Since the work process is normally divided into such steps, it is often necessary to consider how *knowledge ffows* between the agents (knowledge

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1 Andrew Sage in his Economic Systems Analysis (1983) provides an excellent text on detailed methodologies to determine the marginal economics of changes in operations processes.

2 For a further discussion of this use of event chains, see Wiig (1994) A Knowledge Management Framework

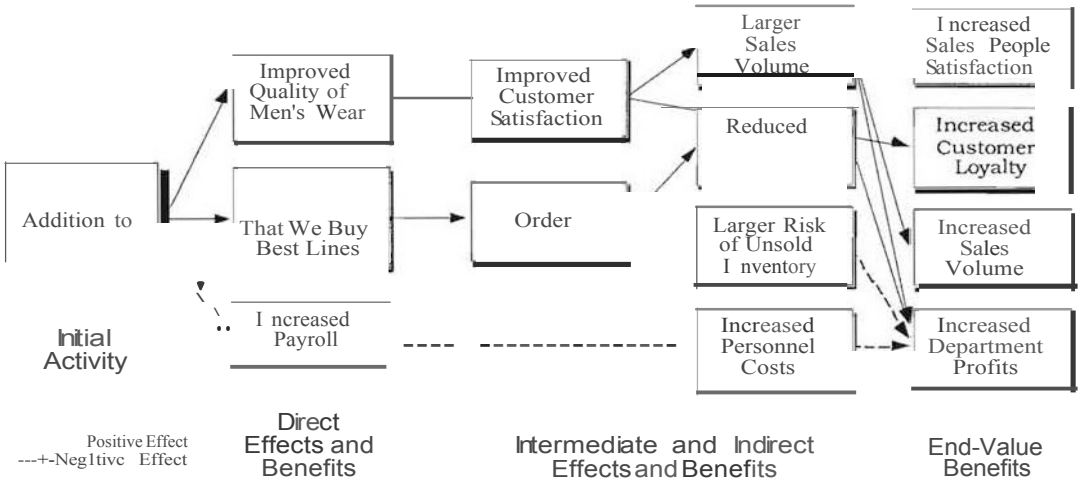
3 The event chains may formally be considered as dynamic Markov processes, where linear or nonlinear transition functions may define the degrees to which certain inputs will result in particular outputs from each Jink in the event chain.

4 See Wiig (1993) Knowledge Management Foundations.

workers, experts, and so on) to the work objects in order to identify where in the production process the various knowledge areas are applied and what their contributions are.

(We will use this example without redesigning the work process. Sequential one-step-at-a-time work processes as in this example are now often changed to allow operating with a collaborative team where many work steps are combined and the knowledge workers can "network" to pool knowledge and information and address the issues quicker with less communication overhead, to reach superior solutions with less resources.)

Figure 6-3. Simple Example of Using Event Chains to Portray End-Value Benefits in the Men's Department.



Consider how knowledge is used in an automobile dealer's service department. From an aggregated perspective, the service is provided in five major work steps starting with Intake Diagnosis as shown in Figure 6-4.

A number of individuals are directly involved in providing the service to the customers: the customer representatives, mechanics, clerks, and managers. From the point when the customer arrives with the car, to the point when the car is finished and given back to the customer, the handling of the customer, the car, and the affairs of the service department depends on the knowledge these individuals bring to bear in each work step.

Figure 6-4 also shows the information flows that support the work steps. The information flows suggest that considerable documentation and information communication is required between the different work steps. For

example, the customer representative needs to capture, document, and communicate the intake diagnosis and customer observations to the diagnostic mechanic who then can subject the car to an in-depth diagnosis. Similar communications are required between the other steps as well.

Figure 6-4. Example of Knowledge Flows in Automobile Service.

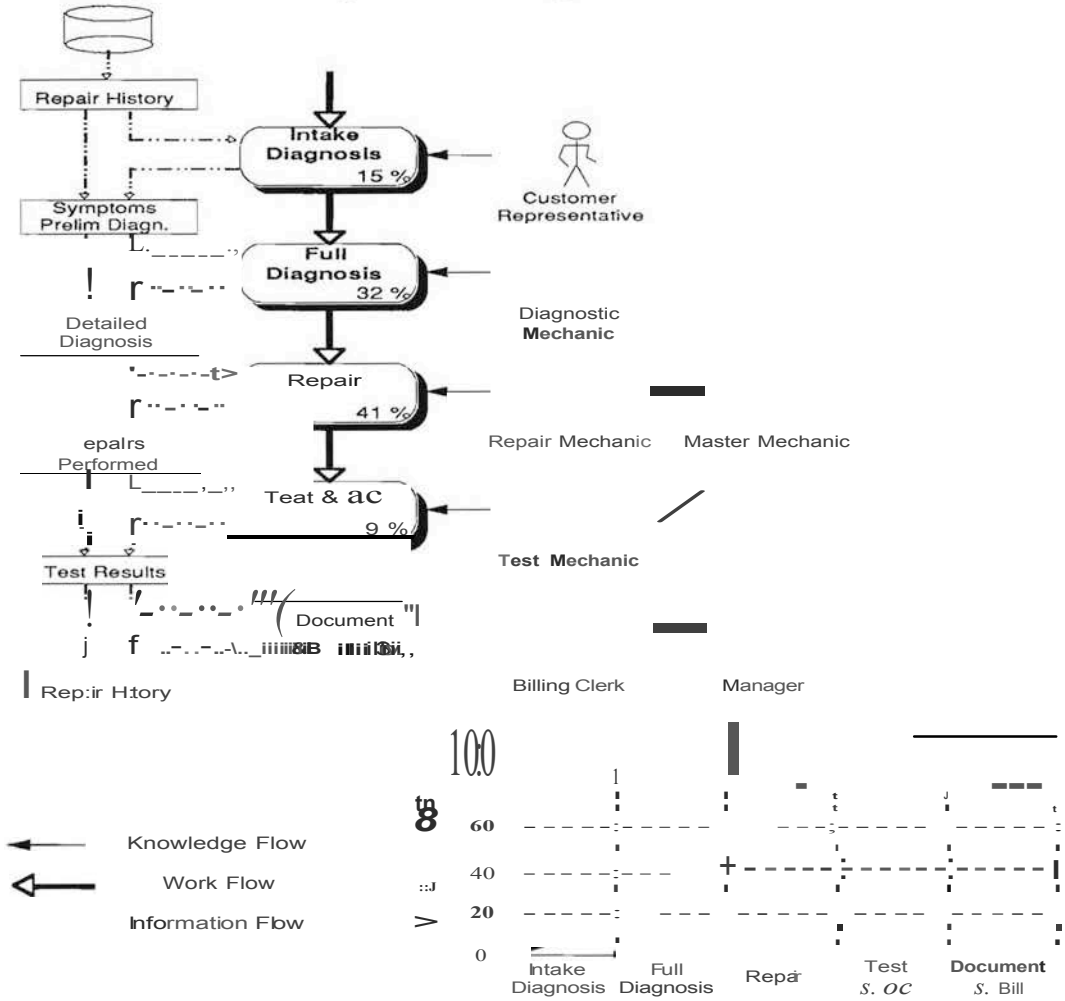


Figure 6-4 also shows the percent value-added to the customer of each work step as perceived by the service department. The graph on the bottom illustrates the cumulative value-added for the five task areas. We may use this approach to identify the relative value of the knowledge applied at the different steps. The approach is not without fault, however. Just consider that we

removed the car repair expertise. We would not remove 41% of the value added. We would probably remove 100% of the value to the customer since the car would remain in disrepair and no customer would come to obtain that kind of service. What we see from this example is that knowledge segments applied at different work steps may be directly dependent upon another, and since they are not independent, they cannot be considered in isolation. They must be considered together as a chain.

We also need to consider the proficiency levels of the knowledge that is made available for each work task. From an overall perspective, the nature and quality of the handling of the work object in each work step are functions of the proficiency of knowledge, the diligence of the knowledge workers, the availability of resources, and the overall work process in the work step. In order to obtain the full benefits of active KM, we need to pay attention to all of these factors. We need to be vigilant in our pursuit of knowledge-related issues and opportunities and we need to ensure that other factors do not impede the realization of benefits. Similarly, we need to ascertain that knowledge does not become the bottleneck.

Part I

Shape the Future!

Chapter 7

Know-ledge Managenient Opportunities and Issues

Management's Role in Knowledge Management

Comprehensive knowledge management (KM) touches many areas of the organization in fundamental ways -- by providing new capabilities that make possible new strategies, by changing the way people work, by depending upon supportive incentives to share, use, and search for knowledge, by taking strategic advantage of knowledge-related capabilities, and in many other ways. Senior management must not only be generally supportive, they need to be convinced that these changes are highly desirable and must take active steps to make effective KM happen and, most importantly, direct the business to reap benefits from these initiatives. Many students of management have emphasized the need for such involvement, particularly Peter Drucker and Tom Peters.[1]

In order to "wrap their arms around" KM and what it entails, managers -- and everyone else -- need to have in mind a good and relatively simple model of what the concept covers and how it covers them. A simple model is presented in Figure 7-1. It focuses on three areas that many managers think of when they consider KM: gaining overview and understanding, distributing responsibilities to individual managers, and coordinating relevant efforts so they all pull in the same direction.

MANY AREAS NEED SENIOR MANAGEMENT INVOLVEMENT

In order for senior management to be able to steer and shape the organization to make it move in the desired direction, some of the knowledge-related areas they may become involved in include:

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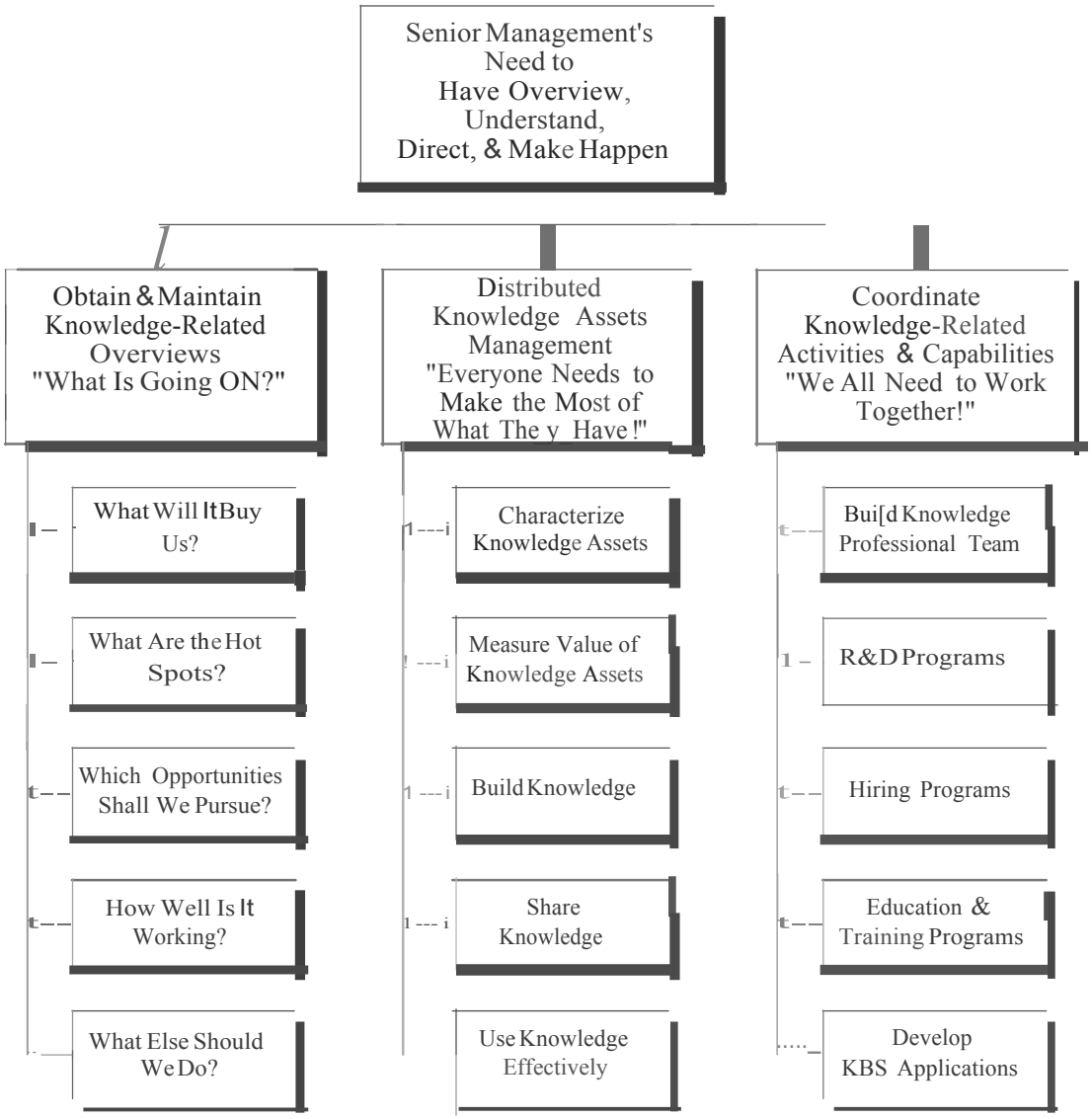
[1] Drucker (1993) Post-Capitalist Society and Peters (1992) Liberation Management.

Figure 7-1. Simple Model of What Knowledge Management Entails with a Few Examples.



- Obtain Corporate Overview and Set Priorities. One of the most important functions provided by KM is to provide broad overviews of knowledge-related issues and opportunities within the organization. Fully operational and comprehensive KM incorporates a large scope with numerous activity areas -- general organizational learning; specific R&D programs; knowledge repositories; verification and validation of appropriate knowledge; knowledge transfer activities such as training, education,

knowledge-based systems, and expert networks; and approaches to making extensive business use of the knowledge, to name a few.

Organizations have unique needs and resources. Hence, KM programs must be tailored to fit each situation. Senior management must obtain overview of the state of knowledge and the opportunities for KM-related work and must set priorities for the activities to provide the greatest business value while coinciding with long-term directions. Often, obtaining overview of the knowledge "landscapen is one of the first steps that management needs to take when introducing KM into its organization.

- Create and Direct Corporate Strategy t.o Facilitate Effective Knowledge Management. When organizational emphasis is refocused to pay explicit attention to knowledge it invariably introduces the need for changes. While major changes must be introduced in management and operational practices, the most important changes will be in redirecting the corporate strategy. For example, to take advantage of the new capabilities, strategic paradigms for products and customer services must be changed -- often gradually -- to reflect the new directions that are envisioned.
- Exploit Knowledge-Related Capabilities. The only reason to invest attention, time, and resources in KM is to provide significant value to the organization. To realize these values, management must shape products and services and the organization itself to take maximum advantage of the added capabilities that KM provides.

  It is not enough to accept passively that improved KM will lead to reduced operating costs and improved product and service qualities, which, in turn, will lead to increased market acceptance and sales. Instead, it may be necessary to change products and services proactively to reflect the added capabilities and to redesign business processes to streamline the organization.
- Allocate Resources. KM invariably competes with other initiatives for the corporation's resources, not only in terms of finances, but more importantly, in terms of highly qualified personnel. Senior management must step in and ascertain that appropriate personnel is assigned in addition to allocating budgets and other resources to the efforts.
- Require Department Managers t.o Manage Knowledge as Corporate *Assets.* Ifit is indeed true -- as most executives assert -- that knowledge is the organization's most important asset, then it must be managed as such! Managers at all levels must be made responsible for how well they invest in and build knowledge, how well they exploit it, how well they maintain it, and how well they ensure that it is being put to use. No organization known to us has started to measure "ROKA" (return on knowledge assets). However, it may only be a question of time before that will happen.
- Establish Policies for How t.o Manage Knowledge. Senior managers need to establish explicit policies for how knowledge should be managed. Such policies may address how unit, department, and division managers will be

measured on how they acquire (invest in and build), organize, deploy and share, and use knowledge. They may also address how employees at all levels will be judged on their handling of knowledge. Other policies may deal with establishing guidelines for how knowledge repositories will be organized and managed, approaches to transferring and deploying knowledge, and associated aspects of required infrastructure.

- Monitor How Well Knowledge Is Managed. The full value of KM and knowledge assets can only be realized when it is well managed throughout the organization. That must be ensured by senior management monitoring by means of specially designed measures.
- Create Incentives to SHARE Knowledge. KM requires that expert knowledge be widely shared, in one way or another. This focus must be supported by the formal evaluation procedures and in the other ways that employees are rewarded -- financially, through advancements, and so on. Yet most organization's personnel evaluation methods encourage and reward contributions by individuals rather than by teams.

  Consequently, implementation of KM often necessitates changes in the corporate reward system from emphasizing individual performance to rewarding whole teams.
- Create Incentives to USE Knowledge. It is far from obvious to most knowledge workers that they stand to benefit from taking advantage of the best knowledge practicably available to them. For example, they may sense that there are corporate, departmental, or peer-related disincentives associated with asking for help, with bringing in outside resources, and with anything that appears to reduce their self-reliance. In addition, they may not even be rewarded for delivering high-quality work when "good enough" is perceived to be the norm.

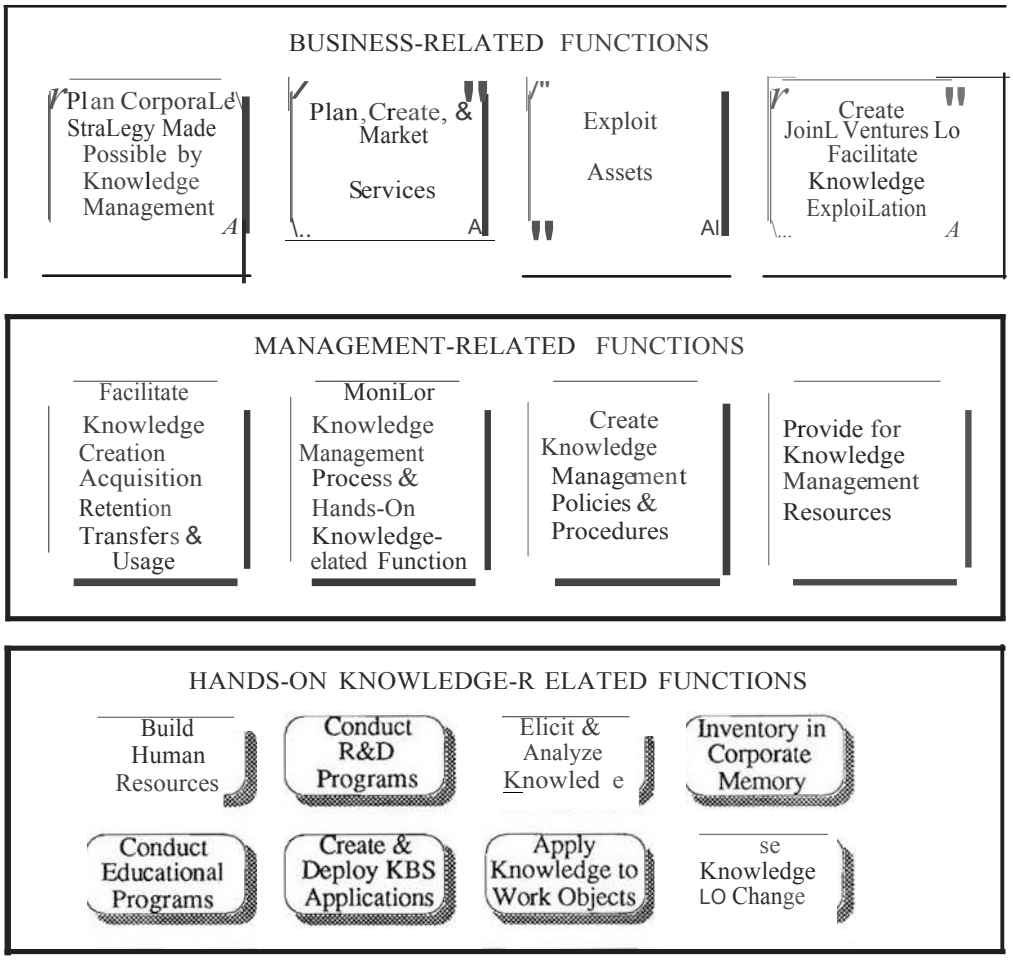
  It is senior management's function to ascertain that desired behaviors are reinforced through appropriate incentives.
- Build Infrastructures to Support Management of Knowledge. It is often difficult for professionals and middle management to justify creation of infrastructure, particularly when it is required to support activities that are of strategic rather than operational value, or when the benefits are indirect instead of tangible in the short-term. Justification is particularly difficult when many different initiatives are to be supported, each one too small to justify independently. Therefore, it becomes senior management's role to identify the overall value of needed infrastructure and to ascertain that it is implemented .

  KM infrastructure can range from putting into place well educated knowledge professionals, create knowledge repositories (knowledge bases with appropriate representational structures), to ascertain th.at corporate-wide workstation architectures will accommodate KBS applications for standardized deployment of expertise.

KNOWLEDGE MANAGEMENT OCCURS ON THREE LEVELS

Another perspective of the KM functions is that they take place on three different strategic levels. Some of the KM functions take place on the organization's business level, others on the management level Still others which are concerned with hands-on work with the knowledge itself take place on the level where all direct knowledge-related work occurs. Examples of functions on these three levels are listed in Figure 7-2.

Figure 7-2. A Three-Level Perspective of Knowledge Management..



The functions that occur on the business level focus on the business reasons for undertaking KM -- for example, using KM to create assets that can serve to

create better business products and services or can be exploited directly. The functions on the management level include such functions as facilitating and monitoring KM-related activities to ascertain that the business purposes are best served. Finally, on the direct knowledge-related level functions are all the "hands-on" activities that deal with the knowledge itself. It should be noted that KM practitioners and even many managers tend to focus narrowly on the hands-on level activities.

Corporate Knowledge Assets

One new issue that follows from these initiatives is the need to be concerned with how well corporate knowledge assets are managed. As indicated in Chapter 2, all CEOs surveyed on this subject indicated that knowledge was the most important asset within their corporations. Yet, they did not know how to manage it. Since KM deals in part with creating, maintaining, utilizing, and safeguarding knowledge assets, we must pay attention to and explore this area. Knowledge assets are also becoming the center of attention for many workers in the field of management.I

WhatIs Included inKnowkdge Assets?

Knowledge assets exist in many manifestations. The most prevalent and obvious manifestation is the knowledge that individuals possess in their mind. However, we find knowledge assets in numerous other manifestations as well, as indicated in Table 7-1. All these manifestations represent valuable assets.

Some manifestations represent knowledge that can be used directly, such as tacit knowledge in skills and habits or explicit knowledge in a person's mind. Technology, in the form of embedded knowledge is also normally directly useful. Other manifestations, however, such as knowledge in R&D reports or patents, may be intermediate, needing further transformations before they can be put to direct use. They nevertheless may be valuable assets.

Many others have started to define what may be included in knowledge assets. Thomas Johnson and Robert Kaplan2 suggest that knowledge assets --

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1Badaracco (1991) The Knowledge Link, Peters (1992) Liberation Management, Sakaiya (1991) 'The Knowledge Value Revolution, and Steels (1993) "Corporate Knowledge Management."

2 Johnson & Kaplan (1987). Relevance Lost The Rise and Fall of Management Accounting, p. 162.

or *knowledge stocks,* as they call it -- could include the firm's "know-how and 'know-why' of production processes that permit zero defect, just-in-time, and flexible production ... and it would also include the firm's superior performance characteristics." Karl Erik Sveiby and Tom Lloyd[1] suggest that in the know-how company the key resources are people, not financial assets or production processes. Jeffrey Wilkins[2] provides an interesting and focused discussion with case histories of what constitutes knowledge assets, how they relate to the organization's performance and accounting, and how they can be measured.

Table 7-1 Examples of Different Manifestations of Knowledge[3]

Tacit Knowledge	
• In skills and habits	• In simple classical conditioning
• In priming	• In nonassociative learning
Explicit Knowledge	
• In a person's mind:	• In books and written materials:
- in facts	- in production knowledge
- in events	- in functional and *systematic* knowledge
- in procedural knowledge	- in images
Implicit Knowledge	
• In historic records of past decisions	• In memoranda and R&D reports
Combined Explicit and Implicit Knowledge	
• In "Lessons Learned" reports	• Knowledge possessed by individuals
Procedural Knowledge	
• In computer programs	• In procedures manuals
Anecdotal Knowledge	
• Memory of particular "cases" in a person's mind	• Stories told as part of corporate folklore
Embedded Knowledge	
• In products and services	• In technology
• In organizational structures	• In patents and inventions
• In systems and procedures	• In cultural traditions

Given all the different manifestations and degrees of knowledge and our general lack of dealing explicitly with it, there may be some difficulties associated with both characterizing and evaluating knowledge assets. However, knowledge can be characterized by identifying its "type," "form," and its business use. The current and potential business uses define the immediate "business value" of knowledge and, as indicated in Chapter 5, it is

1 Sveiby & Lloyd (1987). Managing Knowhow, p.21.
2 Wilkins (1994) Understanding Knowledge Assets: Towards a New Framework.
3 This table is reproduced from Knowledge Management Foundations, Wiig (1993), p. 153.

often an incremental value in that the particular use of the knowledge involved may incrementally improve the value of the ultimate product or service.1

Professwnal KN>wkdge and Skills Can Be Categorized

Earlier, Figure 3-5 showed a typical example of the knowledge and skill profiles for a particular customer service knowledge worker. For that position, 12 "professional" knowledge areas and 12 skill areas were considered important. In most cases, competent knowledge workers need to be proficient in from eight to sixteen knowledge areas and to possess a similar number of skills. In our work, we focus more on knowledge than on skills since considerable attention normally is paid to skills and the associated needs for training to attain the desired levels. After the areas have been identified and characterized, both with regard to what they include and what it means to attain different levels of proficiency, it is possible to estimate one or all the investment costs required to attain that level, the value in terms of the monetary advantage to the organization, the market value, or the replacement value.

Total KN>wkdge Assets in a Departmen t and CumulatWn of Inveshnents

The knowledge assets we deal with can be found in many different forms, often making it difficult to track all of them. However, as part of normal operations, we find that we invest, often considerable amounts, to create new knowledge assets. The accountable manager is responsible for ascertaining tihat these investments are made wisely, that really valuable assets are built, and that they are utilized in the organization's best interest.

A particular asset that must be characterized is the knowledge that employees possess in their minds. Individuals hold extensive knowledge in many areas. Some are cumulated as part of general education, some are received through specific education and training funded by the organization, while others are obtained on the job. In this connection, we often think of six separate knowledge areas of importance for knowledge workers.

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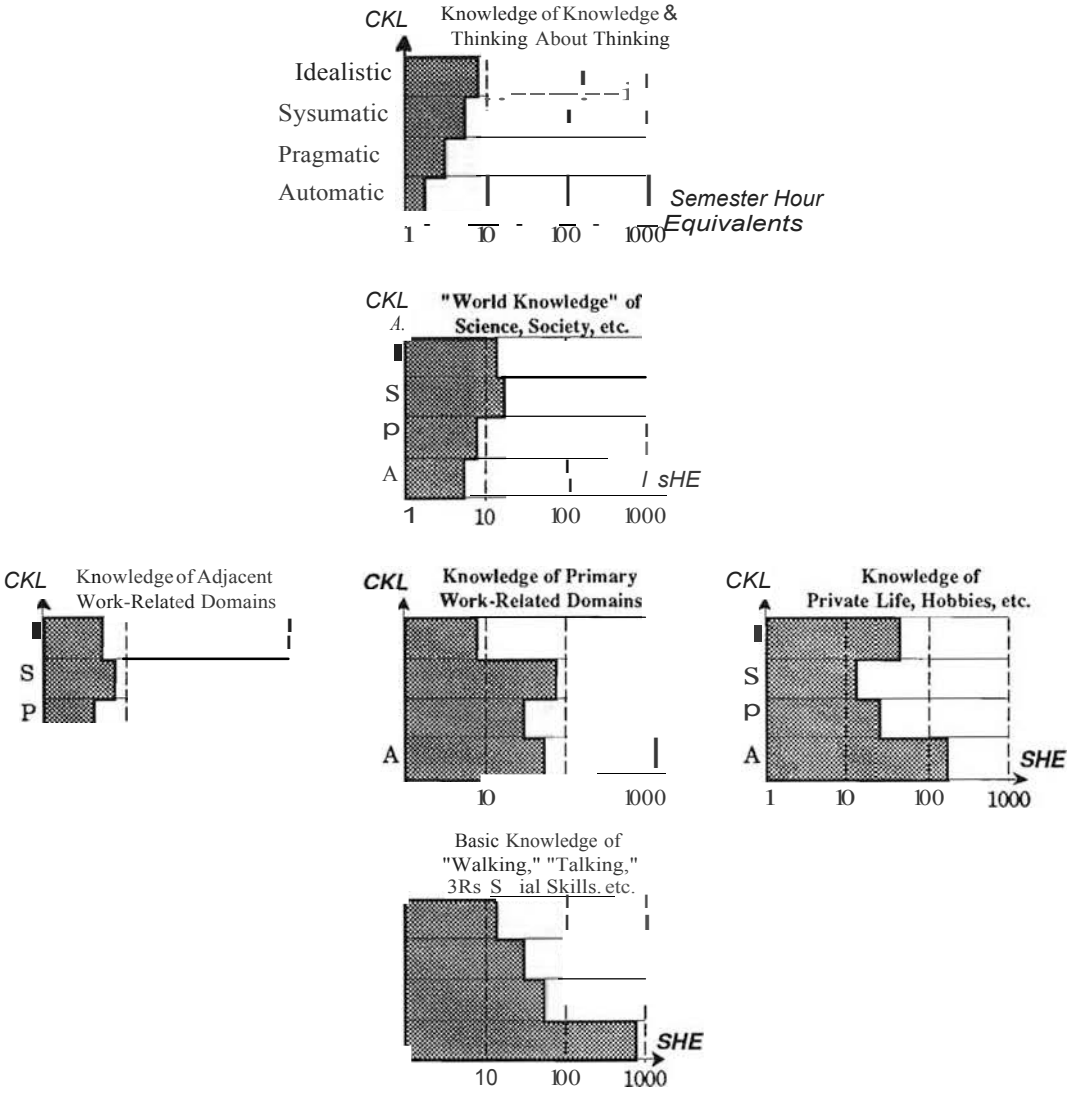
1 See Appendix A for definitions of knowledge types and forms. These characteristics are discussed in Wiig (1993) Knowledge Management Foundations, and some approaches to determining the particular types and forms are provided in Wiig (1994) A Knowledge Management Framework.

Figure 7-3. Example of Knowledge Held by a Hypothetical 26-Year-Old Competent Performer with a College Degree and 3 Years of Practical Work.1



An example of the amount of knowledge by possessed an individual on each conceptual knowledge level is indicated in Figure 7-3.2 The amount of knowledge is characterized by a high-level measure, the "Semester Hour

1This figure is reproduced from Knowledge Management Foundations, Wiig (1993) p. 140.
2 See Appendix A.

Equivalent," or SHE.[1]

An issue associated with characterizing the knowledge assets held by individuals deals with the amount of knowledge that may be considered to be particular to the organization -- above some threshold level that may be attributable to general education and life experiences.

Another personnel-related issue deals with the fact that people are different. Apart from having different knowledge and skills, as we discussed earlier in Chapter 3, people have different personal characteristics that make them more or less valuable for particular positions and work. The extent to which we count a person's unique and inherent personal characteristics as a knowledge asset may be questionable even though the particular characteristics are exceedingly valuable for the business function in question.

On Management of Knowledge Assets

It is far from clear to most what knowledge asset management (KAM) entails. A senior manager in a large organization characterized the general position quite well in the following statement:

> *"Sir, you are advising us to start with knowledge asset management. Right away the question arises: How do we do that? We hardly know what our knowledge assets are. We certainly don't know how to measure them, their value, or how much we have of them. And we don't know how to measure how well they are managed. We don't have any indicators; we don't have any guidelines to go by. All that has to be established. How on earth do we do that? To be able to manage assets throughout the organization, effectively and in ways that make sense, we need a whole machinery in place with incentives, policies, systems and procedures; with indicators that will allow us as management to monitor what and how well our different departments and divisions do, and that will allow them to find out what goes on and determine how well they are doing and where they should focus their attention. All of that has to be created. It is going to be*

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1 We often require to express the *amount* of knowledge present or needed. A convenient, qualitative measure is the amount of *knowledge retained* by a B+ student in one semester hour -- the SEMESTER HOUR EQUIVALENT, or SHE. That means that the knowledge retained in a one-semester course equivalent is 3 SHE, over 100 SHE (amounts to 1,600 classroom hours and over 3,000 exposure hours) in a full college education, and so on. For mucisians it has been established that 5,000 hours of playing an instrument is required to be accepted at a good music school while 10,000 hours of play is required to become a professional musician. We may not require such serious proficiency for professional business performance -- no wonder that we often see numerous errors being made!

quite a change! How do we actually go about that in a way that makes sense? Since you are recommending it, you may be able to tell us good ways of doing it. Otherwise we are just wasting time! The ffoor is yours. Go ahead, tell us!"

This statement is challenging since every organization and its needs and requirements are different. Thus the way the organization shapes its own variation of KAM will by necessity be different from what others have done, but should be based on the best understanding available.

However, to start responding to this fundamental request for guidance, let us first revisit the objectives of KAM. The basic objectives are to let individual section, department, and division managers have responsibility to build knowledge, organize and keep it, deploy it to those that need to know, and make sure that it is used to the organization's best advantage. In addition, there are lesser objectives such as making sure knowledge does not fall into wrong hands.

What the managers really would like, is to devote as much capital, effort, resources, time as is prudent to get the best return for the investments. However, to develop some of the knowledge assets will not cost moneys. These assets essentially are "freebies" such as when people learn on the job and when experiences accumulate from special and unusual situations. In that case, KAM becomes important because it deals with preserving these freebies, taking advantage of them, and making sure that the "lessons learned" stay around for when they are needed the next time.

The Scope of Krwwledge Asset Management

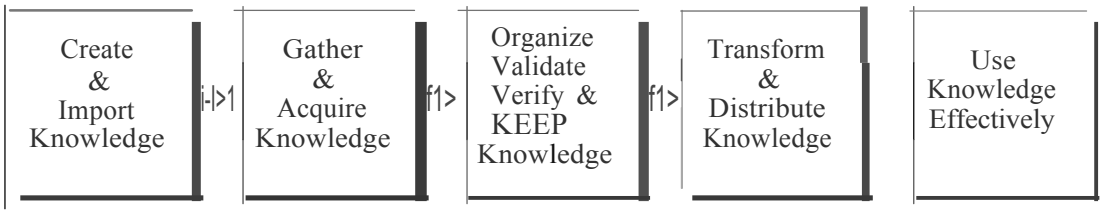
One way to define the specific scope of KAM is to describe it in the form of the "KAM pipeline" indicated in Figure 7-4. The pipeline follows the knowledge assets from creation to their useful application to work objects. A significant function of KAM is to keep -- that is, not forget -- valuable knowledge. The major function, however, is to ascertain that the knowledge assets are put to use in the organization's best interest.

Knowledge Asset Management Indicators

We need to have good indicators and measures for how well assets are managed. However, the diverse nature of knowledge assets make it virtually impossible to have a single, uniform indicator similar to measuring returns of

other types of assets. Instead, different types of knowledge assets will need different indicators, and different aspects of management might need different ways of viewing them.

Figure 7-4. The Knowledge Asset Management Pipeline.



There is one major problem with having separate indicators for how well knowledge is built, distributed, and used. That is that we really do not realize the value of knowledge building and distribution until knowledge has been used effectively in the end. In other words, a manager who works very hard to build knowledge but does not distribute it well and certainly does not end up using it well, is not serving the organization well and may end up being accused -- rightfully so -- for hoarding knowledge and failing to do anything with it. Another manager may pay little attention to building knowledge but may make absolutely sure that whatever knowledge is available is used very effectively. This manager may actually be more valuable to the organization than the former even though s/he may forego opportunities for building knowledge and much of what her/his people has learned may be lost and forgotten.

To be successful, KAM requires a balanced emphasis on all the areas, perhaps with an extra focus on the *use* of knowledge. As a result, we may wish to start with indicators for how well knowledge is used. Before we design this indicator, let us review very briefly what it means to "use knowledge effectively."

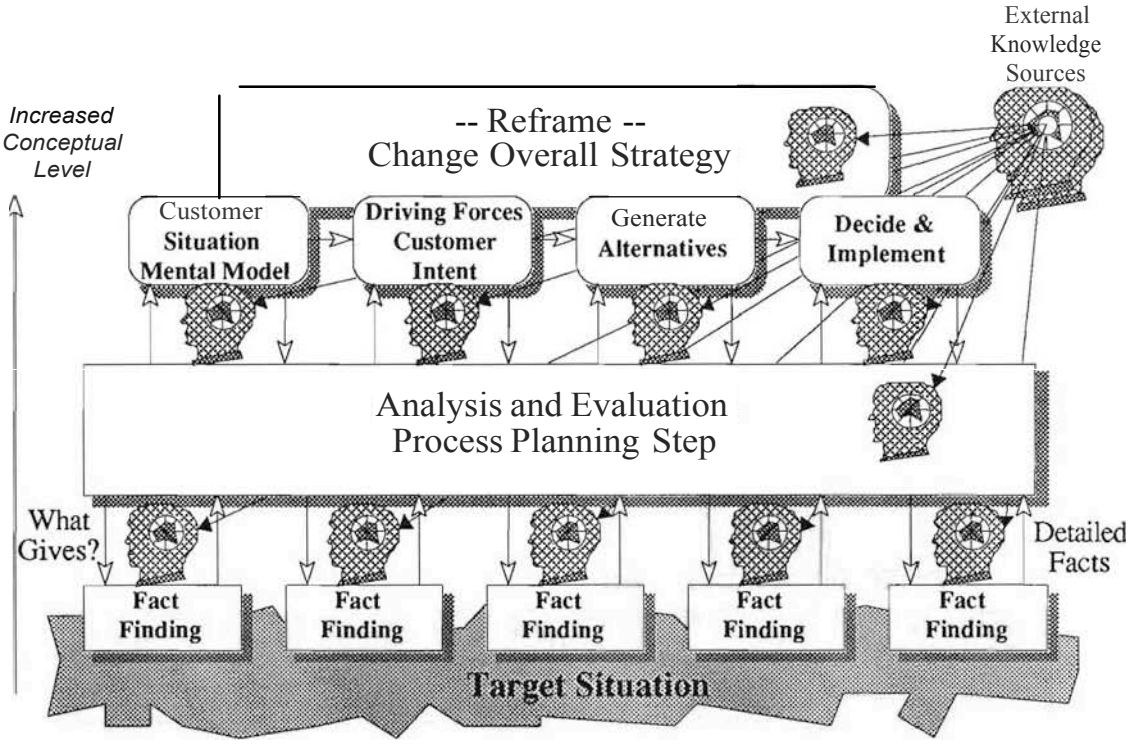
WhatDoes It Mean to UseKnowl.edge Effectively ?

First, we need to recall the model depicted in Figure 3-1 for how experts deal with situations. We can add knowledge flows to this model and portray it as in Figure 7-5. As indicated, experts consult their own and other, often external, knowledge sources to deal intelligently with difficult situations and complex cases. They draw upon all relevant knowledge sources to act

intelligently as the situation demands and time and other resources permit. They exploit their network connections, consult documents and KBS applications, and otherwise try to ascertain that they obtain and pool the best knowledge to deal with the situation. Effective use of knowledge assets leads to intelligent but depends upon two major factors.

The first factor -- pertains to the extent to which knowledge is pooled from e:xpert networks, outside specialists, coworkers, reference documents, and so On. Pooling also includes consulting KBS applications from personal workstations, using available manuals, support documentation. and recalling personally possessed knowledge.

Figure 7-5. Experts Draw Upon Knowledge Sources *t.o* Deal with Complex Cases.



The second factor -- once pooled, knowledge must be applied effectively to the situation at hand. Application of available knowledge can be very effective when the knowledge worker -- or another active agent such as an automated computer function -- takes all of it fully into account and reasons correctly with

it. However, it can be equally ineffective when only arbitrary parts of the assembled knowledge are selected and used or reasoned inappropriately with.[1]

The degree to which either of these factors are executed optimally is difficult to make explicit. Effectiveness of knowledge use, therefore, often becomes a subjective or judgmental assessment that at times may require in-depth study. Nevertheless, it is an important yardstick for managers who wish to identify how well their associates utilize the knowledge assets available to them.

HOW CAN WE MONITOR KNOWLEDGE ASSET MANAGEMENT?

There are many approaches to assessing the effectiveness of KAM. One approach discussed below is to devise specific knowledge-related performance measures. Another approach is to use existing performance measures that capture aspects of knowledge-affected performance. Examples include measures used for total quality control (TQM), continuous improvement or learning, and even conventional efficiency measures such as unit costs.

The major behavioral outcome of effective knowledge use is the degree to which the organization acts intelligently to deal with routine and special situations. Given a detailed model for intelligent-acting such as that presented in Table 1-1, it is possible to devise performance measures based on some of the factors.

There Is a Prob'lem with Indicators

Indicators and performance measu res do not capture everything of importance in an operation. Typically, they cover only those aspects thought to be significant and indicative of desired operations given the organization's "bottom-line" objectives. For example, in a service orga nization, one operations performance indicator for customer service organization may be the unit cost of servicing customer calls, another may be the quarterly customer service satisfaction survey summary, while a third may be number of customer complaints in a month, and so on.

These and other indicators portray a fair amount of the operating performance. However, they do not explain all aspects of the unit's overall

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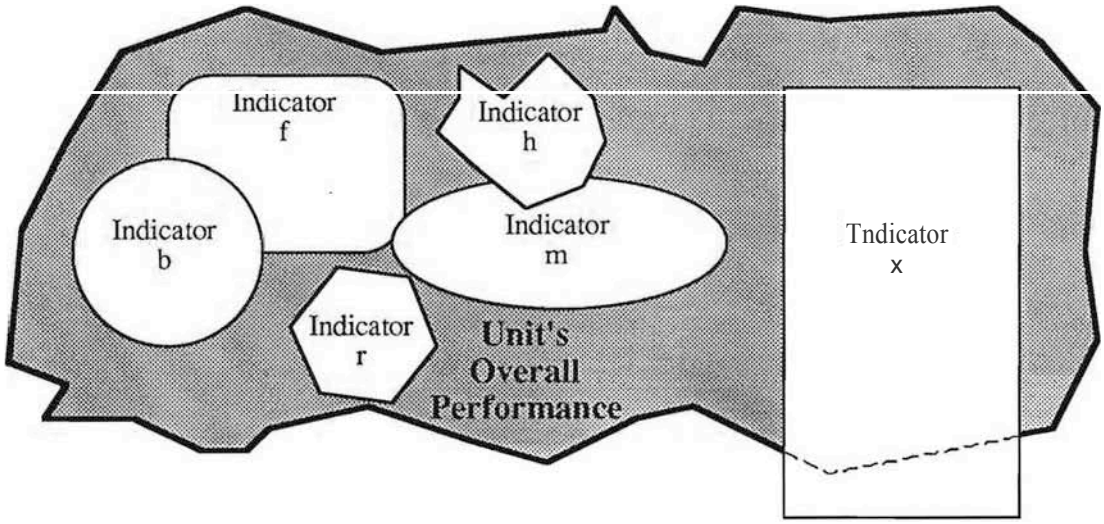
1 Effective and ineffective use of knowledge for reasoning, problem solving, and decision making is discussed in Chapters 7 and 8 of Knowledge Management Foundations (Wiig, 1993).

performance. Additionally, some indicators reflect factors that may have nothing to do with the performance under study. This is illustrated schematically in Figure 7-6. As an example, in one organization it was found tlhat the commonly used customer service effectiveness indicator, the unit cost of servicing a customer call, was totally invalid as an indicator for the quality of service provided.

By their very nature, indicators and performance measures are simplifying projections of the complexity of the operations. They are designed to aggregate effects while ignoring the actual mechanisms that are at work. For example, unit operating cost is an excellent indicator, but it does not cast any light on what happens in the operation to make the particular value happen. Only in-depth analyses can make that apparent.

When implementing KAM, this situation is further complicated because the basic objective of effective KAM is to improve the overall performance of the whole organization, which interacts extensively with many other factors.

Figure 7-6. lndicat.ors Do Not Tell All.



PERFORMANCE MEASURES FOR KNOWLEDGE ASSET MANAGEMENT

A wide variety of performance measures may be established for KAM. Some are quite simple and require little effort to assess and interpret. Others may require considerable insight and much effort to determine on a periodic basis. The more complex measures may also be difficult to interpret at a

glance, which many managers would like to do.

However, the more complex knowledge-related measures have additional benefits that can be quite important for the manager. By having to assess the value of a measure such as the quality of knowledge assets, the manager obtains valuable insights into the current status and how to deal with it.

Examples of Potential Knowledge Asset Management Measures

To illustrate potential KAM measures, we distinguish between measures that portray existing knowledge assets, knowledge inventories, knowledge-building, knowledge preservation, knowledge deployment activities, and how knowledge is used. Some examples of potential measures are:

Knowledge Inventory

- Knowledge assets
  - -- Categorization of all knowledge assets within the unit's domain1
  - -- Overview of quality of knowledge assets (as in Figure 7-7) with implicit or explicit indication of how well the unit's operating scope is covered by the knowledge assets
  - -- Detailed assessment of knowledge asset quality for each category
  - -- Assessments of the business value of individual and total knowledge assets

Knowledge Building

- Investments in building knowledge assets
  - -- Percent of time devoted to lessons learned and other "nonproductive" learning-on-the-job activities
  - -- Percent of operating budget used to support lessons learned functions, R&D and exploratory activities, importing knowledge, etc.
- Activities of knowledge asset building
  - -- Descriptive summaries of specific activities, their objectives, results, methods, resource requirements, etc.
  - -- Plans for continued knowledge asset building

Preserving Knowledge Assets

- Extent of knowledge asset repositories
  - -- Descriptive summaries of existing knowledge repositories, their contents, organizations, methods of access, availability, and so on
  - -- Plans for extensions of knowledge repositories

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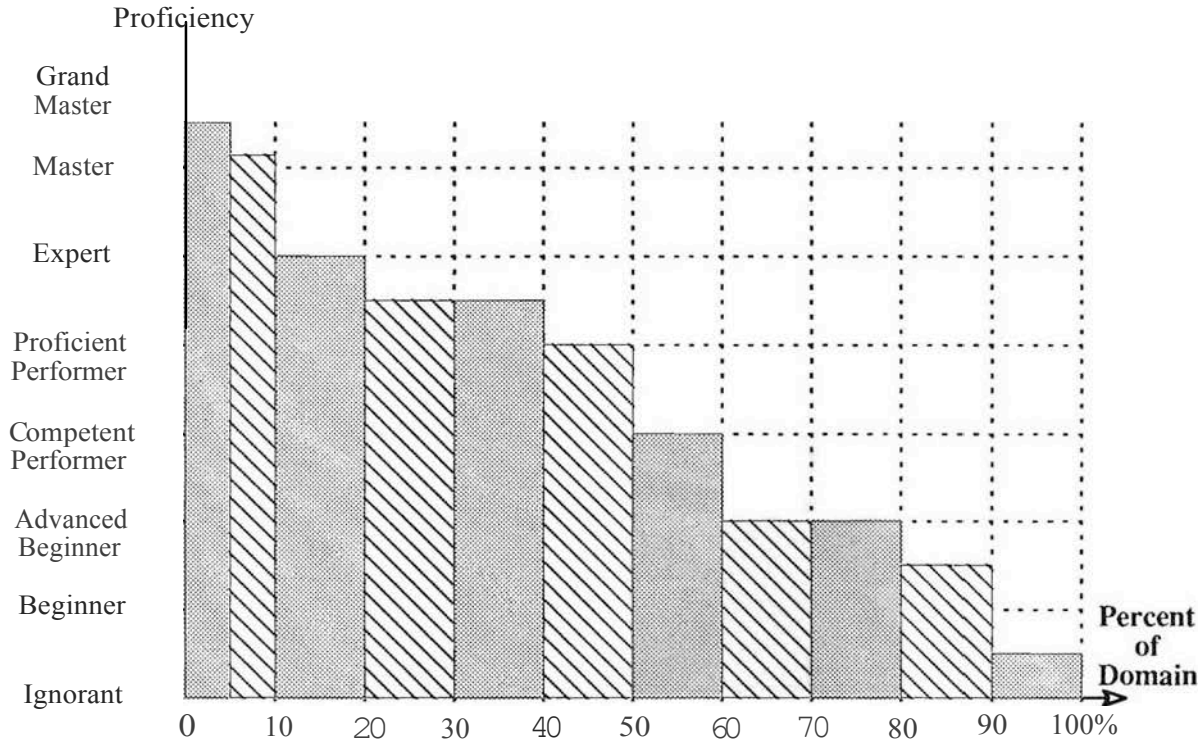
1 Knowledge asset categories within the domain are often defined to the detail levels of Knowledge Section (see Appendix A). Rarely are they defined to the levels of Knowledge Segment or Reference Case levels as that would lead to very large numbers of categories.

Figure 7-7. Overview of Knowledge Asset Quality across the Domain.1



- Security of knowlede assets

Deployment

- Investments in knowledge deployment and knowledge sharing
  - -- Percent of time recipients devote to education and training
  - -- Percent of operating budget used for knowledge deployment (e.g., education, training, development and deployment of KBS applications, needed infrastructure, etc.)
- Distribution or concentration of knowledge assets
  - -- Assessments of where knowledge assets reside -- in inanimate repositories, single

1 Each bar represents the quality of several knowledge categories that may be labeled in the graph. The quality of knowledge assets is obtained by qualitative assessments of each knowledge category. The percentage of the domain is obtained by judgmental assessment of the business value fraction that each category contributes to the overall departmental function which the domain serves.

In this example, there were 20 knowledge areas, each judged to be 5% of the total. Normally, all bars would be labeled to identify the knowledge area they represent. Also, the graph shown indicates the "effective" proficiency within the group. (Of the groups' 24 people, two had better than Master proficiency. Since the work required only one or two experts in that area, the "effective" proficiency was judged to be at the Master level.)

individuals, concentrated groups of experts, knowledge workers at points-of-action, or automated facilities (KBS applications, for example) ubiquitously available, etc.

- Activities of knowledge transfers
  - -- Descriptive summaries of specific knowledge transfer programs and activities, their objectives, results, methods, resource requirements, and so on.
  - -- Plans for continued knowledge deployment

Knowledge Use

- Pooling of knowledge
  - -- Availability of expert networks
  - -- Description of knowledge pooling options
  - -- Knowledge pooling practices and incentives
- Application of knowledge
  - -- Quality of knowledge work

MEASURING RETURNS ON KNOWLEDGE ASSETS

The potential for measuring return on knowledge assets (ROKA) in one way or another is important. As discussed in Chapter 6, such information would allow distribution of personal responsibility for creating, maintaining, and utilizing the organization's assets similar to management's responsibility for other assets. However, several issues need to be resolved by the organization before that can happen. One approach is to measure the monetary value of returns from the use or sale of knowledge assets relative to its "book value."

To make ROKA a reliable and good measure requires establishing acceptable methods to characterize the knowledge and to evaluate its monetary effects on operation and business. A few related issues are discussed below.

Book Value of Krwwledge -- CapitaUzation of Krwwkdge Assets

Establishing the initial "book value" of knowledge assets requires procedures that may be unique to each organiza tion. A relatively simple approach that may be appropriate for some knowledge is to assign as the book value the investment required to create it. That may be acceptable for such knowledge assets as the shared understanding of the corporation's methods for dealing with customer complaints in its 100 customer service representatives. In this case, the corporation may have invested a known amount of moneys in eliciting and organizing the knowledge, preparing

training courses, conducting the training, and providing follow-up refresher courses. It may consider these investments to be the total value of the knowledge.

For other knowledge, such as these individuals' understanding of how to "navigate" the organization, there may not be a clear cost to building the knowledge. They may have learned the important and valuable expertise on-the-job at no discernible cost to the organization.1 This issue becomes more pronounced when considering knowledge of a production process, for example, that has been built gradually over years or decades of on-the-job experience, perhaps augmented with exchange of lessons learned from coworkers and with outside expertise. It may be impossible to assess the "investment" that has created this knowledge. Still, it is of significant value to the organization.

A second approach to assessing the value of such knowledge is to estimate the monetary advantage to the organization of having the knowledge available and being able to use it when required. Another is to estimate its market value -- the price that such knowledge would command if sold or purchased in the open market. A fourth approach is to estimate what it might cost to create the knowledge anew from a defined threshold knowledge level -- the replacement value.

Valuation of Inventions, Patents, and Unique Produ.ets and Their Byprodu.ets

Most organizations will have little difficulty assessing sunk cost, or even market value, of special assets such as inventions, patents, and proprietary products. Frequently these assessments are made only for the products themselves while other associated knowledge assets are typically ignored. For example, when a drug company develops a new prescription drug, patents it, and obtains FDA approval for specific uses, the company may assess the value of this asset as its investment in R&D, clinical trials, and all the other sunk costs associated with creating a marketable product. Normally, the company does not consider as part of the asset's value the associated knowledge that has been developed along the way. Typically, specific additional knowledge will have been developed about potentials for other drugs, new understandings of techniques for creating and analyzing complex molecules, and many other

1Some organizations note that they indeed make investments of reduced job performance while individuals learn, i.e., build their understanding of how to navigate the environment.

side benefits. These assets are often ignored, or at most considered implicit parts of the organization's general capabilities.

We are not suggesting that these knowledge assets be valued as part of inventions, patents, or unique products. Instead, we are suggesting that the general capabilities they represent be assessed explicitly as part of the portfolio of knowledge assets that the organization possesses and benefits from.

Depreciation of Knowledge •.Jlea], and Accounting Life of Knowledge

Another issue associated with using ROKA as a measure is the need to evaluate the change over time in the value of the various knowledge assets. Personal and corporate memories alike deteriorate if the knowledge is not used. We forget -- the associated knowledge decays and loses its value. On the other hand, knowledge assets that are used constantly increase in substance as well as value -- often without additional investments since the intelligent-acting knowledge worker or organization innovates and creates new and better approaches to achieve the work goals.

Another factor is the effect on the value of knowledge assets of its current or competitive value. Much knowledge becomes outdated as the world changes. For example, reorganizations may make organizational navigational knowledge obsolete and with little value. Rebuilding a production line or introducing new products may invalidate previously priceless knowledge. In other words, knowledge may depreciate or appreciate in value (similar to the value of an organization's market image) depending upon the circumstances. As a result, its value may need to be reevaluated periodically instead of determined by use of predetermined or standard depreciation or appreciation formulas.

The "Clincher" of ROKA - Estimating Returns from Use of Knowledge

If we choose to use ROKA as a measure of management effectiveness, we need to identify how the realized value of knowledge assets should be assessed. The value of knowledge assets is often implicit and benefits of their use may be intangible. For example, improved customer service expertise may result in greater customer service satisfaction that in turn may lead to greater sales and later, greater profits. The monetary return from particular knowledge assets in this context -- expertise in identifying what the customer situation is and what the customer needs, for instance -- can be estimated within

acceptable brackets of uncertainty. However, methods for estimating returns may in some situations become both elaborate and cumbersome. Instead of using monetary estimates, it may be acceptable to substitute subjective, well delineated measures.

It is no longer sufficient to use the narrow perspectives of considering only direct and tangible benefits. As emphasized in Chapter 5, obtaining estimates of the value of knowledge-based activities and knowledge assets requires explication of longer term and indirect benefits. It is necessary, therefore, to establish methods that permit formal use of event chains and subjective (responsible managers' best) estimates of the benefits to be realized by particular knowledge assets -- both before they are put to use and on an after-the-fact basis.1

A simplified measure of how effectively knowledge assets are used may be obtained by considering only the return on investments made instead of broader value considerations as indicated above. Accounting for knowledge-related investments is simpler than including in the total asset value the market value, replacement value, and other value estimates. Return on knowledge asset investments (ROKAI) may be used when this approach is selected.2

RETURN ON KNOWLEDGE AsSETS ALONE IS INAPPROPRIATE

Measuring knowledge asset management effectiveness by ROKA or ROKAI alone may not be very helpful and it may actually be totally inappropriate. Crafty managers will realize that by holding asset measures low while maximizing the benefits of their use may bring a better score than investing in additional knowledge (which makes the denominator greater, thereby requiring greater returns from knowledge to create the same score). Thus, use of ROKA or ROKAI by themselves may lead to undesirable and short-term profit milking.

It is also inappropriate to use ROKA or ROKAI alone because it is vital to manage important assets that may have no book value or required no discernible investments. This is similar to the need to manage fully depreciated machinery that still performs central manufacturing functions on

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1 Additional discussions of the use of event chain considerations and subjective benefit estimates are provided in Wiig (1993) and Wiig (1995).

2 Sveiby & Lloyd (1987) in Managing Knowhow suggest that a potential realistic measure might be return on knowhow capital.

a major production line. An example of a knowledge asset of this type is the unique diagnostic expertise of a particular employee who has accumulated a deep understanding over a long tenure with the company. Another example is the customer understanding and handling expertise that a team of customer service reps have gradually built over several years by learning on-the-job. These knowledge assets must be managed skillfully to ascertain that the organization continues to derive value from them.

Instead of ROKA or ROKAI, it may be desirable to use additional knowledge asset-related measures that by themselves describe how well managers build knowledge (for example, through on-the-job learning or lessons learned programs); have their employees share knowledge with others; and describe other relevant factors. The important measures will vary with the circumstance and business of the organization and its management focus. Hence, a financial service organization may emphasize knowledge building and sharing in the customer service ranks while a high-technology firm may wish to emphasize development of new technology solutions and their successful embedding into new products.

Jeffrey Wilkinsl discusses several measures ("Tobin's q" and return on capitalization of net R&D and training). He proposes as an improved metric for the value of knowledge assets "the net present value of the incremental cash flows associated with the best and fullest deployment of knowledge."

The Chief Knowledge Officer

The concept of "Chief Knowledge Officer" (CKO) has emerged in response to the questions of how knowledge can best be managed in the organization.2 After it has been accepted that knowledge is the foundation of the organization, it becomes evident that all aspects associated with knowledge must be managed coherently and effectively with deliberation, purpose, and constancy. Within that context, it makes sense to consider what the purpose and scope of a CKO might be. Tom Peters provides an interesting perspective of the role of

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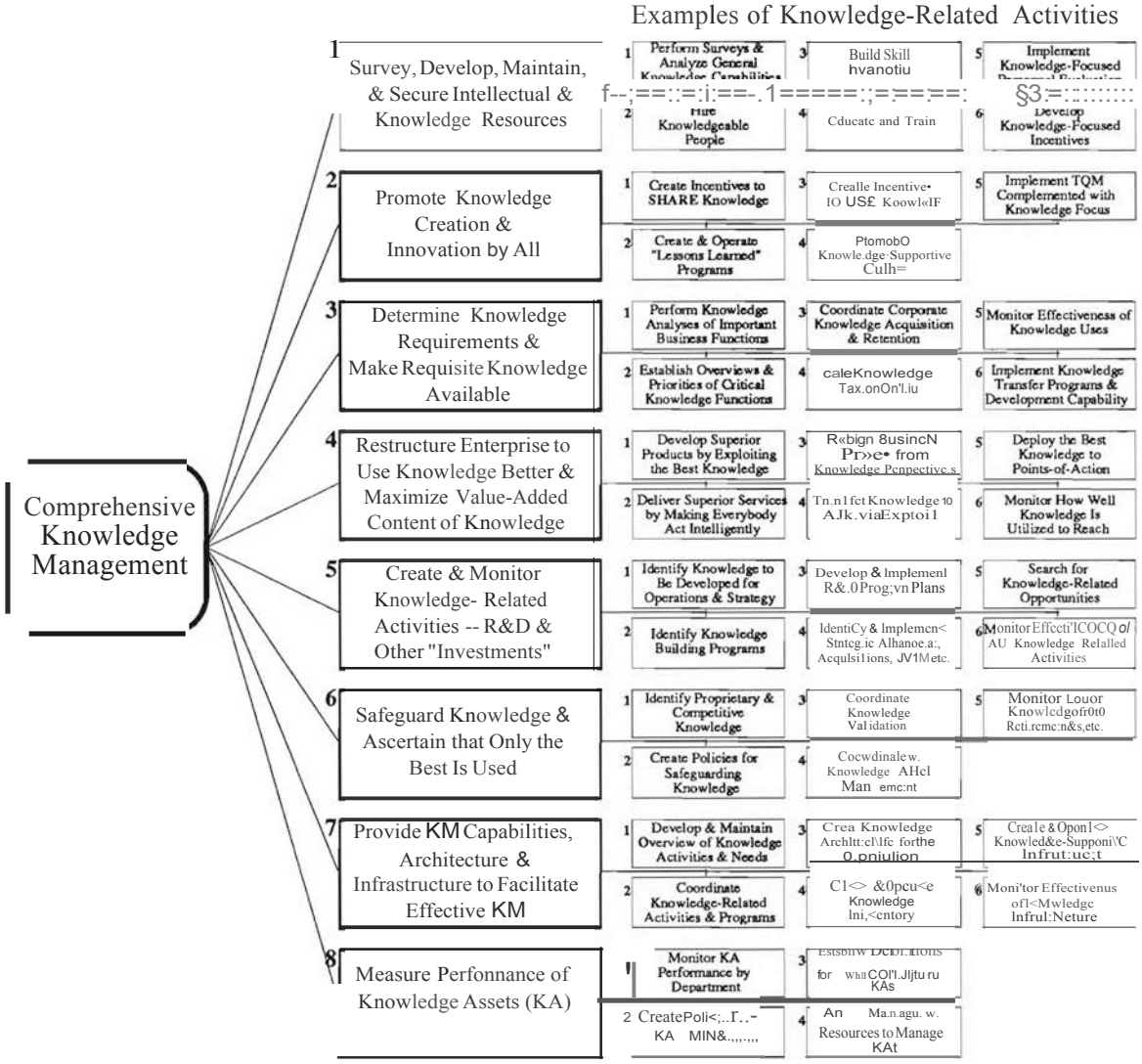
1Wilkins (1994) Understanding Knowledge Assets: Towards a New Framework.

2 David Hertz in The Expert Executive (1988, pp. 45-47) broaches the need for advanced organizations to start thinking about a Chief Knowledge Officer whose function it would be to focus the knowledge-related activities in the organization. This notion has been discussed informally by several organizations since. However, to our knowledge no one has instituted this office as yet.

Figure 7-8. Focus Areas for Comprehensive Knowledge Management..



KM within the organization -- and thereby the role of the office of the CK0.1

1Tom Peters (1992) in Liberation Management devotes four chapters to the functions of KM under the general heading of "Knowl edge Management Structures." The chapters provide an interesting overview of Peters' perspective of KM. Their headings are: "Taking Knowledge Management Seriously," "Getting Physical," "Knowledge Bases, Expert Systems, Computer-Augmented Collaboration, and the Potential of Information Technology," and "Developing and Tapping Expert Power in the Hierarchy-less Organization."

THE CHIEF KNOWLEDGE OFFICER'S SCOPE

In Chapter 1, we summarized the scope of comprehensive KM by describing eight focus areas. These are illustrated in Figure 7-8 along with selected examples of relevant knowledge-related activities.

These focus areas and activities define a comprehensive scope that affects all aspects of an operation -- even more so than the information system activities that occupy a central support and infrastructure role in most companies. As a result, if the KM oveew activities (#1-1, 3-2, and 7-1 in Figure 7-8) is the responsibility of one management function, it may be desirable to place that function close to the top of the organization.

To a large extent, the scope of the CKO function should focus on enabling the rest of the organization to practice KM efficiently and effectively as part of its daily operations. However, due to the long-term and competitive aspects of building and exploiting knowledge it is also important that the scope of the CKO function supports the strategic and long-term planning functions and other strategy setting bodies.

POTENTIAL CHARTER FOR THE CHIEF KNOWLEDGE OFFICER

The CKO's charter is likely to be quite broad and may involve a number of responsibilities, many of which need to be coordinated closely with both the CEO and the COO. In fact, since most executives agree that knowledge is the organization's most important asset and that it must be managed creatively, these officers should not only **coordinate** their knowledge-related activities with other offices and departments, but, as all chief officers, they should **collaborate** to create the best solutions for the organization.

The CKO must also collaborate with several staff functions (Human Resources, Organization Development, Information Services, R&D, Management Sciences, Quality, and so on.) and department and division managers throughout the organization. In some organizations, some of the central staff functions may ultimately come under the direction of the CKO as a natural outgrowth of the responsibilities of that office.

Essentially, the CKO's charter should primarily focus on making KM part of the organization's accepted culture and monitor its effectiveness. Initially, that will require extensive "missionary" work to create the correct environment and have it accepted by practitioners. Later, it will require

continued focus on improvement of the KM capabilities and practices. To meet these goals, the CKO must provide a "tall" KM planning framework as described in the next section designed to build a cohesive strategy that bridges the visions of executive management with the strategies and tactics of middle management and the approaches and detailed work of the knowledge workers at all levels.

A "TALL" KNOWLEDGE MANAGEMENT PLANNING FRAMEWORK

Strategy setting covers broad activities with joint collaboration by executive and middle managements and by professionals and other knowledge workers. All these individuals need to provide inputs and expertise -- each on their own organizational level -- in ways that are efficient and permit extensive "buy-in" while allowing considerable creativity and flexibility.

Table 7-2 illustrates a simple framework that allows each party to contribute to corporate direction and formulate and implement the strategic thrust within their purviews. It identifies the nature of different elements of the corporate direction and provides a few abbreviated examples of the nature of the content that typically is included within each planning element. This simple framework is easily expanded to cover quite large scopes and helps communicate and explicate the thrust both upwards and downwards.

The framework is built on Peter Drucker's management model in which each management level deal with external inputs that create a desired state (visions, objectives, guidelines), actions to achieve the desired state (policies, strategies, activities), and end results or deliverables (goals, tactics, work products). Monitoring functions and controls are not included in this table.

Corporate direction is created by explicating a strategic thrust for each focus area on the lower levels, perhaps following from a single vision on the highest level. The corporate direction is typically developed over time by cycling or iterating the planning issues and directions through all levels involved. This allows each party to create the best approaches and solutions as they build joint understanding and insights. The result is a comprehensive and flexible plan that spans from executive visions to practical activities while outlining expected work products and deliverables.

Knowledge workers need to perform two roles in this process. In addition to detailing the tactics into guidelines, detailed activities, and so on., they must provide their managers on all levels with understanding of, and insights into, what KM can do for the organization and what it can do from other

Table 7-2. Example of a Knowledge Management Planning Framework.

EXECUTIVE MANAGEMENT:

Visions

- For our organization to excel, we need to make it act intelligently; effective KM must be the primary vehicle for making that happen
- KM will help us build and use knowledge and information better to become more productive and creative, develop new products and services, reduce internal costs

Policies

- Create KM capabilities with emphasis on building and organizing knowledge and information and make it available to all who need it to perform their tasks as well as to become broadly aware
- Incorporate intelligence-related perspectives in all relevant functions

Goals

- Within the next year, we will have completed the first KM activity or project
- Within one year, we will have a comprehensive plan for KM introduction; that plan will be integrated with other corporatewide programs and tluusts

MIDDLE MANAGEMENT:

Objectives

- We will become acquainted with KM concepts, opportunities, benefits and approaches
- We will acquaint ourselves in-depth with the Threats-Opportunities-Weaknesses -Strengths of the present state of knowledge within the organization and with opportunities and methods for improving

Strategies

- Explore and conceptualize potentials for improving operations
- Start planning for permanent KM practice
- Build KM implementation plans with involvement of people at all levels and from all functions
- Start designing and shaping concepts for operations and doing business with KM emphasis

Tactics

- Build a professional KM core group to provide central resources for intelligence-related work
- Hold KM information seminars and meetings and start interest groups
- Start programs to survey decision-making and work practices to identify general opportunities
- Bring in outside experts to spearhead KM introduction process and train and monitor

PROFESSIONALS AND OTHER KNOWLEDGE WORKERS:

Guidelines and Authorized Methods and Procedures

- Provide guidelines for identifying which areas and situations to focus on for KM-related work
- Provide recommendations for methods and approaches for relevant types of KM projects
- Include KM concepts and approaches in all new systems and procedures

Detailed Activities

- Survey, analyze, conceptualize, and implement improved management of Critical Knowledge Functions, Knowledge Flows, and Knowledge Resources
- Support functional redesigning and QFD with KM approaches
- Build KM core group and educate and train other practitioners

Work Products & Deliverables

- Educated knowledge workers
- Completed KM projects
- Changed knowledge flows and reduced knowledge bottlenecks in many areas
- Increased codified knowledge and better deployment of knowledge and reasoning capabilities
- Continually expanding knowledge architecture

perspectives -- with particular focus on how business and operating practices may be improved. As shown in Figure 8-2, the knowledge workers need to act as methodology and solution resources to help their superiors develop the background required to formulate their managers' visions to related strategies.

Another important aspect that this framework supports is identification and detailing of companion activities. Many -- if not most -- significant strategic KM opportunities require implementation of other activities to take advantage of the capabilities that are provided by the KM project. These companion activities also need to be conceptualized and incorporated as integral parts of the strategic thrust by the parties responsible.

Knowledge Management Is Integral to Other Activities

For us to consider how KM relates to other activities, we need to review what KM is. Simply put, it is managing to acquire and cumulate ("build") the right knowledge and expertise within the organization; verify and validate it; make it available to all relevant points-of-use; motivate its diligent use and otherwise exploit it as appropriate; ascertain that it is safeguarded; and create an environment and infrastructure that support these functions.

A number of programs and activities within the organization rely on the effectiveness of knowledge-related activities. Although intelligent behavior on the part of all personnel is a prerequisite for the success of any of these programs, it is often an assumed and neglected capability. As an example, the success of efforts to flatten the organization depends on how knowledgeable the people are who need to take on new responsibilities. Similarly, TQM programs depend on the extent and quality of knowledge available to workers who are asked to analyze, manage, improve, troubleshoot, and correct their own situations. Improved customer service is a function of how well requisite knowledge is made available to the point-of-action. And most of the 12 competitive factors listed in Table 6-4 also depend significandy on superior knowledge -- and its management -- to provide high-quality and excellent availability of knowledge, and improved ability of knowledge workers.

A simpleminded model for how KM may relate to other organizational functions is based on the notion that success of all functions and initiatives is directly dependent upon the quality of the knowledge assets that are made

available. As a result of this view, KM is a natural extension, and an integral part, of many other activities in the organization.

Management Initiatives and Knowledge Management

Many focused management initiatives are of great importance to progressive organizations. Most of these initiatives depend on the effectiveness of knowledge-related activities, and the intelligent behavior of all personnel is a prerequisite for their success.1 Yet, in spite of its agreed importance, knowledge is often an assumed and neglected capability that is not planned for or taken into account when these initiatives are implemented. Figure 7-9 provides a simple model of how several management initiatives rely on the knowledge assets that are created, maintained, and made available through effective KM. Similarly, Figure 1-1 indicated some of the connections between KM and other activities.

Many KM methods are complementary to the various management initiatives. More importantly, several KM activities are valuable precursors and provide important foundations for these initiatives. Specifically, they provide increased knowledge and knowledge access, whiclh supply the expertise and intelligent behavior required for the management initiatives to succeed . They also provide basic knowledge-related insights such as the knowledge required to make quality decisions and knowledge work, which are necessary to tailor the management initiatives appropriately.

In addition, KM is a natural extension, and a centrally integral part, of many other activities in the organization. One example concerns how one deals with the intellectual aspects of people -- in day-to-day interactions, in personnel management and reviews, and very importantly: in using their skills, knowledge, and professional assets in conducting the organization's business. In addition to these areas, KM integrates with product and service development and delivery, technology planning and development, and research and development activities.

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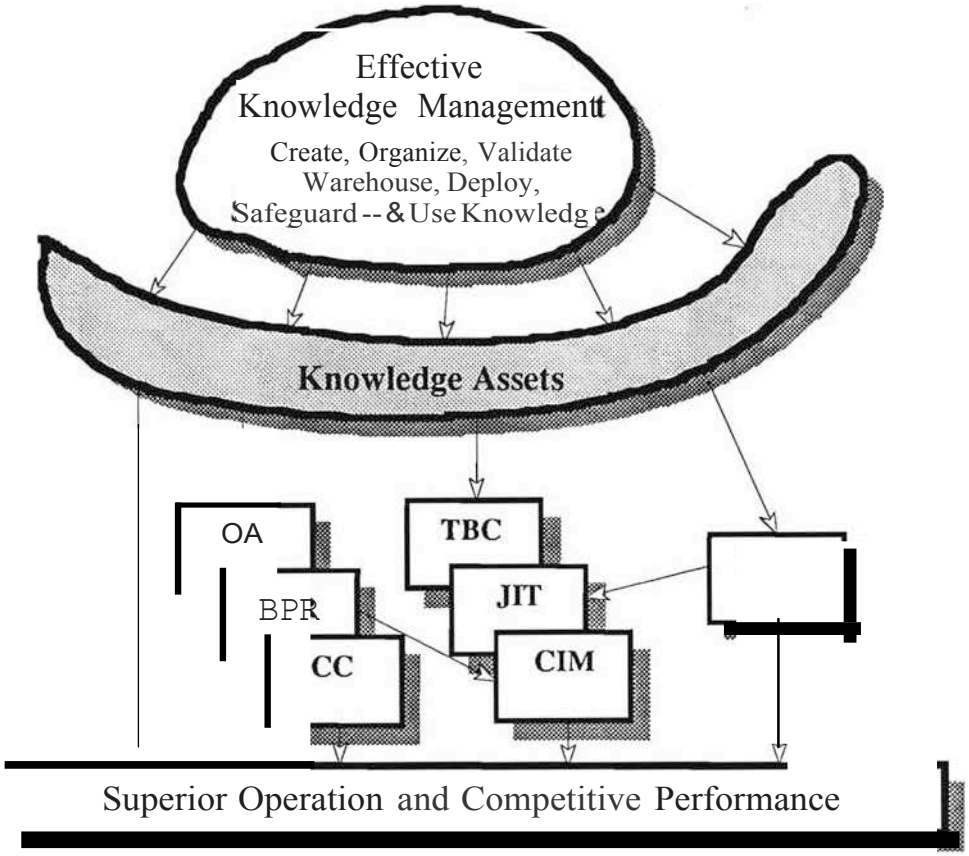
1 As indicated in the first chapter, the purpose of Knowledge Management is to foster and promote
Intelligent Behavior of the organization.

Figure 7-9. Knowledge Management and Its Relation to Some Initiatives.



Below we discuss several relations between six selected management injtiatives and KM: Learning Organization (LO), Time-Based Competition (TBC), Busi ness Process Redesign (BPR),1 Core Competencies (CC), Organizational Architecture (OA), and Total Quality Management (TQM).

LEARNING ORGANIZATION INITIATIVE

Focus is on the notion that learrung is central to success -- organizations need to adapt to changes in the surrounding world. "For any organization to

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1 We use the term "Business Process Redesign" instead of "Business Process Reengineeri ng" to denote the broad scope and comprehensive considerations needed to achieve the revolutionary results that potentially are possible and that are based on the best practices, experiences, and knowledge available.

survive and have a chance of growing, its rate of learning has to be equal to, or greater than, the rate of change in its external environment."1 This requires seeing the big picture; understanding complex and subtle relationships; and continually finding new ways while discontinuing old ones.

- General Relationships with Knowledge Management: A learning organization requires effective adaptation and innovation to create the new desired ways. This requires extensive knowledge -- knowledge of valuable old ways, of potential new solutions, and deep understanding of underlying factors and of potentials and ideals -- all focus areas of active KM.

  Relevant KM focus: Identify areas of the organization that particularly can benefit from learning opportunities. Identify specific learning opportunities in key areas as well as general, corporatewide learning approaches. Proactive -- tailors analysis and creation of specific actions to fit the Emerging Organization -- as the organization will be in a year or two after implementing new management incentives and other changes.

- Overlaps: The Learning Organization Initiative and KM both focus on the continued need for the organization to gather, organize, and put to use new knowledge -- with different emphases and detailed approaches.

  In some sense, the Learning Organization Initiative falls within the purview of KM. From another perspective, an initiative targeting the Learning Organization provides a forceful focus to start other KM efforts.

- Complementary Areas: (I) KM provides deep insights into the present state of knowledge, its use, and its value in different areas in ways that are important for the Learning Organization Initiative; (2) Active KM provides specific identification and recommendations for improving knowledge flows -- organizational learning opportunities.

- Reliance on Knowledge Management: KM provides added understanding of learning opportunities and needs and generates a practical framework for implementing the learning organization objectives.

  KM is a set of perpetual activities within the organization th.at provides a permanent foundation for the learning organization.

- Applicable Knowledge Management Methods:
  - -- Knowledge flow analysis for identifying specific opportunities for improving transfer of knowledge -- from outside the organization and within the organization -- and identifying opportunities for using existing knowledge better.
  - -- Knowledge-analysis for improved and distributed decision-making and higher quality knowledge work.
  - -- Task environment analysis (TEA) for specific understanding of knowledge use in the broader corporate environment with additional focus on potentials for learning through collaboration between different areas of the organization.

1Garratt, B. 1990, Creating a Learning Organization, p. xiv.

BUSINESS PROCESS REDESIGN [INITIATIVE]

Business process redesign is motivated to achieve greater effectiveness in all areas -- better products, services, quality, and customer response; lower costs; shorter lead times; greater customer and employee satisfaction, return to owners, and societal acceptance; and fewer accidents and adverse impacts (side-effects). As a result the focus is on fundamental rethinking and radical redesign of operations and management leading to changes in designs of jobs, work environment, organizational structures, and management systems. However, redesign is not a "clean-sheet" design activity, but is based on the best understanding available of how the business should be operated while taking into account all relevant learnings from the past.

- General Relationships with Knowledge Management: Redesign of the business process can be considered as motivated by a wish to obtain a more time-effective and intelligent-acting organization by changing all aspects of the organization that will promote that. Knowledge -- although fundamental to achieving intelligent behavior -- has not been considered explicitly in the past.

  Relevant KM focus: Identify knowledge-related issues that will inhibit, or make possible, optimal operating performance. Identify knowledge required to perform the processes to create and deliver the organization's deliverables. Establish knowledge requirements and knowledge delivery systems (knowledge flows, and so on.) for the redesigned organization.

- Overlaps: Shared focus on identifying (1) Work tasks required to produce deliverables; and (2) Ways to change workflows, organizational structures, and work practices to achieve improved operations.
- Complementary Areas: KM provides specific focus on the role and status of knowledge in the performance of the organization's knowledge work and the decision-making required to produce its deliverables effectively, timely, and intelligently.
- Reliance on Knowledge Management: (1) To provide sufficient insight into the knowledge-related strengths and weaknesses that influence redesign considerations; (2) To identify and plan the specific knowledge-related changes required to implement the redesigned organization.
- Applicable Knowledge Management Methods:
  -- Knowledge-analysis for improved understanding of knowledge requirements for decision-making and higher quality knowledge work.
  -- Task environment analysis (TEA) for specific understanding of knowledge use in the broader corporate environment, with additional focus on potentials for learning through collaboration between different areas of the organization.

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[1] An discussion of BPR is provided in Knowledge Management Methods (Wiig, 1995).

-- Knowledge-focused Threat-Opportunity-Weaknesses-Strength (TOWS) analyses to explicate the knowledge-related strengths and weaknesses as well as the threats and opportunities that need to be incorporated in redesign.

ORGANIZATIONAL ARCHITECTURE INITIATIVE

Focus is on changing the structure of the organization to ascertain that work, practices, people, logistics of all kinds, and all structures are integrated and work well together in the organization's best interest. Perfecting the organizational architecture leads to autonomous work teams and strategic alliances -- all to promote effective operations and intelligent behavior.

- General Relationships with Knowledge Management: Building an effective organizational architecture relies in part on identifying the desired distribution of responsibilities -- authority and accountability -- as well as deciding which decisions need to be made, where, and by whom; which tasks need to be performed; which "networking" is required to perform the tasks; and which work practices should be followed. Other considerations are associated with work flows, information flows, and physical proximities, and so on. Underlying most of these considerations is what people need to know to perform their jobs as intelligently and effectively as possible.

  Relevant KM focus: Identify knowledge requirements for decisions and key knowledge work. Design knowledge delivery systems for the new organization and its functional requirements.

- Overlaps: Very few.
- Complementary Areas: Explicit understanding and recommendations for knowledge-related requirements and opportunities needed to support the new organization and make possible intelligent behavior.
- Reliance on Knowledge Management: Explicit understanding of who knows what and what their role is in producing and delivering products and services; identification of knowledge requirements for decisions and quality knowledge work; and specification of potential improvements in knowledge flows.
- Applicable Knowledge Management Methods:
  -- Task environment analysis for improved understanding of the role of knowledge in key operating areas.
  -- Knowledge-analysis for improved and distributed decision-making.

TIME-BASED COMPETITION INITIATIVE

Focusing on reducing cycle times in all processes, it is related to concepts such as reducing "time-to-market" (from concept to marketable product) and

"touch-time," streamlining decision-making paths (faster decisions), collaboration between departments (eliminate rework and feedback time), early problem detection and correction, and so on.

- General Relationships with Knowledge Management: Knowledge -- expertise, competence -- is key ingredient to speed up decision-making and increase collaboration and interdisciplinary team work. Personal knowledge is key to early problem detection and correction. Personal knowledge is key to performing any task speedily and taking on additional tasks thus reducing time-consuming hand-offs.

  Relevant KM focus: Provide knowledge to people by education, training, expert networks, KBSs, etc. Analyze knowledge required to make decisions and determine how decision-making and associated knowledge can be transferred to people closer to the point-of-action. Analyze knowledge required to perform quality knowledge work and find ways to increase proficiency. Determine requirements for effective collaboration and interdisciplinary team work.

- Overlaps: Focus on improving decision-making, fostering collaboration, empowering workers.
- Complementary Areas: Whereas Time-Based Competition focuses on reducing process cycle times, KM focuses on understanding the underlying requirements for knowledge, opportunities for improving existing conditions, and approaches to remedy deficiencies.
- Reliance on Knowledge Management: Determination of knowledge requirements for target decisions, knowledge work, teaming.
- Applicable Knowledge Management Methods:
  - Knowledge-analysis for improved and distributed decision-making;
  - Task environment analysis for improving knowledge work.

CORE COMPETENCIES INITIATIVE

Focuses on identifying the company's special expertise areas that of greatest competitive value, for the purpose of pursuing them by organizing around them and concentrating on them. Requires particular insight into who knows what -- and how well -- and into the organization's ability to execute these competencies.

- General Relationships with Knowledge Management: The focus areas of this initiative are knowledge, organizational capability, and technology with particular competitive value.

  Relevant KM focus: Identify who knows what and how well -- at the beginning of the initiative and continually thereafter. Establish competitive value of knowledge -- the value-added of particular knowledge and how it can be leveraged. Specify opportunities for

improved exploitation of specific knowledge areas based on detailed knowledge-analysis.

- Overlaps: Some knowledge survey methods. Some knowledge value assessment methods. (Overlapping methods will vary with experts who lead the initiative.)
- Complementary Areas: (1) KM methods provide thorough insight into the details of how knowledge -- expertise -- competence is used to generate products and deliver services. (2) KM identifies opportunities for how present knowledge can be augmented, accessed more efficiently, repackaged to increase leverage, and so on.
- Reliance on Knowledge Management: Inadvance; determine "who knows what -- and to what depth," In conjunction with the initiative, determine knowledge situation in greater depth to generate superior solutions.
- Applicable Knowledge Management Methods:
  - Create skill inventories for all relevant areas.
  - Task environment analysis for key competency areas.
  - Knowledge surveys (one or several among some 15 alternatives).
  - Value-added knowledge-analysis.

TOTAL QUALITY MANAGEMENT INITIATIVE

Focuses on improving quality in products, services, and performance in many areas, particularly if TQM follows Dr. Deming's 14 points for management. Many of these points are directly knowledge-related.

- General Relationships with Knowledge Management:
  Relevant KM focus: Consider how people can perform higher quality knowledge work by being given better knowledge-- themselves, teaming and collaboration, knowledge pooling, or other knowledge flows such as KBSs.
- Overlaps: Joint focus on a number of aspects ranging from intelligent behavior to performing quality knowledge work and making quality decisions. TQM, however, does not consider knowledge as a capability that underlies all the organization's activities.
- Complementary Areas: KM provides explicit perspectives on needs and opportunities for knowledge-related activities in all areas.
- Reliance on Knowledge Management: KM provides perpetual support of TQM when KM is institutionalized and has become part of the organization's continued practices.
- Applicable Knowledge Management Methods:
  - Task environment analysis for identifying detailed knowledge-related

cultural and environmentally rooted issues and opportunities.
- Knowledge-analysis for improved knowledge work and better (including distributed) decision-making.

Functional Areas of Knowledge Management

Comprehensive KM requires several functions, some of which may be integrated with each other, while others may be operated as segregated entities. Some functions associated with the tasks of bringing knowledge from its sources to points-of-use are:

- Create new knowledge from learnings and through research and development where and when that is required and made possible.
- Acquire -- Collect and Elicit -- knowledge from experts, others who have appropriate knowledge, and from outside sources through contracting, benchmarking, and other approaches.
- Explore material that may contain relevant knowledge to detect and select valuable knowledge.
- Analyze, and Organize knowledge to represent and structure it effectively.
- Validate knowledge to ascertain that it is correct, the best available, and otherwise appropriate.
- Inventory knowledge inknowledge bases and other repositories. The organization's knowledge "warehousing" function is a major aspect of the "corporate memory." As such, it is vital to the long-term success of the organization.
- Transform and Edit knowledge into different forms suitable for deployment and other use.
- Deploy knowledge by transferring it to the field and ascertain that its use -- effective application to work products -- is facilitated.
- Apply knowledge to work objects and Use it to the organization's best interest.
- Facilitate knowledge use and motivate and promote its application to work.
- Monitor knowledge use to ascertain that it is used appropriately and effectively and that it fulfills the actual needs.
- Learn from its use how it can be deployed differently, which other knowledge is required, and how other knowledge-related aspects may be improved.

There are numerous other functions that comprehensi ve KM also must cover. Many are planning and exploratory tasks performed by a lead individual. Others are coordinating and management tasks. Still others are

highly technical tasks such as the development of a KM infrastructure.

Examples of how some of the KM functions relate to each other and to the overall knowledge creation/gathering-organiza tion/preserva tion-prepara tion/ transfer-use process are illustrated in Figure 7-10, including some of the overlaying management functions. Again, several other important KM functions are not represented.

Human Resource Management and Knowledge Management

One of KM's most important relationships is its connection with HR. Traditionally, HR is responsible for training and education, career d!evelopment, to make available and develop appropriate (e.g., skilled, knowledgeable, and otherwise capable) human resources. HR has other functions as well, but these may be ofless relevance in the KM context.

Edueation and Training

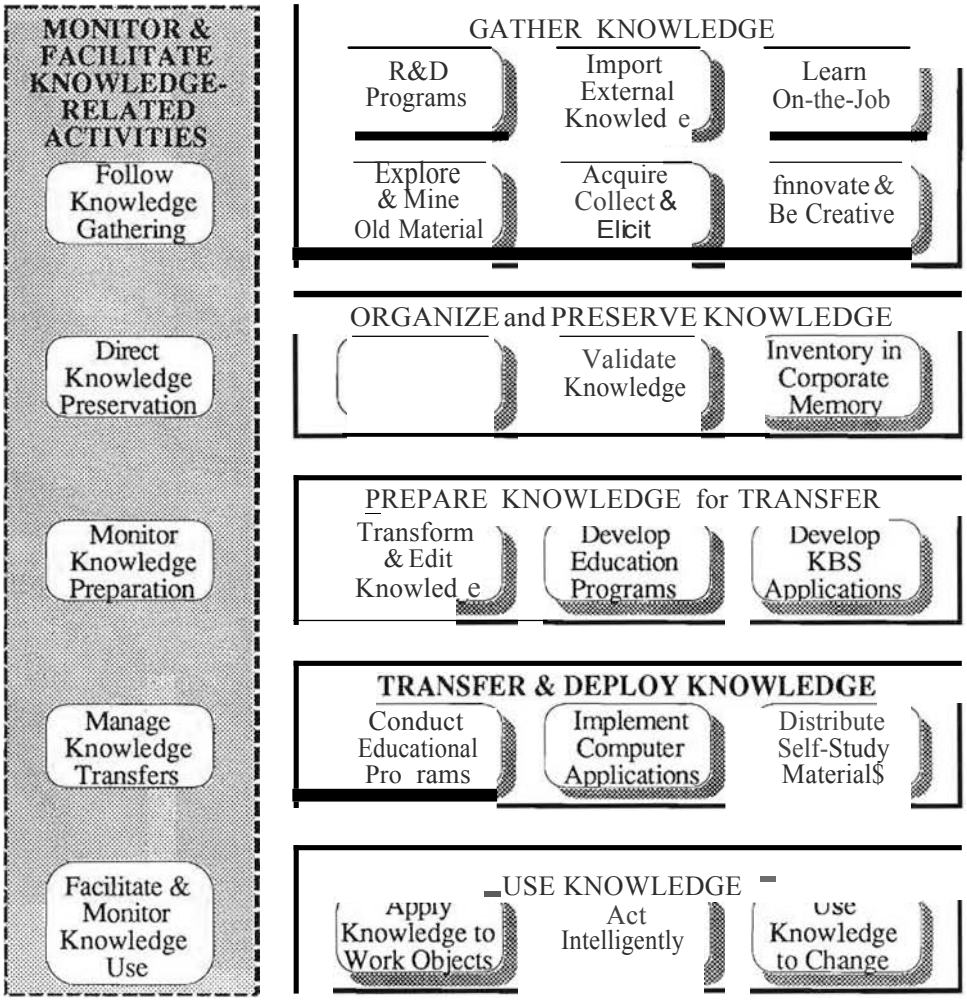
Education and training departments perform many different functions in the typical organization, toward the end-objective of transferring the appropriate skills and knowledge to those who need it in order for the organization to function properly. To achieve that objective requires performance of a number of functions that are closely related to KM perspectives, in particular assessing the needs for particular knowledge and skills for specific positions. Traditionally, needs assessment analyses performed by training departments have focused on observable tasks and activities, being less concerned with the internalized expertise in the forms of concepts, mental models, judgments, goals, and methods that proficient workers employ when performing knowledge-intensive activities.

After educational needs are identified, training specialists are normally required to perform "knowledge acquisition" to obtain the knowledge to be transferred to recipients. The sophistication and depth of acquisition (i.e., the degree to which it gains access to internalized expertise) vary considerably between organizations.

One significant function that most training departments perform and that is infrequently recognized is to validate that the knowledge is correct. It is

followed by the tasks of updating prior knowledge in previous training and educational programs.

Figure 7-10. Examples of Some Knowledge Management Functions.



A major function of any training department is to develop educational and training materials -- the actual transformation of knowledge into presentation formats, exercises, and other forms suitable for knowledge and skill transfers. Typically, however, the choice of knowledge transfer modes corresponds to, or is limited to, the department's scope and past experience, thus omitting many important and complementary modes such as expert networks, KBS applications, embedding knowledge for automatic execution as part of

conventional MIS applications, and so on. Considerations of the full spectrum of knowledge transfer choices must, therefore, be made under the auspices of the KM function.

An Important Caretaking Function

Training departments typically end up maintaining considerable knowledge bases -- extensive knowledge libraries, in effect -- that contain completed education and training programs and additional knowledge that has been acquired but not included in these programs. Although it requires considerable resources, this function is often not recognized. Materials range from interview notes, recordings or transcripts, paper- or computer-based training programs, reference documents and educational videos, to other manifestations. Some may employ multimedia technology. Rarely do the materials include advanced KBS applications and technology-based interactive educational support systems. Understandably, this wealth of knowledge is organized to facilitate development of new programs, normally without consideration of broader KM perspectives.

The ultimate purpose of the training department is to provide education and training -- to transfer or deliver the requisite knowledge to the intended recipients. As indicated earlier, this function is again part of KM's scope.

Given the complex tasks that training departments normally perform, and their collinearity with basic KM functions, it is natural to expect that their work be closely coordinated with -- or by -- the KM initiative. From a broad KM perspective, the training and education function is actually a part of the KM purview. That is particularly the case with the need to providing overview of education and training needs, setting priorities, and monitoring the performance of the whole process.

Hiring and Personnel Development

As opposed to the education and training functions of HR, the administrative aspects of personnel development and hiring may not be a part of KM functions. Most HR functions, for example, general performance issues, hiring, firing, reviews, and so on are not directly KM-related. However, some have knowledge-related aspects such as for example career planning and other functions that deal with the expertise and skills that needs to be developed and promoted within the organization and they are part of

KM's purview.

Skill inventories is another example of the relationship between HR and KM. In the next chapter, we discuss how skill inventories are developed to provide explicit characterization of which knowledge areas need to be developed to support the organization's business. Such inventories are also used to identify candidates for development for new areas and to determine educational needs.

Personnel Evaluation

Several organizations have started to include explicit characterization of proficiency as part of their periodic personnel evaluation function. Some use knowledge and skills profiles such as those illustrated in Figure 3-5 to define important knowledge areas for the positions in question. Further discussion of this approach is provided in Wiig (1994).[1] This HR approach to personnel evaluation provides significant detail and, when aggregated, overview information to the KM function.

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1 A particular approach to personnel evaluation is discussed in A Knowledge Management Framework.

Chapter 8

Starting a Kno\Vledge Manageillent Prograill

The First Important Step

Unless KM efforts are started in the "skunk works" as small initiatives led by convinced professionals, the first and most important step is for senior management to understand what KM entails. Whether or not they agree in detail on how to approach KM, is not the first order of business. Instead, it is to recognize the need to initiate KM through active exploration and by implementing realistic and useful initiatives to reap valuable benefits.

As we have seen, understanding what KM entails is far from simple. Intellectually, it may be quite obvious that it involves initiation, coordination, and monitoring of activities to build, validate, distribute, use, and safeguard knowledge. However, what that means from practica1 perspectives that correspond to the organization's situation and in terms of the responsible manager's "gut feel" is quite different. It is important that the management team develops -- and shares -- a vision of what effective management of knowledge will result in for the organization and which activities it will need to engage in to make that happen.

How Large a Commitment Do I Want, or Need, to Make?

Currently, very few organizations have a KM focus or are implementing broad KM programs of any type. It has not been a topic of concern and has not been well understood. That, is now changing, however. ▮

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1 See Bohme & Stehr (1986), Cleveland (1985), Drucker (1989), Peters (1992), and Drucker (1993) for discussions of need to consider effective management of knowledge.

Three factors dictate how comprehensive the initial KM effort should be. Management's conviction that KM is important is the major driver for setting priorities and allocating resources. Strength of knowledge professional expertise available to the organization directs how extensive and how fast it will be possible to proceed. Finally, the particular situation in which the organization finds itself provides the focus and, to some extent, the scope of the initial efforts.

Clearly, there are many different ways to approach KM even in quite similar situations. Considering the different kinds of situations that organizations find themselves in, it is particularly important to find an approach that makes good sense. In this chapter, we will look at models for introducing KM that require quite different levels of effort.

THE SMALL-EFFORT APPROACH TO INTRODUCING KM

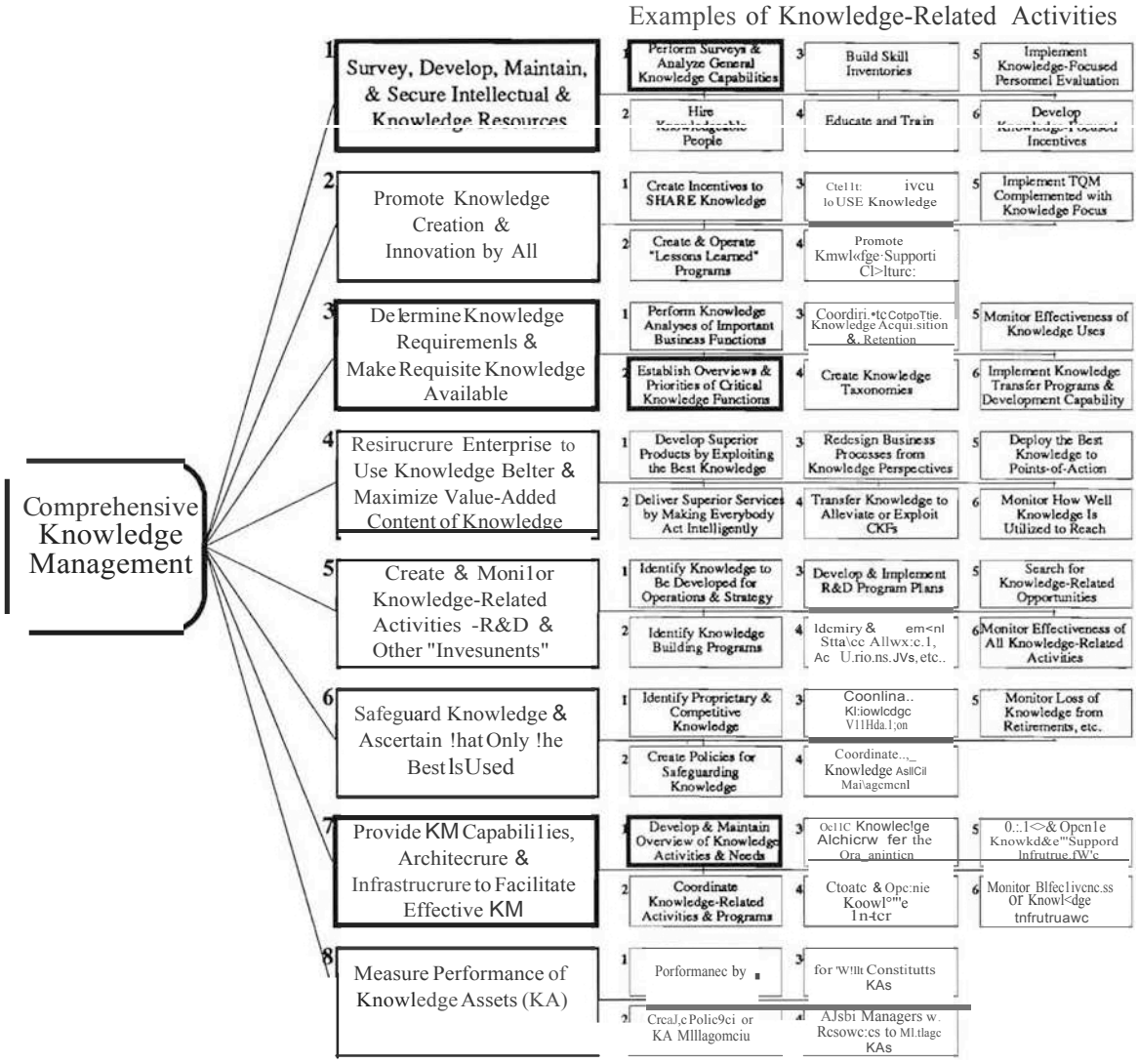
"We see the need to manage knowledge effectively, but we do not have any knowledge professional expertise and cannot go into a hiring program now. Also, we are not sure about how we should approach it. Isn't it anything we can do on a small scale right now?"

This situation is quite typical and many managing teams are convinced that while they would like to initiate KM immediately, they only want to do so on a small scale. They may not be able to free up resources to start a large program, they may have other issues on the front burner, or they may have different management initiatives underway that would make it disruptive or improper to change course in midstream.

Under these conditions, the interested management team have the choice to select from several different directions and may take various approaches to initiate a KM effort within its organization.

A small KM effort, particularly if focused on providing an overview of the organization's general knowledge status, is likely to lead to increased scope after the program is underway and as opportunities and needs are realized in related areas. Figure 8-1 indicates three KM project areas (#1-1, 3-2, and 7-1) that may be candidates for starting KM efforts with that focus. As indicated elsewhere, many other starting points may also be appropriate and can lead to broadening the KM effort and scope. In many cases, it is highly desirable to start with a small effort, especially because it may often be started immediately hence gaining important time and insights while larger efforts are explored.

Figure 8-1. Initiating Knowledge Management with Overview Development..



Obtain Overview of the General State of Knowledge

It is vitally important for managers to gain an overview of the activities and functions they want to deal with. This is particularly the case when a new area such as KM is approached where the managers must be given to understand how the various functions relate to each other and to the organization's business, where the hot-spots are, and where their attention and resources are needed.

Different approaches may be pursued to gain such overviews and often several are combined to obtain a better picture. The particular approaches chosen may depend upon available resources and lead times. Frequently encountered approaches are (in order of comprehensiveness):

Organizationwide surveys where managers respond to specially designed questionnaires focusing on such issues as the existence of critical knowledge functions (CKFs), special knowledge needs, desired approaches to KM (from well-defined lists), and other topics of interest.

Middle-management group sessions (often limited to a single division) of daylong duration consisting of an initial orientation to KM issues and practices followed by break-out sessions. Here the focus is on eliciting and documenting viewpoints, concerns, opportunities, and specific needs and potential activities.

Personal interviews with selected managers conducted by knowledge professionals in partially unstructured formats but with predetermined topics to be covered. The objective of these interviews are similar to the surveys but more information is often obtained.

Sampling of selected work functions by analyzing knowledge-intensive work where the work functions are chosen based on perceived importance, problems, potential opportunities, or broad representativeness of the organization at large.[1] Knowledge scripting and profiling -- although more labor-intensive -- provides a greater and more specific insight into the organization's state of knowledge and may be well worth the effort even in situations where it can only be performed for a very few positions. In all these cases, the results from this exploratory work need consolidation to provide the desired overviews.

Assembling Overview of Knowledge-Related Activities and Functions

All organizations have a variety of knowledge-related activities underway and functions in operation. The activities may range from training and hiring programs to building advise into conventional computer-based applications. Similarly, the functions may range from R&D departments to formalized benchmarking and TQM efforts to "Improve constantly and forever the system of production and service to improve quality and productivity, and thus

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[1] An example of knowledge scripting and work function profiling was presented in Chapter 3. These topics are also discussed further in Wiig (1993) and Wiig (1994).

constantly decrease costs."1 It is highly valuable for management to obtain an assembled overview of these activities and functions and to coordinate them from a knowledge perspective. This is particularly important for organizations where the knowledge focus is new and little understanding exists of how the different activities and functions complement or compete with each other.

Identify and Conceptualize Knowledge-Based System Candidates

It is often possible to initiate KM work by identifying and conceptualizing KBS candidates to serve as a foundation for selecting the most suitable applications and start preparing the application team for development and implementation. As most practitioners have experienced, several important aspects are associated with this activity. In particular, opportunities need to be identified, which requires visions for how it may be possible to change the current way of doing business. Conceptualizing applications and the role they may play in the operations requires intimate knowledge of both the actual business operation (understanding the "Task Environment") and applied KBS technology (AI). Justifying the potential application may rest more on management's belief in mechanisms at play in the marketplace than on conventional cost/benefit analysis and justification.

Build Knowledge-Based System for Particular Business Function2

Many organizations start KM work without a comprehensive commitment by building a single KBS application for a particular business function. They may have goals of generating economic benefits while developing in-house expertise. Frequently, an organization will find a "natural" expert system or other KBS application opportunity. It can develop the application with relatively little investment and thereby obtain a better understanding of what that area of KM entails. However, as indicated in Figure 7-8, knowledge transfer through automation is a very small part of comprehensive KM -- something that should be borne in mind by the conscientious manager.3

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1 Dr. Deming's fifth point for Total Quality Management; Deming (1986).

2 For a discussions of how to proceed with KBS development, see Payne & McArthur (1990) Developing Expert Systems: A Knowledge Engineer'sHandbook for Rules and Objects and Wiig (1990) Expert systems: A managers guide.

3 Managers should be aware that it takes considerable expertise to implement KBS applications

Nevertheless, KBS applications are already very important by themselves. It is expected that they will continue to increase in importance and extent as the technology improves and the expertise to implement them becomes more widespread. A number of influential students of KBS applications and technology have provided valuable insights of business applications and their potentials. David Hertz and the team of Edward Feigenbaum, Pamela McCorduck , and Penny Nii have provided very valuable and unusually insightful perspectives and case studies.1

Create Skill Inventory to Build Better Teams and Fill Knowledge Gaps

Many organizations, particularly those engaged in project-related work, have started KM efforts by implementing "skill inventories." That is, they have assembled estimates of each of their knowledge workers' expertise level in a large number of relevant categories. Considerable effort is often required to determine the categories which frequently number over one thousand in a medium-sized organization with broad services and product lines. Skill inventories are used for several purposes: to identify potential project team members with the best complementary expertise, to plan careers, and to determine educational and hiring needs to fill knowledge gaps.2

Implement Lessons Learned Systems

Many organizations are concerned that much of what is learned as part of daily operations or as a result of important situations is lost and unavailable when similar circumstances occur later. One approach to preventing such valuable learnings from being forgotten is to create a "lessons learned" capability of some sort. This may be a corporatewide program to capture

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successfully. Of every 100 systems implemented, it has been estimated that only 15 will be in general use two years later. This is attributed to the fact that most unsuccessful applications were implemented by novices without requisite expertise, by professionals in other fields who received short introductions to KBS tools without fully understanding the complexity of automating knowledge-intensive tasks. (Dr. Karen Gardner [1993), personal communication.)

1 Hertz (1988) in The Expert Executive provides a thorough and important overview of the role and value of KBS applications in the modern organization. Feigenbaum, McCorduck, & Nii (1988) in The Rise of the Expert Company provide a number of well documented examples of the value and specific benefits that KBS applications have provided to a number of well-known companies.

2 A discussion of complementary knowledge requirements for teams can be found in Chapter 9 of Knowledge Management Foundations, Wiig (1993).

significant lessons in preestablished formats by those who are involved and assemble the learnings in suitable repositories from where they can be obtained or distributed to those that need to know. Or it may involve holding periodic review sessions to share experiences as part of a TQM program. To support beginning KM initiatives, these efforts need to be incorporated in the organization's broader culture. They also need to be incorporated in management's considerations for how to take advantage of improved understanding of the way knowledge is built, shared, and utilized within the organization.

ColkctKnowkdge fro mDeparting and PromotedExperts

Several organizations have decided to initiate their KM efforts by initiating broad programs to acquire expertise from highly knowledgeable individuals who are nearing retirement, promoted, or otherwise become unavai lable to their prior positions. As one senior manager in a large organization phrased it, "Previously, we were letting millions of dollars of expertise walk out the door after each retirement party and had no way to replace this knowledge in the short-term. We had to start learning many things all over again!"

These programs require that competent knowledge professionals perform functions to: (1) Elicit and codify knowledge from the target experts using appropriate knowledge acquisition methods, (2) Create suitable knowledge repositories (knowledge-bases) to receive the collected knowledge, and (3) Make available mechanisms to use or otherwise exploit the collected knowledge. For these programs to be successful and valuable, all three functions need to be developed with great care. The total effort may be significant when many target experts and knowledge areas are involved.

Perfonn Sekcted Knowledge Audits

Selected knowledge audits identify knowledge domains and CKFs of particu lar value or concern to the organization. Important domains may require active management in several different ways depending upon the opportunities that are present and the resources that are available. For example, CKFs may be vulnerable as a result of potential key staff reassignments or departures; may be unavailable where needed; or may be available, but with "holes." Conversely, they may be good candidates for new products or services that will differentiate the company, render it more

competitive, or contribute additional revenues or new markets.

Knowledge audits can be performed over a period of a few weeks in a single operational area to provide an overview of some of the opportunities in that area. In-depth knowledge audits take longer and typically include coordination with business, personnel, and technology planning for a given area. The goal is to identify opportunities for complementing the existing knowledge with automated knowledge-based systems. Other means of managing knowledge such as research, training, or hiring may also be appropriate. The deliverables from knowledge audits are a set of working memoranda that outline strong and weak knowledge areas and corresponding opportunities both for exploitation and improvements.

Unikrtake Strategic Planning for Knowl.edge Management

Strategic planning for KM needs to be performed to identify and decide on approaches to pursue opportunities for KM by operations and general management. This activity is not to develop "yet another strategic plan" but focuses on identifying approaches and priorities to be adopted for managing knowledge in support of day-to-day operations.

Knowledge audits typically uncover a number of valuable opportunities for exploiting an organiza tion's existing knowledge. In most cases, the opportunities exceed the resources available. It is, therefore, desirable to c-0nsider the longer-term strategy to deal with valuable knowledge as part of normal operations.

Approaches to KM may outline how CKFs are to be identified by operations and technical management as part of their daily work; what options may be pursued to take advantage of strong areas of critical knowledge; how to strengthen weak areas; and how the corporation should prepare for changes in business and personnel expected over the next few years.

It is often easier to formulate these strategies after initial knowledge audits have been performed in one or two selected operations. The audits provide concrete examples, opportunities, and needs which provide a better focus for thinking about the options and merits of guidelines and strategies. In developing guidelines for active KM, opportunities are typically found that include activities that impact on other operational areas, such as personnel management, training, marketing and customer relations, research and development, and planning functions for strategic management of technology, in addition to MIS and general management.

The deliverables from strategic planning consists of working memoranda that outline the desired strategic actions. They also include structured working sessions with staff functions and members of operations and general management.

In addition to these examples, there are numerous other ways to start KM with relatively small investments. All these approaches provide managers opportunities to build understanding of the poten tials of KM for their organization, and allow the organization to start building the knowledge professional expertise required to manage knowledge competently.

PRUDENT, INTERMEDIATE-SIZED APPROACH TO INTRODUCING KM

"We understand that we need to manage knowledge actively and deliberately to stay ahead of our competitors. We would like to proceed gradually to build our expertise and shape the methods to fit our environment. How should we best proceed? "

For some organizations, it is appropriate to start with larger, more deliberate step-by-step KM introduction programs. They may, for example, tackle the most important critical knowledge functions (CK.Fs) first, while gradually deciding on the next direction to expand the KM initiative. In addition to pursuing an intermediate KM program, it is important to obtain an overview of the organization's general state of knowledge to understanding of where the organization needs to focus next. There are many options for intermediate-sized opportunities as indicated by the examples below.

Coor<linate Knowledge-Related Programs and Activities

Almost all organizations have numerous knowledge-related programs and activities underway. These include research and development programs, sponsorship of academic research, exploratory studies to increase understanding of some area, development and fielding of training programs, hiring programs, and embedding knowledge into computer-based systems or into other systems, procedures, and policies.

Rarely are all these activities considered together from the perspective of how they advance and contribute to the organization's near and long-term goals and how they can be made to complement each other to better achieve tlhese goals. Additionally, individual priorities are not considered given the overall view and the individual contributions. More importantly, the absence

of an overview leads to difficulties in identifying missing activities that also should be considered.

By identifying significant programs and activities, their objectives, scopes, and approaches, management obtains an overview that allows coordination and reshaping of the overall knowledge-related program in the organization's best interest.

Change the Organization to Become a Learning Organization

Some organizations will wish to focus on changing to become a "learning organization." Large changes are needed to create a fully functioning learning organization. It is desirable to make these changes gradually, starting with specific programs that by themselves will make important differences. Candidates include different kinds of programs. Some are to identify, categorize, and distribute lessons learned; comprehensive benchmarking and learning about best-of-breed practices; extensive market intelligence efforts to observe, analyze, and react to competitor, customer, supplier, and general economic moves and changes; and fostering creativity and feedback from knowledge workers at all levels as part of their normal work practices. Additional discussions of these aspects are provided in the next chapter.

Transfer a Broad Know'ledge Area to Organizationwule Points-of-Action

Many organizations find that they need to transfer expertise from groups of highly qualified professionals to a larger population and that creating an appropriate transfer program requires considerable overview and coordination of the business purposes, knowledge areas, and resources involved. Examples include distributing special manufacturing engineering expertise to a large group of design engineers or providing the expertise of a groups of central experts to a large number of customer service representatives. In these situations, the expertise in question falls into several categories.

For example, some knowledge is complex, methodological, quite permanent, and used relatively infrequently for reference purposes. Other knowledge is highly conceptual and abstract -- consisting of schemas and scripts -- and is used as part of time-critical reasoning. That may require that it is deeply internalized as automatic knowledge. Still other knowledge is volatile and changes frequently, yet affects important problem-solving

judgments. In other words, the knowledge area is broad and its transfer must take place via several different mechanisms or modes: training courses, KBS applications, expert networks, and so on. By developing and coordinating -- from a KM perspective -- all efforts related to the transfer of the knowledge area, a number of the additional knowledge-related issues are brought forward, thereby leading to a more comprehensive approach to KM.

Organize a Coordinated Kiww'ledge Transfer Capability

Knowledge transfers from knowledge sources to points-of-use take many forms. As discussed later, they may range from apprenticing, expert networks, and issuing procedures manuals, to developing and fielding knowledge-based systems and training or educational programs. These activities are typically not coordinated or assembled under common leadership. Instead, they are initiated and managed by different departments which often are ignorant of each other's activities or in outright competition with each other.

The KM approach considers all these activities as integral parts of a common effort to enable the different points-of-use to perform as intelligently as possible. Coordinating the knowledge-transfer activities allow the creation of broad transfer programs that consider the nature and sources of the knowledge to be transferred and how it is to be used. From those factors, appropriate and complementary transfer mechanisms and modes can then be chosen.1 It is important to create a coordinated competent knowledge-transfer capability and include within its scope groups such as the training department, expert system developmen t function, hiring program management, knowledge-base librarians, systems and procedures group.

Find and Afleviate, orExph>it,AU Significant Critical,Kiwwkdge Functions

Critical knowledge functions (CK.F's) are identifiable by five characteristics as listed in Table 8-1. A medium-sized KM program may focus on finding and

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1 Appropriate knowledge-transfer mechanisms and modes may be dictated by how volatile the knowledge is, how well it must be internalized by the knowledge workers at the point-of-use to be applied in time-critical situations, when it can be remotely accessed for rare exception situations, etc. The transfer alternatives may range widely such as educating individuals to internalize deep understanding, expert networks accessed over telephones, KBS applications in workstations, etc. These factors are discussed briefly in the next chapter and at greater length in Knowledge Management Methods (Wiig 1995).

manage all important CKFs throughout the organization. Surveys and studies, often in the form of quick and targeted knowledge analyses, may be used to characterize the different candidates prior to ranking and setting priorities for which to address, and when.

Table 8-1. Five Characteristics of Critical Knowledge Functions.

1. The type of knowledge (or expertise or skill) involved in perfonning a function or task.
   Example: • Chemical reactor operating expertise.
2. Business use of that knowledge.
   Example: • Increase the value of a retirement fund portfolio for mutual fund customers.
3. Condition that surrounds the use of knowledge: *Constraint* that prevents the knowledge from being utilized fully, the *vulnerability* of the situation, or the *unrealized opportunity* that is not taken advantage of.
   Examples: • There are too few proficient operators. As a result, many reactors are not run well *(constraint)*.
   • The expert will retire at the end of the year, and we have not trained anyone to replace her *(vulnerability)*.
   • "Our design knowledge is superb compared with competition and we, therefore, should offer a broader line of highly specialized custom designs to create a larger and more profitable market." *(opportunity)*
4. Opportunities and alternatives for managing (i.e., improving, correcting, or exploiting) the CKF.
   Example: • The securities trader can either be supported by a second trader or by a knowledge-based system that operates in the background to perform initial analysis and screening of trade opportunities and changes in market conditions.
5. Expected (incremental) value of improving the situation -- release knowledge constraint, take advantage of (exploit) the opportunity to use knowledge differently.
   Example: • Direct and indirect benefits resulting in increases in market share, revenues, profit, and decreases in costs.

Many CKFs are candidates for inclusion in larger initiatives, particularly business process redesign efforts. Others are candidates for inclusion in broad educational or expert-to-field knowledge-transfer programs, while others will be the source of developing new knowledge through research and development.

Initiate Corporatewi<k Knowledge Asset Management

As emphasized in the previous chapter, managing knowledge assets is important but rarely done. A corporatewide program to manage knowledge

assets actively and effectively is a relatively large undertaking that requires surveying and cataloging of assets, creating systems and procedures for how their management is to be performed, changing performance measurements and incentives, and finally, implementing all these changes to become integral parts of management and operating practices.

Intermedia te-sized approaches to introducing KM require senior management vision and conviction as well as availability of expertise in several different areas. The thrust associated with KM must support and coincide with the organizations goals. Regardless of the particular application area, it requires a team of proficient knowledge professionals as described later. In addition, it requires middle-management enthusiasm and vision.

COMPREHENSIVE, SIZABLE PROGRAM TO INTRODUCING KM

"We are convinced that our leadership position and future depend directly on how well we manage knowledge, and we already have considerable knowledge professional resources and related experiences. We will, therefore, proceed with a broad and active KM program as quickly as prudently possible! In this case, what should the initial elements of our program be?"

A few organizations have considerable backgrounds in advanced methods for transferring knowledge from areas of expertise to the points-of-action. For example, they may have experienced groups that already have fielded advanced multimedia educational programs, they may have expert knowledge acquisition and KBS development teams, and they may have a culture that reinforces organizational learning and sharing of knowledge.

In these situations, it may be possible to embark directly on a comprehensive KM program. Nevertheless, it is advisable to start by obtaining overviews of the organization's knowledge situation of the to identify priorities and focus areas. These initial steps may be conducted in the same ways indicated for the small effort. They may be conducted in parallel with other steps to address known needs and when resources permit it.

We expect that transformation from an organization that has not paid explicit attention to knowledge to one that is knowledge-aware will proceed through four stages as outlined in Chapter 5. A comprehensive KM program is normally started with limited experimentation. It will expand gradually until the activities cover the full scope indicated in Figure 7-8. Depending upon management's conviction, the organization's capabilities, and competitive and market pressures, the transformation may be quicker but this has not been

observed to date. At the present, few if any organizations have covered the full complement and it may be expected that the process may take quite a number of years, even a few decades, as indicated in Figure 5-2 and related text.1

Another Perspective -- 10 Ways to Get Started with Knowledge Management

The steps outlined above are clearly not the only ways to start KM programs. Many other approaches are possible, as reflected by the fact that KM touches almost every part of the organization. Examples of other approaches include:

1. Introduce KM in personnel evaluation and periodic reviews.
2. Use KM approaches for mapping different knowledge areas and their proficiency levels throughout the organization.
3. Use KM approaches to plan, organize, prioritize, and coordinate the organization's expert system strategy.
4. Use KM approaches to support TQM methods by, for example, introducing into root-cause analysis methods concepts such as knowledge flows and required expertise for individuals and teams.
5. Use KM approaches to identify potential products and services that the organization might provide based on the expertise available in different departments.
6. Use KM approaches to ascertain that the correct knowledge and levels of proficiencies are present to perform work tasks in different areas.
7. Use KM approaches to determine trade-offs between availability of in-house expertise and contractor capabilities to evaluate make/buy decisions.
8. Use KM approaches to identify CKFs to change the way of doing business or improve operations and business changes.
9. Perform broad knowledge surveys of important work functions on the departmental level to determine where management attention needs to be directed.
10. Set up a KM culture and framework within the organization to facilitate creation, organization, retention, deployment, and use of knowledge.

Since there is great flexibility with regard to starting KM initiatives, each organization should give thought to what is appropriate in its particular situation. Nevertheless, preference should always be given to obtaining some kind of an overview of the state of knowledge at an early stage.

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1 This time scale is based upon experiences with other management initiatives such as TQM.

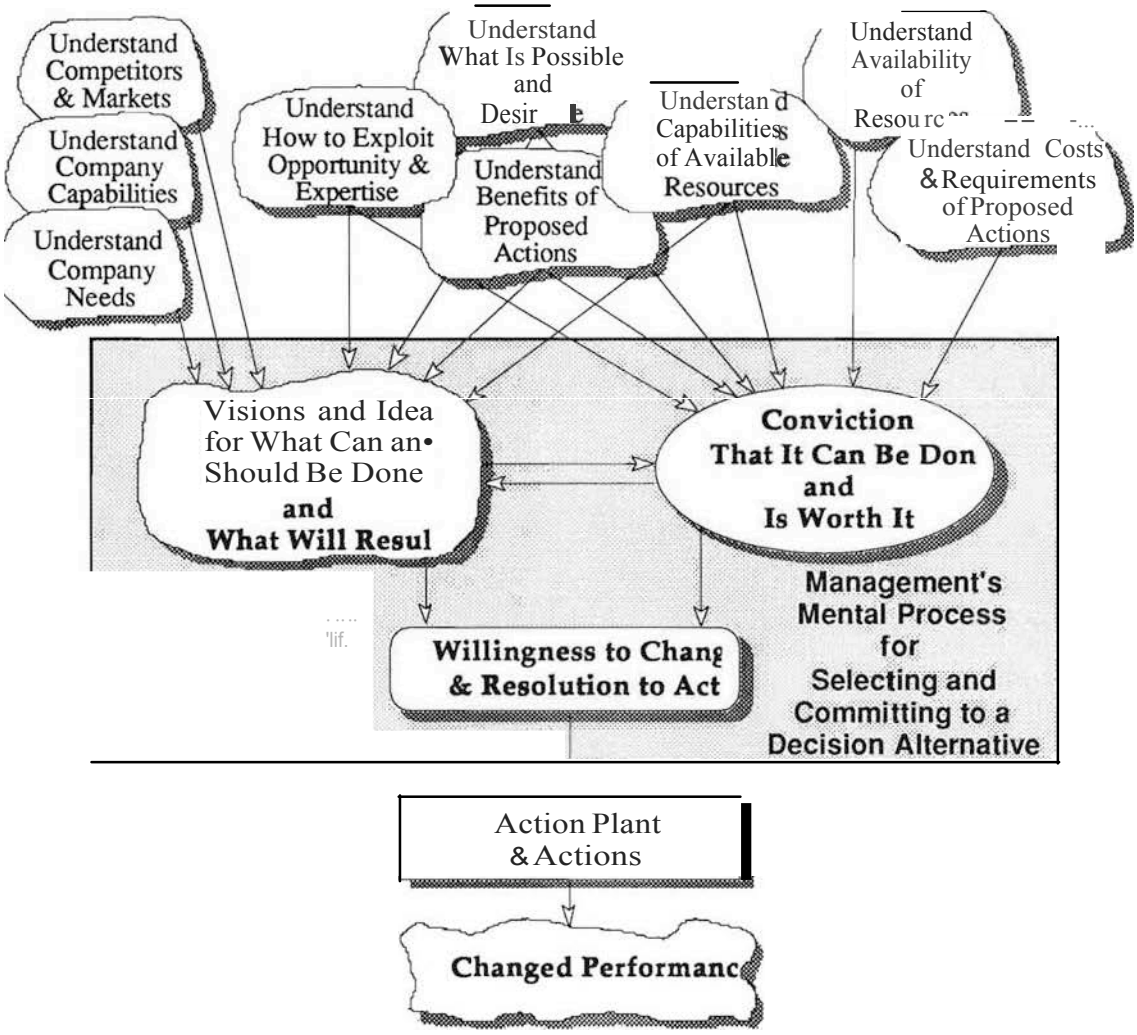
Prepare to Undertake a Knowledge Management Program

Let us assume that senior management would like to start a KM program that involves the active participation of executives to shape it and set its business direction. Even in situations where key executives are convinced that this move is appropriate and desirable, there still is considerable work to be done and understanding to be gained before it is possible for the key individuals themselves and by the management group at large to act with confidence. The general situation is illustrated in Figure 8-2.

From this figure which was discussed briefly in Chapter 5, we see that to be convinced that it should act decisively to create the desired KM program, the management team needs to gain good understanding of several areas. In particular, guided by their own awareness and with the help of staff members and others with deep insights, they need to understand knowledge-related implications such as:

- Competitors and markets -- present and future roles of competitive knowledge in market penetration, customer acceptance of products and services, relations with suppliers and distributors, and the viability of the organization.
- Company capabilities -- the state of its expertise in core competencies and other key knowledge areas, and its capabilities to manage these assets.
- Company needs -- desired strategies that cannot be pursued with the present knowledge-base and knowledge-related deficiencies and threats.
- How to exploit opportunity and expertise -identification and description of the portfolio of KM and other knowledge-related actions that may be feasible to pursue to achieve the envisioned goals.
- Costs and requirements of potential actions -- demands to be placed on the organization's resources -- people, finances, introduced changes, education and training, new systems and procedures, and cultural and incentive changes of all kinds.
- Benefits of proposed actions -- how the various actions can be expected to impact intermediate factors such as corporate operating efficiency or market penetrations as well as bottom-line values such as short- and long-term financial performance.
- Capabilities of available resources -- competencies of people and organizational entities for such work as knowledge acquisition, knowledge deployment, change management, and monitoring the resulting KM processes.
- Availability of resources -- in-house or external expertise, funds,

Figure 8-2. Conditions That Must Be Met Before Management Can Act with Confidence.



managerial talent and allocable time, and the organization's capacity to change.

- What is possible and desirable -- the particular actions that may be undertaken with available resources of appropriate capabilities and given expectations for the results that may obtain.

With these understandings at idealistic levels -- and preferably also at systematic levelsl -- the senior managers will have firm visions and ideas for

1 See Appendix A for definitions of Idealistic and Systematic conceptual knowledge levels.

what can and should be done, as well as realistic expectations for what will result if they embark upon a KM program. They will also be convinced that it can indeed be achieved and that it will be worth it. Only at this point will the individuals -- and the group -- be willing to change and have the resolution to act.

The management team needs these insights for other reasons as well. Specifically, they need to have broad understanding to: (1) Monitor and redirect the KM program when required; (2) Allocate and free up resources to make the program go forward; and (3) Take business advantage of the capabilities and knowledge assets that the KM program creates.

A SCRIPT FOR STARTING A KNOWLEDGE MANAGEMENT PROGRAM

A potential script that an organization may follow in exploring potential directions for starting a KM program is illustrated by the following 16 points that outline activities that may be considered. These points are provided as an example, many variations are possible and the program should be shaped to provide the best match to the situation at hand.

1. List potential advantages and benefits that can be expected from better management of knowledge while focusing on both internal effectiveness and external customer service.
2. Rough out a few strategy alternatives for how to build and manage knowledge within the organization. For example, if the objective is to reduce general people content of products and services while at the same time maintaining and improving quality, one change that must be made is to give every employee access to and increased ability to use more knowledge and to be able to handle more relevant information.
3. Identify areas where knowledge is missing in particular work situations. That means finding and describing where crucial knowledge may be available in the organization or in the community at large, but not where it is needed, (i.e., at the points-of-use).
4. Identify knowledge bottlenecks, whether the knowledge is in the organization, but cannot be applied fast enough, or the information required to use the knowledge is unavailable.
5. Locate any vulnerable knowledge where important parts of the critical or valuable knowledge may reside in employees who are about to retire, be promoted, or shifted to different locations. Knowledge may be concentrated in one or two people who may "get up and walk," or may be in line for promotion to another position where the knowledge will not be as useful.
6. Identify opportunities for, and value of, new knowledge that may be

acquired through research, studies, collaboration, or even hired into the organization.

7. Detennine needs to inspect and validate knowledge used in critical knowledge areas to weed out false, improper, or otherwise undesirable or unusable knowledge.
8. Decide which knowledge should be controlled, (i.e., safeguarded for competitive or other reasons) and which knowledge may be given away or sold on the outside to customers or even competitors.
9. Identify how to organize appropriate approaches to standardized acquisition (that is, elicitation and codification) of knowledge so that knowledge in different areas can be cumulated and merged with other knowledge entities.
10. Determine applicable candidates for knowledge repositories and possible knowledge representations for each.
11. Identify how knowledge can be codified as part of every professional function and knowledge worker's domain so that over time it is possible to harvest, safeguard, and deploy the considerable knowledge assets that constitute the enterprise's particular strength and competitive advantages.
12. Prepare the workforce through awareness, education, and training to perform the tasks of:
    a. Codifying knowledge as part of their work
    b. Dealing with the technology that supports these activities
13. Identify the opportunities that year by year allow "sewing together the quilt" that over time will form the complete and coherent knowledge network that is envisioned and that will be competitively useful in all areas of operation as the market evolves.
14. Prepare the action plan, subject it to reality checking, and obtain agreements for collaboration by affected parties.
15. Secure the resources required to pursue the action plan.
16. Initiate implementation of the action plan.

Planning for Knowledge Management

A few organizations have started to plan for introduction of their KM programs. The major areas that they focus on for this purpose are:

A Planning for KM with a focus on the following areas:

- Development of strategies, approaches, and an enterprise environment which support and promote individual innovation, exploration, discovery, and learning to continually create new and better ways.

- Identification of important critical knowledge functions that affect the success of the enterprise. Definition of the activities for managing knowledge within the organization in order to exploit knowledge to take advantage oflarge opportunities. Development of a perspective of the explicit and realizable monetary and strategic value of knowledge, with particular focus on elucidating and building valuable knowledge within the organization. Estimation of the value of knowledge when built and deployed in terms of implicit, intermediate, or end-values when exploited in actual operation for support of the organizational purpose. This area consequently includes identifying research and development (R&D) activities to create new knowledge, as well as the performance of knowledge audits to map out what knowledge is present, where it resides, and what form it is in. Associated efforts may include:
  - --Strategic planning by senior management
  - --Management education of a general nanire
  - --Focus group concentration that include line management and operational users
  - --R&D Planning
- Knowledge audits, charting, and surveys to identify the critical knowledge the enterprise possesses and needs, and to explicitly identify potential knowledge processing operations
- Economic, feasibility, and other studies to determine specific courses of action or research and development related to the strategic plan

B. Building KM capabilities:

- Define means to manage knowledge in the organization, whether through people, changes in conventional systems such as the organization itself, or through advanced automated reasoning systems such as knowledge-based advisory systems, imbedded fully automatic systems, or other varieties and roles of AI-based systems. Endeavors may be undertaken to:
  - -- Establish basic technological competence in knowledge engineering and artificial intelligence through
    - Human resource identification and networking
    - Formal education and training
    - Internal and external resource identification and cataloging
    - Technical publication resources
    - External relationships with universities, consultants, AI vendors and "appliers," professional organizations, customers, and suppliers
  - -- Elicit and capture knowledge by acquiring existing expertise
  - -- Create or obtain knowledge not currently available using:
    - R&D
    - Recruitment
    - Training
  - -- Formalize knowledge through codification and modeling using knowledge engineering methodologies

C. KM implementation planning including:

- Design a new human work process capable of exploiting knowledge and identify the role which KBSs should play in that process. A broad perspective encompassing both technical and human factors as these interact in the work process is required to integrate a KBS into the work flow. KBSs require changes not only in information handling within an organization, but also in the users' perspective and attitudes toward the way work is done and the role an automated system may play in accomplishing that work.

  Be aware that the plan must "respecf' that broad KM cannot be planned from t.op-down. Instead, it must be "grown" with much local particiration.

- A universal cognizance is required to analyze pre- and post- implementation process implications, particularly since human perception plays an important role in the overall system design and performance. Critical dependency relationships must be identified to discriminate root -causes from contingent local factors and subsequently focus effort on areas of high potential leverage.
- Selecting the best approaches, methods and tools;
  - -- Product evaluations to provide direct determination and identification of the most appropriate tools for any given application. No single hardware and software configuration is the ultimate answer to all problems. Products selected must be tailored to specific applications
  - -- Product acquisitions:
    - Hardware
    - Software
    - Specific technical training and documentation
    - Software engineering using iterative methodologies customized to fit the personality of a given organization and the nuances found in KBS implementations
- Establish programs, policies, procedures and processes to exploit the results of application of knowledge-based technologies

D. Sustaining knowledge administration, which integrates KM with the rest of the organi7.ation in terms of:

- Support of individual innovation and initiative
- Strategy and tactics in the operating environment
- Organizational functions and compatibili ty with existing MIS base
- Policies and procedures for knowledge asset management
- Maintenance of the currency of knowledge bases
- User support
- Continuing knowledge quality assurance (validation and verification)
- Providing security of proprietary knowledge

PLANNING

Action planning for implementing KM programs is similar in nature to action planning for other management initiatives. It includes specification of work to be done; estimation, scheduling and mobilization of resources; authorization to initiate tasks; and coordination with other activities within the firm. Since KM in part involves technologies that may be new to many organizations, it becomes crucial to assist management in developing visions for the business opportunities and the conviction that "it can be done" to act and authorize activities and plans. The effort and experience required to work with direct knowledge-related tasks are at times underestimated, with the result that the quality of implemented KM work is of unacceptable. Additional and early investments in these areas, therefore, provide considerable economic leverage.

Again, it is important to recognize that a total KM program cannot be planned top-down. Instead, the plan must allow for local participation and development to fit individual needs and take advantage of insights and innovations that

Capabilities and Resources Required for Knowledge Management

Although most of the resources required for effective KM are already in place in the typical organization, some will need to be acquired or built. Some new resources are in the form of expertise as indicated below, others are more technical in nature, while still others are part of the general organizational capabilities and infrastructure.

Without appropriate resources, KM initiatives -- as all other management initiatives -- will fail. It is, therefore, important here to introduce some of the particular requirements that are likely to be needed.

INFRASTRUCTURE AND TECHNICAL CAPABILITIES

Several kinds of capabilities are likely to be required at different stages of the KM initiative. Their timing will depend upon the particular approaches that are chosen to pursue the program. While, many of the capabilities will be needed in any event, the extent of their use will vary considerably.

Knowledge Architecture

A major infrastructure requirement for effective KM is the knowledge architecture, which will need to be designed and specified according to the hierarchical levels within a given conceptual framework for KM. Major knowledge-architecture elements consist of humans, organizational entities, documents, books, other knowledge repositories, and operating practices. Technical components such as computer equipment and software are required to serve as support platforms. Knowledge-based systems, automated knowledge bases, and related entities are technical manifestations of codified and organized knowledge architecture elements which are introduced to satisfy specific operational requirements.

The knowledge architecture is defined at seven hierarchical levels. After the first which is highly conceptual, the levels become increasingly more concrete and detailed. The seven levels are:1

Level I. Top-level conceptualization of the knowledge architecture provided in a single goal statement such as the one adopted by a process company:
"The knowledge architecture objective is to support and facilitate management of knowledge in the broadest terms to fulfill the corporation's goals to the greatest extent possible."

Level II. Organizing principles that spell out basic objectives and characteristics for the knowledge architecture's use and composition. The emphasis must be on use of the knowledge architecture in the business domain considering that the informatics2 domain is a subset of the business domain.

Level III. General overall arrangement of the knowledge architecture and its interplay with the user and technical environments and the functions that it will support.

Level IV. Identification of knowledge-architecture elements and building blocks with brief indications of their role and functions and how they relate to one another, to the supported environments, and to the adjacent organizational, technical, and external environments.

Level V. Functional descriptions of knowledge-architecture elements and building blocks in considerable detail and with functional definitions of protocols to govern interrelations.

Level VI. Detailed implementation or design specifications of all elements of the architecture. (Modern organizations rely extensively on automation,

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1The knowledge architecture is discussed in greater detail in Wiig (1995).

2 We use the international term "informatics" to denote the overlapping fields of information sciences, management information systems, telecommunications, and computer sciences.

hence emphasis is placed on the elements in the informatics domain.)

Level VII. The operational knowledge architecture (i.e. the physical system itself), including implementation of the design with all its architectural components being operational -- be they people, books or documents, organizational entities, computers, software tools, application software, or whatever. (Again, emphasis must be placed on the informatics domain.)

One complement to the broader concepts of knowledge architecture is informa tics-based "corporate memory infrastructures"[1] and similar technological alternatives to knowledge bases and knowledge deployment systems. These solutions adopt highly practical approaclhes that are implemented with state-of-the-art technology to serve the specific purposes of selected companies.

Knowkdge R.epositories

A major building block in support of effective KM is the corporate memory or the collected set of knowledge repositories. As indicated elsewhere, these come in many forms ranging from relatively loosely organized expertise possessed by knowledge workers to highly organized and strictly represented computer-based knowledge-bases that support KBS applications. In addition, extensive written materials may be found in memoranda, formal reports, and procedures manuals, numerous training and education course materials, and endless amounts of support documents and personal notes.

To be effective in the KM context, knowledge repositories must support continued cumulation of knowledge, verification and validation, appropriate access,[2] and transformation into other forms for use or transfers. To facilitate the desired support, the formal knowledge repositories -- and many of the less formal ones -- must be subject to organization and cataloging. Computer-based knowledge bases must be organized according to agreed-upon knowledge representations, determined by intended uses as well as the nature of the knowledge itself. Other knowledge bases may be assembled in less formal structur es. For example, lessons learned memoranda may be written in narrative styles but according to a predetermined format, teaching materials

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1One particular implementation approach to corporate memory infrastructure is discussed in a white paper, Leveraging Knowledge through a Corporate Memory Infrastructure, by Marble Associates (1994).

2 To gain "appropriate" access to knowledge repositories is very complicated. It deals with easy, timely, only authorized access. Additionally, it includes being able to find useful knowledge through conceptual associations and many other indirect access approaches, most of which are undefined at the time of creating the repositories. Only very good cooperating experts seem to be able to provide appropriate access to their knowledge.

and training manuals may also be organized according to formats, and other organizations may be chosen as well.1 A major aspect of knowledge-base organization is the cataloging of knowledge that is vital for identifying where different knowledge is located.

Clearly, many repositories, particularly personal knowledge, will continue to be informal and to fall outside explicit control by KM guidelines. In many ways, that may be both appropriate and desirable as it allows flexibility and adaptation to new conditions.

Technical llequirem.ents

Several technical requirements are needed to support KM, most of them associated with storing, deploying, and accessing knowledge in different forms. For those purposes, typical requirements include:

- Capabilities to hold knowledge. Computer-based repositories for knowledge bases in the form of object-oriented data bases.2 These knowledge bases typically require considerable technical work to create proper architecture through categorization of relevant knowledge areas and to integrate the knowledge bases as complements to the organization's data base architecture.
- Capabilities to deploy knowledge. Knowledge-based system (KBS) architecture standards for different kinds of applications based on "rule-based expert systems," "case-based reasoning," and other technologies. Requirements include technical expertise and integration of software into the overall software architecture.
- Capabilities to make knowledge accessible.
  (1) Powerful personal workstations with suitable human interfaces (such as graphical user interface or "GUI") to facilitate use of computer-based training (CBT) programs, KBS applications, and other computer-based knowledge deployment modes.
  (2) Local area networks (LANs) and wide area networks (WANs) for deployment of knowledge and for support of communication functions for such modes as expert networking.

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1 Many organizations, led by the U.S. Department of Defense are adopting standards for internal organization of documents. The most widely used is the Standard General Markup Language (SGML), which allows limited specification of topics and other document organization features. SGML was developed to deal with textual documents and are now being augmented by markup languages for hypertext and virtual reality.

2 Object-oriented data bases presently provide the most powerful structure for knowledge bases. Relational data bases are less suitable for knowledge bases.

HUMAN RESOURCES

Many KM activities require extensive and unusual expertise. In particular, analysis of knowledge-intensive activities -- the mental tasks people perform and the mental models they use to deliver work products -- is complex and based upon deep insights into what typically takes place in the knowledge worker's mind during different stages of work. Part of hands-on KM work consists of in-depth analysis of knowledge-intensive work functions, knowledge acquisition and, often, building KBSs for significant work functions. This work requires knowledge professionals with proficiency in many areas to better understand the functional req uirements and the knowledge content that need to be included in the final approaches.

Without proper knowledge professional expertise, there is a tendency to describe work in terms of its most factual and visible (or action-oriented) c·omponEmts. Lack of expertise, therefore, leads to focusing on directly observable actions while ignoring the hidden mental activities and less observable knowledge-related tasks that knowledge workers perform -- mostly because of inadequate methodologies or lack of awareness. In addition, required expertise, skill, and personal characteristics are also overlooked. The result is a misrepresentation of the actual requirements for deeper conceptual, experiential (judgment), and methodological knowledge needed to perform the work with the desired quality outcomes.

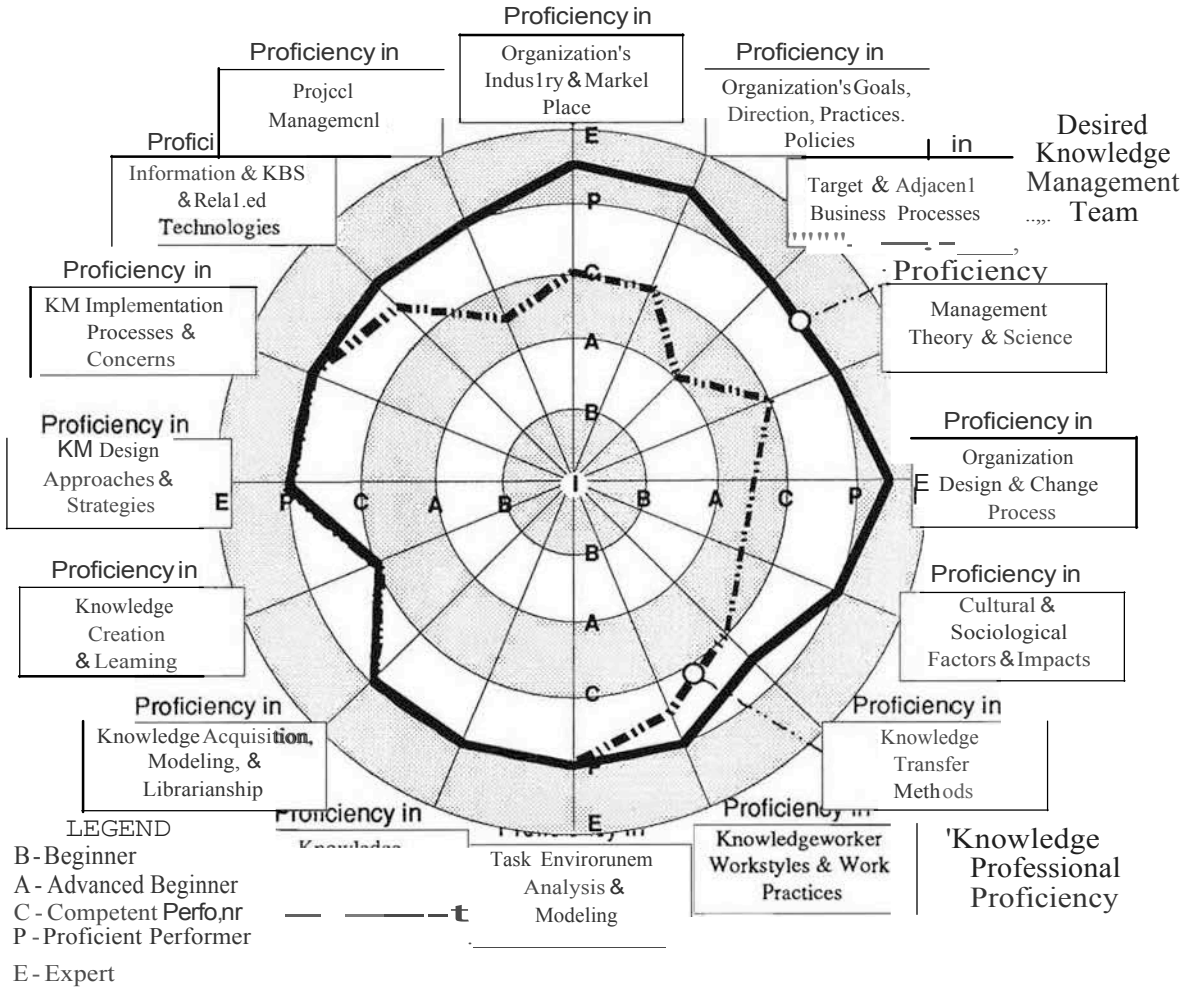
The Knowkdge Management Team and Its Proficiency Profile

In order to perform competent work, KM teams must have broad interdisciplinary backgrounds. Some of the knowledge areas required are well represented in most organizations while others may need to be developed tihrough education or hiring. We normally expect that KM teams will be composed of at least four types of professionals with different backgrounds, generally falling into the following categories:

- Management representative with understanding of the overall organization and its general business.
- Target-function specialist who has great practical experience -- as expert or supervisor -- and who, therefore, understands the professfonal content of routine and nonroutine work within the function.
- Management scientist with methodological and theoretical understanding of organizations, business principles, and related areas. This individual may also have background in business process redesign (BPR).
- Knowledge professionals with expertise in knowledge-analysis, knowledge

other disciplines since there may be considerable flexibility in their background s. The solid line reflects the desired proficiency profile of the combined KM team, while the broken line indicates the desired proficiency profile (i.e., the expertise contributions by the knowledge professionals on the team). In order to develop well-conceived systems, it has proven essential to complement in-house systems people with conventional backgrounds with outside resources experienced in defining and implementing knowledge-based systems.

Figure 8-3. Desired Proficiency Profiles for Knowledge Professionals and Knowledge Management Teams



In this exhibit, the 16 axes indicate the areas of expertise that must be

represented to develop high-quality KM programs with high utility to the organization. The six levels of proficiency are specified as: I - Innocent; B ·Beginner; A • Advanced Beginner; C - Competent Performer; P ·Proficient Performer; E • Expert.

Potential,Needs for Outside Assistance

Since most organizations do not have extensive in -house knowl edge prrofessional expertise many chose to seek outside assistance. When that is the case, external knowledge professionals typically will work with the user organizations in two modes:

1. Complement in-house skills to perform the KM work as efficiently and appropriately as possible, and
2. Provide technology transfer of theory and methods for KM to make the organization self-sufficient to carry on its own work in the future.

Often, technically sophisticated clients have less need for outside services for KBS development (knowledge acquisition , AI programming, and knowledge encoding into a "shell"). However, most organizations have needs at least to learn how to perform knowledge-analysis and conceptualize broader KM solutions from a business perspective.

A typical work program involving outside consultation may start with assisting a KM team with knowledge audits in selected operating areas followed by the development of a strategy and action plan. This kind of engagement commonly lasts for several months. When in-depth task environment analysis is required and objectives are added, further effort is required.

The Knowledge Management Framework[1]

To obtain an appropriate overview of the tools and approaches available for supporting KM programs, they need to be assembled into a coherent framework . We illustrate this framework by visualizing KM as being supported by three pillars of methods and approaches, which rest on a broad foundation as indicated in Figure 8-4.

Known KM methodologies and approaches must be considered to be

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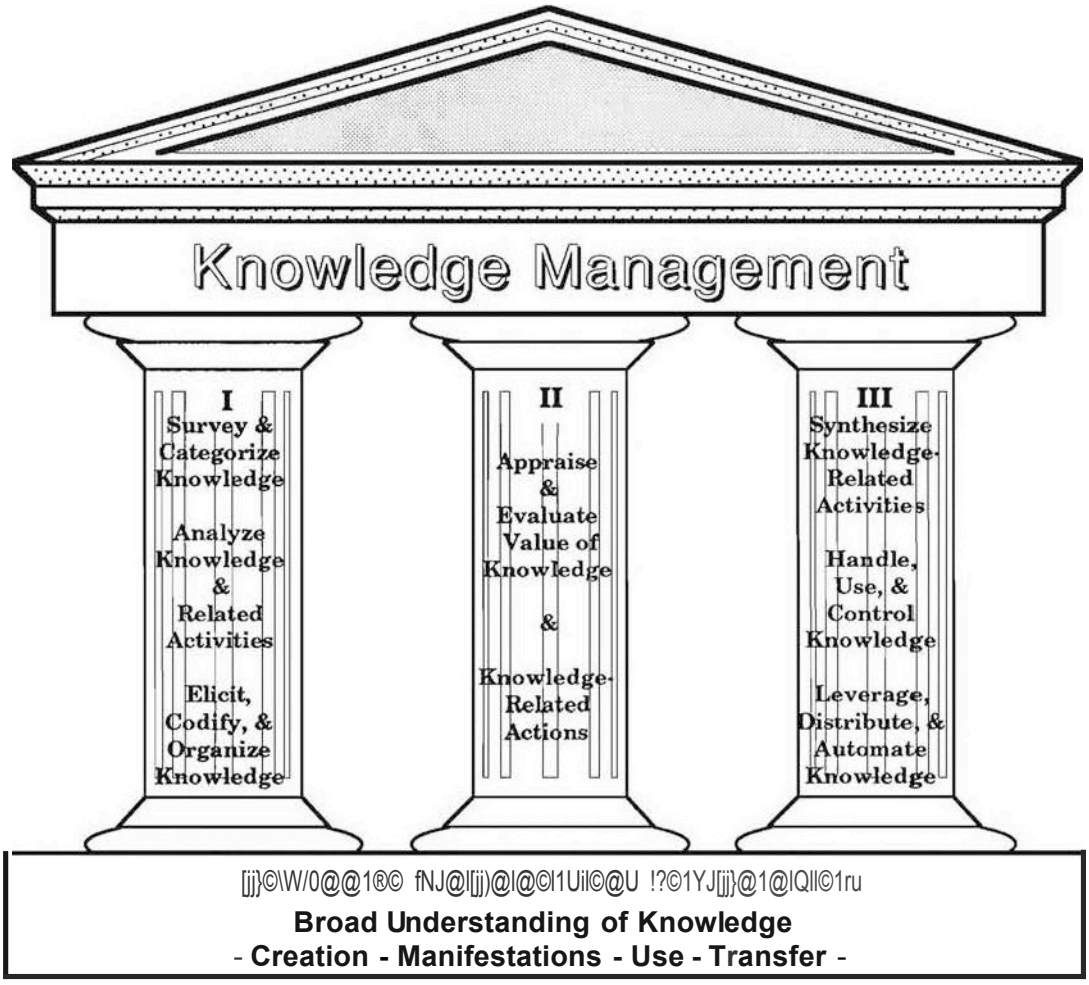
1 Wiig (1994) A Knowledge Management Framework describes many approaches and methods on which the knowledge management framework rests.

preliminary as they will be improved and modified as the field gains more experience and we develop a better understanding of applied KM. The pillars on which comprehensive KM rests consist of a number of methodologies and approaches which can be described as:

Figure 8-4. Three Pillars of Knowledge Management.



L Explore the Knowledge and Its Adequacy

-- Survey Knowledge
-- Categorize Knowledge (i.e., describe and characterize)
-- Analyze Knowledge and Knowledge-Related Activities
-- Elicit and Codify Knowledge

-- Organize Knowledge

IL Establish the Value of Knowledge

-- Appraise and Evaluate the Value of Knowledge and Knowledge-Related Actions

m Manage Knowledge Decisively

-- Synthesize Knowledge-Related Activities

-- Handle, Use, and Control Knowledge

-- Leverage, Distribute, and Automate Knowledge

-- Implement and Monitor Knowledge-Related Activities

The foundation underneath the KM framework reflects our general understanding of knowledge, that is, how it is **created** and **manifested** in people's minds as well as in procedures, culture and even technology; how it is **used** in making decisions and other knowledge-related work by individuals and businesses; and how it is **transferred** -- that is how we learn and how we otherwise can capture and exchange knowledge. The objective of presenting the framework is to create a working understanding of these methodologies and approaches, show how they relate to each other and the overall task of managing knowledge, and illustrate how the concepts and methods can be made useful in business.[1]

Knowledge has normally been managed **operationally** by the managers who are directly responsible for a particular function. Often activities were devised or selected to take care of immediate problems, almost to the point of "fixing symptoms." However, supported by its three pillars of methodologies and approaches, the KM framework allows both immediate and higher-level managers to look at the underlying functions and problems. The framework can be used in planning their actions with respect to how well they serve the broader needs and goals of the enterprise and setting strategies and developing tactics that will serve them well.

[1] Extensive discussions of the underlying aspects of knowledge management are presented in Knowledge Management Foundations, Wiig (1993).

Chapter 9

The Learning Organization

Companies, as other organizations, are operated to ensure that they are successful by attaining their operating objectives to the largest extent possible. Frequently, that means they are expected to be better than their competitors and must maintain or better their financial and market positions as the world around them changes. To fulfill these expectations, companies constantly need to change and improve. They constantly need to *learn* -- from their own experiences, from research, from observations of what others do, and from any possible source that is available. To change, organizations must put to use what they learn and not forget the valuable lessons. Only when they are successful in these activities, can they be successful. As a matter of fact "for any organization to survive and have a chance of growing, its rate of learning has to be equal to, or greater than, the rate of change in its external environment."1 Some organizations are very organized in their approach to learning as exemplified in an aggressive service company in the United States.

> *A service company works hard to stay ahead of its competitors. To achieve this objective, its managers deliberately wish everyone to learn as much as they can about its customers, its competitors, the effectiveness and performance of its products and services, what can be expected in the future, and anything else that may be of importance. The company makes available what has been learned to all who can use this knowledge to its best advantage.*
>
> *This approach has led the company to adopt formal perspectives of what it needs to learn; how it wishes to learn it; what it already knows and how well suited and organized that knowledge is; who has it; where the knowledge is needed; and how to get it there. The company has implemented an impressive training program to transfer the knowledge to all who can use it. Thus, every employee spends one half day every week on learning -- in formal training or in other knowledge-building activities.*

1Garratt (1990), The learning organisation, p. xiv.

In this company, knowledge transfer occurs at several levels. On the most basic level, knowledge about jobs (i.e., task execution, prod ucts, services, etc.), are continually codified and updated into training program formats to provide employees with the skills necessary to perform their functions proficiently. On a higher level, employees receive education to learn broader aspects and underlying princi ples of such areas as their industry and dealing with people and the world in general. On yet a higher level, special programs provide insights into "knowledge about knowledge" -- how to view the knowledge they have and how it should be used, how to organize what is learned, how to learn on-the-job, techniques for problem-solving, and so on. Both theoretical concepts and practical methods for these areas are taught.

On a different level, the company embeds what they learn in the design of its products and services. It also incorporates selected aspects of what has been learned into its systems and procedures in fiexible ways that allow relatively quick updating when required. The company has achieved a reputation for having the most responsive, cooperative, and knowledgeable service representatives in its industry and is recognized for being highly fl,exible in its response to customers and for having the most up-to-date and best-performing products and services within the industry. In addition, the company has become very profitable and dominant in its market.

What Does It Mean That an Organization "Learns"?

On a broad level, an organization "learns" when it adapts to deal competently with challenges through internal discoveries, knowledge obtained from the outside, or internalized observations of external factors. On a more detailed level, it means that an organization makes its personnel continually capable of dealing intelligently with both routine work and new challenges and adapts it systems, procedures, infrastructure, and organizational arrangements to best deal with both internal and external changes.

Thus, organizations "learn" in many different ways. They learn by acquiring new knowledge that is organized and integrated with valid, prior knowledge, discarding outdated knowledge, distributing relevant knowledge to points-of-use, and using and exploiting all available knowledge to the best advantage. The particular modes through which organizations learn also vary. For example, they may learn through learning on the job, educating personnel, R&D projects, "lessons learned" programs, benchmarking, monitoring its environment -- customers, competitors, suppliers, and all other

potential sources of new insights. All these opportunities provide rich and extensive learning environments that need to be managed carefully to provide the best return for the efforts.

Learning Organizations in the Knowledge Society: Perspectives on Knowledge and Its Transfer

THE EMERGING KNOWLEDGE SOCIETY PLACES CHALLENGING REQUIREMENTS TO LEARN ON ALL ORGANIZATIONS

We have entered the knowledge society! Although we do not yet know the full implications,[1] we do know that a larger percentage of our working population than at any earlier time are knowledge workers -- much over 50% -- who are increasingly engaged in sophisticated knowledge-intensive activities. We also see that the quality of their work products and services increases; however, because of ubiquitous competition, these improvements often do not command noticeable increases in prices and, therefore, may not appear to have value as expressed in increased economically measured productivity. They are indications of desirable societal progress, as we think of it. As a consequence, however, everyone is constantly asked to "do more with less."

On the individual level, the increased requirements for knowledge workers to handle more sophisticated knowledge-intensive activities with greater intelligence result in a need for greater competency and expertise -- greater knowledge. To respond to these needs, we must prepare workers to a greater extent than ever before. Additionally, since there are limits to our mental capacity and speed of learning, people must have access to greater knowledge beyond what they can learn and hold in their minds.

On the organizational level, the increased requirements lead to a constant need for all organizations to change as Garratt stated. In addition, to perpetually redesigning their products, services, and business processes to provide acceptable deliverables to the marketplace at reasonable prices, in the knowledge society, learning organizations must also transfer sufficient knowledge to their workforce so all can act intelligently and competently and perform the required knowledge-intensive tasks proficiently -- with efficacy, ease, and personal satisfaction.

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[1] Bohme & Stehr (1986), Drucker (1993), Peters (1992), Senge (1990), and Wiig (1991, 1993).

TRANSFER KNOWLEDGE FROM EXPERT AREAS TO POINTS-OF-ACTION -- A CHALLENGING SCENARIO

Alta Co is a large service firm with a central pool of experts who work with difficult customer-related issues. In addition, they develop new perspectives, judgments, and approaches to deal with problems and work with outside experts to continually improve available knowledge. They are responsible for supporting customer representatives in over a hundred field locations whenever difficult situations occur.

Over time, as the organization grew, these activities led to thousands of daily telephone calls and e-mail messages, most of which would not be required if the field reps could be provided with appropriate knowledge. Unfortunately, the experts' ability to help was often hampered by not having as complete information on a given situation as the fields reps had. Overall, the need for field reps to refer to the central experts caused delays, was disruptive to customers, and very costly to Alta -- a highly undesirable situation.

To improve customer service and reduce costs, the firm decided to transfer as much knowledge as practical from the central experts to the field reps. The reps are well trained in the basics of their work so the major questions became one of determining how the additional knowledge they needed could best be made available to them.

Alta undertook in-depth analyses of the knowledge-intensive scripts and activities for the most important (most frequent and highest value-added) tasks, thereby identifying the knowledge required by reps to perform competently. The results also determined which knowledge the reps needed to possess in their minds and which knowledge could be provided by computer-based or other support systems.

The resulting knowledge transfer program includes several modes: education of complex and general concepts (rather than training of factual knowledge to develop skills), knowledge-based and conventional decision support systems, and several reference documents -- some paper-based and others available in electronic form. Some of the less frequent and more difficult situations still need referral to the central expert pool which has been reduced as many of the experts are transferred to demanding positions elsewhere. The pool now also assumes greater responsibility for benchmarking and building new knowledge where that is required.

WHAT CAN THE LEARNING ORGANIZATION DO?

The example in the above scenario is typical of organizations that wish to learn to deal actively with specific problems and issues. For example, they may identify a critical knowledge function (CKF) that needs attention. To decide how to deal with it, they perform detailed field work using specific

knowledge-analyses with the best expertise they have access to. As mentioned elsewhere, these organizations focus their top management's interest on the long-term business implications of having better knowledge. To them, knowledge becomes one of the most important competitive tools they have.

The learning organiza tion in the above scenario is proactive. Its management agrees that it needs to manage knowledge effectively. That implies communicating clearly how knowledge is built, managed, and used. The firm is eager to take advantage of the business implications expected from good KM. Management particularly focuses on both first- and higher-order benefits and costs. It conducts in-depth qualitative impact analyses to ascertain that it has decided to do the right things. Frequently, such cost-benefit analyses are based upon senior management's perceptions and beliefs and good business sense rather than strict quantitative analyses of first-order tangible effects.

Perhaps the two most common approaches to organizational learning are for the organization to: (l) Identify opportunities for internal changes from continued learning on-the-job and otherwise encourage creative behavior in its employees and (2) Observe and internalize valuable understanding of changes in the world around it.

ASPECTS OF THE LEARNING ORGANIZATION

Several models can be used to understand and communicate knowledge-related mechanisms. The "knowledge creation wheel" (Figure 9-1) is a working explanation of the basic knowledge building and value-adding process.I

Expanding this model, management plans for the organization to continuously build its knowledge base, having adopted the "knowledge spiral" (Figure 9-2) as its representation for this concept. As a measure of how fast the organization learns, it can identify representative cycle times for new concepts and knowledge to emerge: be perfected (built), be organized, and be put to practical use in an effort to create value-added contributions.

These broad concepts provide a beginning understanding of some of the mechanisms that lie behind the learning organization concepts. It must be realized that actual sources and handlers of knowledge as it is transferred to the points-of-use must be identified. In p'1rticular, it is important to identify

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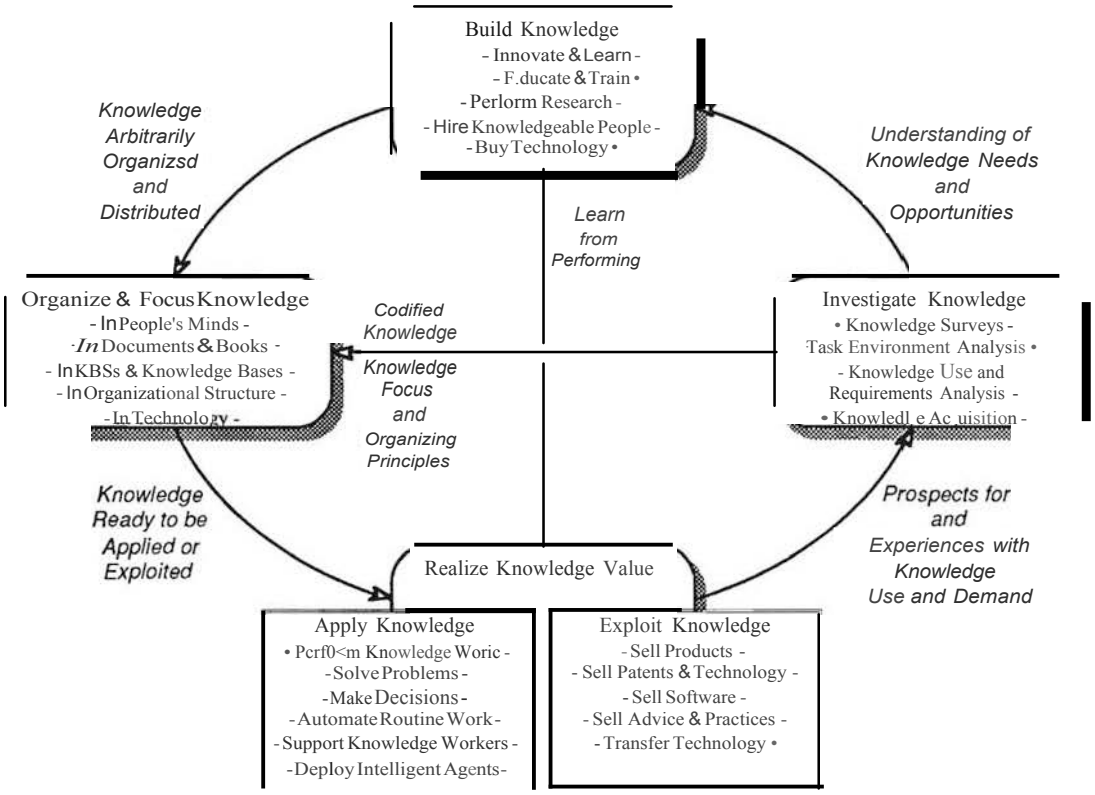
1This figure is reprinted from Wiig (1993), where it is discussed at some length.

where knowledge resides at the different transfer stages and who is responsible for the various functions. For that purpose, a high-level knowledge flow model (Figure 9-3) with more than 30 flows has been identified.

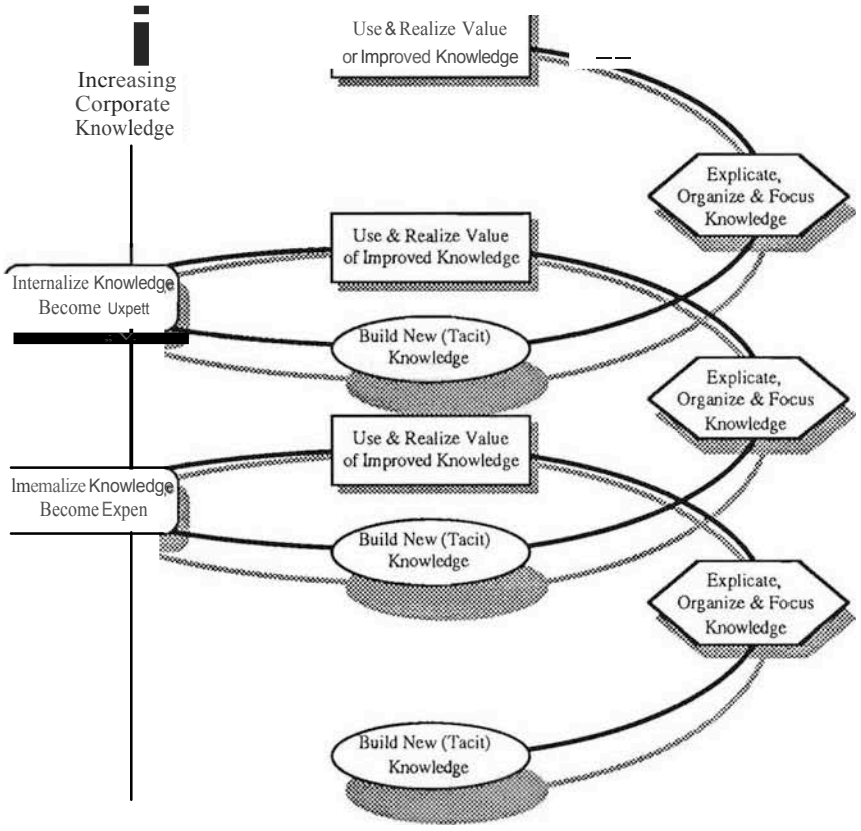
Figure 9-1. The Basic Knowledge Creation Wheel.



In the example shown Figure 9-3, five different knowledge sources were identified to transfer knowledge to the customer service representatives in the field. Three separate functions were identified as being responsible for compiling and transforming the knowledge to be transferred. The existing training department has obtained additional responsibilities to develop and deliver modern educational programs. A new, separate, multidisciplinary entity has been created in partnership with Human Resources, Training, and Management Information Systems. This group is responsible for knowledge acquisition and analysis, and for organization, compilation, and validation to ascertain that the knowledge base is properly represented, well structured, and containing only acceptable facts, concepts and perspectives, judgments,

and approaches.

Figure 9-2. Ascending the Knowledge SpiraJ.1



Knowledge is disseminated by five separate functions as shown in Figure 9-3, each having many different knowledge transfer modes at its disposition. These modes are chosen based on the requirements of the particular types of knowledge involved and the way work is performed at the points-of-action. For example, some rarely needed and relatively simple conceptual knowledge is delivered to the field as part of paper-based manuals in addition to having been treated in the computer-based educational system. By comparison, frequently needed and more complicated knowledge is taught in the form of concepts and principles, while some of the related details are provided through computer-based knowledge-based support systems.

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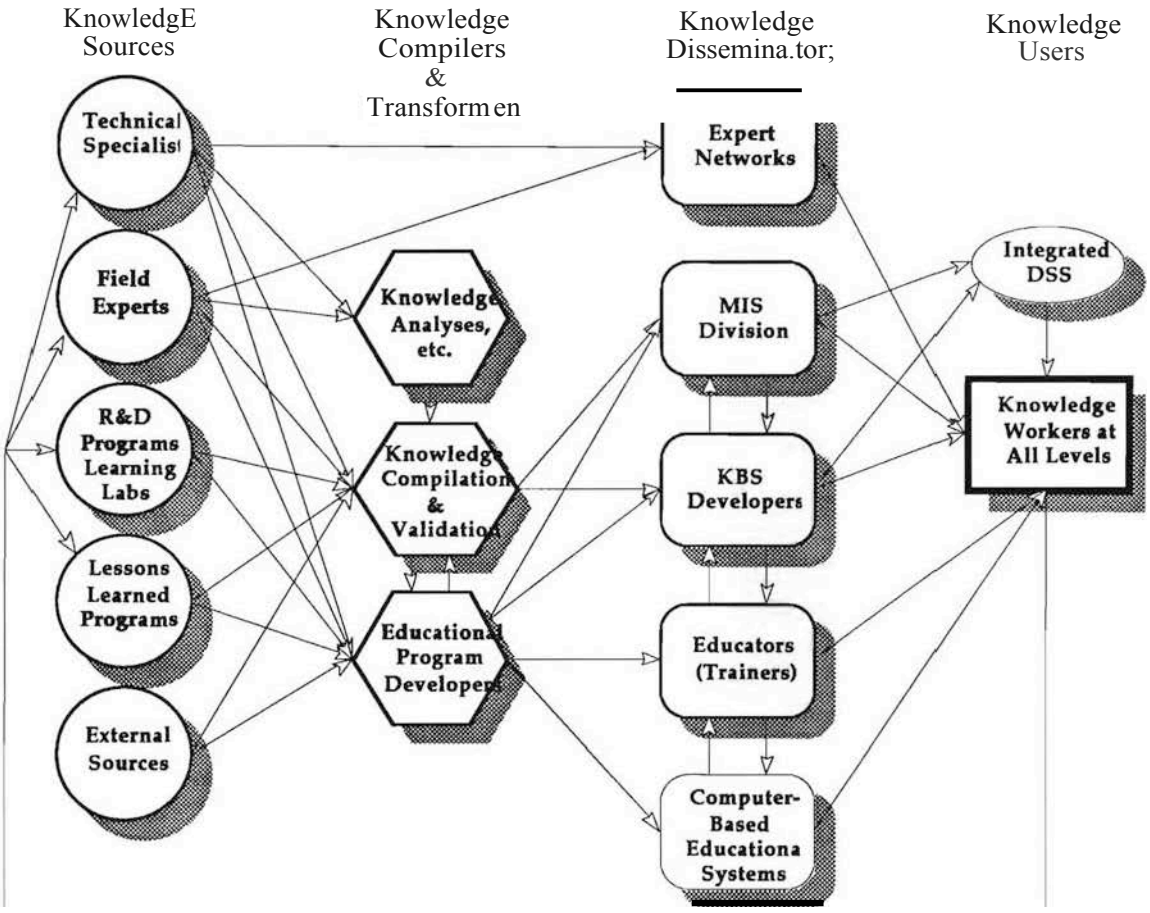
1 This figure is adapted from Ikujiro (1991) and reprinted from Wiig (1993), where it is discussed in the context of organizational learning.

Figure 9-8. Examples of lnt.ernal Knowledge Flows.



DESIGNING KNOWLEDGE-TRANSFER PROGRAMS

Knowledge transfer programs must be designed with great care to complement the organization they will serve. There are numerous knowledge transfer mode options and many of these are very effective and sophisticated but require considerable infrastructure. Knowledge-based systems is an example. As computer-based multi-media delivery vehicles are reduced in price, it makes great sense to consider these as parts of the delivery process. On the other hand, human interactions, networking, and teaming are very important and need to be considered for many important knowledge flows.

The nature and use of knowledge will determine the modes by which it can

be transferred. For example, when knowledge is stable and infrequently used and its use is not time-critical, it may be transferred through written material. On the other hand, when knowledge is to be used in quick-paced situations such as during a dialog with a customer or in a currency trading situation, it must be possessed as deeply internalized automatic knowledge in the knowledge worker's mind. In this case, therefore, it should be transferred through training and education to the people involved. Further, when knowledge is complex, by for example involving complex procedures and methods, it may be better transferred through computer-based systems.

ROLE OF COMPUTER-BASED EDUCATIONAL SYSTEMS IN THE KNOWLEDGE-TRANSFER PROCESS

Transferring knowledge from its sources to points-of-action is very valuable, but also very difficult and costly. It is expensive to elicit, organize, and structure knowledge in computer-based systems. However, when that is done, it becomes inexpensive to deploy it. By comparison, the up-front costs of teacher-delivered knowledge is often negligible, but in large organizations the cost of providing personal one-to-many education can be excessive. In addition, other factors must also be considered. For example, personal real-time education may interfere with working schedules and may involve costly travels whereas computer-based systems may provide highly flexible time management opportunities.

Designing computer-based educational systems that emphasize deep understanding of knowledge-intensive tasks is quite different from designing conventional computer-based training systems (Helander, 1988). For example, knowledge acquisition -- eliciting and organizing knowledge -- requires higher specialization and is costlier. Besides, since the specific design of these systems is a function of the particular knowledge involved, a standard approach cannot be used. In spite of these difficulties, modern knowledge transfer is already highly dependent upon computer-based educational systems and, as our expertise in this area increases, the systems will become more important.

Another value of computer-based education relates to the fact that we occasionally find that some high-performance knowledge that people need to possess has a very short mental half-life and needs to be refreshed through games, simulation, or other means. Computer-based educational systems, resident in workstations, are very useful for this purpose.

ADDITIONAL PERSPECTIVES

Learning organizations need to become experts at building and transferring knowledge from its source to points-of-action. To achieve that goal, they need to learn to deal with KM and knowledge-analysis in greater detail than most now are prepared to do, and they need to have people with the necessary technical expertise to staff all KM-related functions in the process.

When considering how knowledge should be managed, it is imperative that the process be driven by senior management's perspectives of how and where the business should go. Similarly, it is important that potential value-added contributions from KM actions be considered, given senior management's visions for higher-order market reactions and such issues as what it means to deliver quality products and services into the marketplace.

For a learning organization to be successful in these efforts, its culture and incentives must be changed to facilitate and promote all activities that need to become second nature for everybody within the organization. They need to learn at every opportunity, as well as share knowledge with others. It is clear that if the culture and incentives support the separate contributions of individuals -- rather than team efforts or the overall organization -- there will be little motivation for experts to share their knowledge with others.

The very notion of active KM implies a particular management philosophy. Thus, when a management team promotes the concept that knowledge must be built and deployed to the best advantage of the organization, it follows that knowledge is distributed to the point-of-action so that it can be applied at the time of maximum impact by the people who are present and responsible for that operation. It also follows that knowledge building -- learning -- must play a major role to enable people to improve the way they perform work within the present process as well as to improve the process itself. The knowledge flows must be kept efficient -- as short as possible -- and learning must take place where all relevant perspectives and collaborative knowledge can be brought to bear to produce the most insightful interpretations and generate the best new knowledge.

Organizations Learn in Many Ways

An organization "learns" and builds knowledge in many different ways. We need to think about our organizations from the perspective of how they

accumulate knowledge, insights, and valuable expertise over time. From a broad and aggregated perspective, one of the most important ways to measure that a company learns over time is to chart the accumulated benefits from all its improvements.

One widely accepted model for how organiza tions benefit from accumulation of experience is illustrated by the "Accumulated Experience Curve Principle" or the "BCG learning curve" shown in Figure 9-4.1 This principle is based on the phenomenon that companies are able to gradually reduce their internal costs and delivered price as the accumulated production volume increases. The BCG learning curve is widely used as an indicator of how well an organization has been able to learn from its experience. It expresses how the company's **cost** for a product is reduced over time as a function of the number of items produced and compares the internal cost with the market **price** for the same product. If the company learns well, its costs will be reduced faster than the market price is reduced and the organization will be able to achieve a profit.

According to the BCG learning curve, continued manufacturing experience allows an organization to learn more about how to rationalize and improve the production process and the product itself. This principle is valid for all types of organizations -- manufacturing companies, service firms, and public agencies. However, it is a macroscopic perspective and does not provide detailed insights into precisely how and where learning might, has, or should take place.

The world around us changes constantly. Our work environment and our daily work tools change; our relations with coworkers, customers, and suppliers change; and our competitors become better. People must constantly learn to take advantage of their new and changing work environments and to perform the new tasks that new products and services require of them. Similarly, the organization itself must be changed in terms of its structure, operating practices, and standards Also, it needs to change its products and services to fit into the markets as they change. As a result, the organization must forever continue to learn. However, at the same time, it must not forget any of the valuable knowledge it already has.

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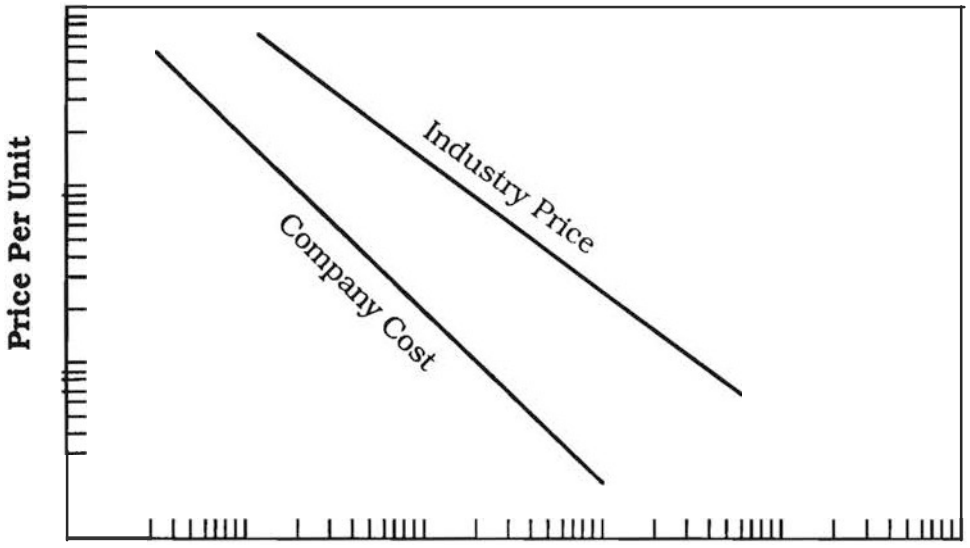
[1] The Accumulated Experience Curve Principle was proposed by Bruce Henderson of the Boston Consulting Group. It has since been called the BCG learning curve, or the BCG experience curve (Henderson, 1979, p. 110) and is widely used as an indicator of how well an organization has been able to learn from its experience.

Figure 94. Accumulated Experience Curve Principle.



A different and more basic perspective on the need for an organization to learn is emphasized by Dr. Demingl in his fifth principle for transforming an organization: "Improve constantly and forever the system of production and service" Dr. Deming emphasizes further that it is imperative that learning from experience be deep:2 "Experience without theory teaches nothing!" This perspective is in full agreement with the view that it is not enough to train people in new skills to make them proficient in performing their tasks. They must also be provided with systematic knowledge to help them construct r,eliable mental models that they can use to build new knowledge and to understand the underlying principles.

Dr. Deming's emphatic statement points to another requirement. In order to learn about or create comprehensive new solutions, it is necessary to investigate in-depth and with thorough understanding. Such creative investigation is only possible if all involved possess the requisite knowledge, the requirement that the necessary knowledge must be built into the system, or

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1See Deming (1986) Out of the Crisis, p. 49. In this book Dr. W. Edwards Deming discusses his 14 principles for transformation. Dr. Deming is considered the father of modem Total Quality Management or, as many now prefer to term it, The Deming Management Method. A very readable expose of Deming's Management Method is presented by Walton (-1986) The Deming Management Method.

2 See Deming (1986) op. cit. pp, 19, 317, 403-4.

otherwise made available to the people who perform the investigations.

Some of the important, detailed ways an organization builds and accumulates knowledge are indicated in Table 9-1. Several of these examples illustrate how knowledge is built in individuals who then can perform their work better. Other, and quite important, examples deal with how the organization learns by building knowledge in repositories outside people. Part of this area is starting to involve advanced information technology. We can expect the use of automated reasoning systems (expert systems) and knowledge bases to become more important and commonplace as the technology of knowledge-based systems is perfected and becomes more widespread. Still other examples show how the organization learns and builds knowledge by embedding it into its infrastructure and its products and services.

Table 9-1. Examples of How an Organization warns and Builds Knowledge.

METHOD of Knowledge Building	*PURPOSE* of Knowledge Building
Build Knowledge in People.	
Train People	Transfer Skills & Know-How to Perform Tasks
Educate People	Transfer *Basic* Knowledge & Understanding
Learn On-the-Job - 1	Improve Ways of Performing the Task
Learn On-the-Job - 2	Improve Ways of Redesigning the Task
Hire Knowledgeable People	Obtain Knowledge That Is Missing or Sparse
Build Knowledge in Repositories Outside People.	
Document Knowledge in Manuals	Codify & Distribute *How-To* Expertise
Document Knowledge in Books & Articles	Codify *Basic* & *How-To* Expertise
Build Knowledge Bases	Codify & Archive *How-To* Expertise
Build Expert Systems	Codify, Distribute, & Automate *How-To* Expertise
Perform Research & Document Results	Create New *Basic* & *How-To* Knowledge
Build Knowledge by Embedding.	
Embed Knowledge in Technology	Improve Technology & the Way It Is Used
Embed Knowledge in Standards	Improve Standard Technology Solutions
Embed Knowledge in Operating Practices	Spread Better Ways of Operating to All
Embed Knowledge in Organization Structure	Facilitate Operations Based on Experience
Embed Knowledge in Systems & Procedures	Make It Easier & Required to Use Better Methods
Embed Knowledge in Products & Services	Improve Products & Services

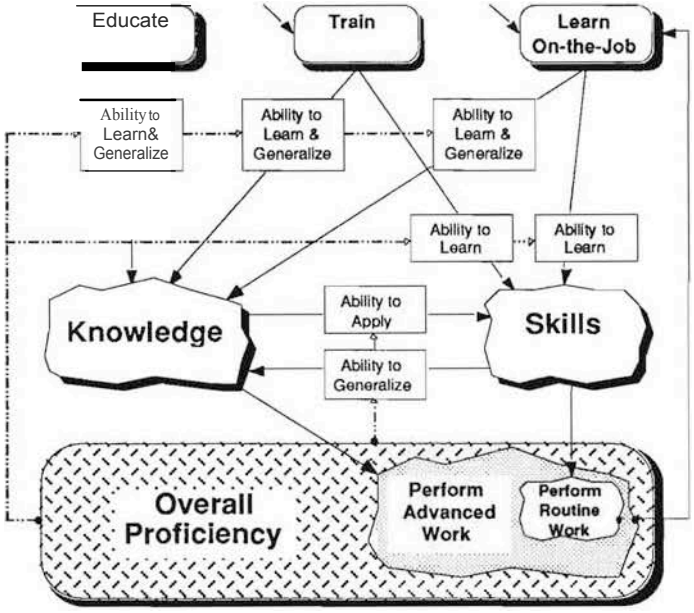
Perspectives on Knowledge and Learning in the Company

A PROCESS MODEL FOR LEARNING

To fully grasp how learning occurs in the organization, it is helpful to consider a model for how people learn through education, training, and on-the-job. One such model, shown in Figure 9-5, includes different kinds of learning associated with building knowledge and skills; overall proficiency; and the ability to learn new knowledge and skills, generalize information to build knowledge, and apply knowledge in practical situations.

As indicated in the figure, we normally do not expect skills to be built through education. Skills in the form of "how-to" expertise are usually built by training and on-the-job learning. Education by comparison, builds deeper and general understanding and knowledge of a domain. Knowledge in turn, is required for a person to build overall proficiency and to achieve the ability to perform both advanced and routine work.

Figure 9-5. Idealized Perspective of Personal Learning Processes under Various Conditions and for Different Purposes.



When we consider how an organization learns, the process is much more

complex, as implied in Figure 1-2. For example, numerous feedback flows from the operation of the organization and from the outside world lead to building of knowledge and expertise. In addition, there are numerous learning mechanisms associated with building knowledge in all the different embedded forms within the organization itself.

KNOWLEDGE FLOWS

In considering how learning takes place in a corporate setting, we need to analyze how knowledge flows from sources to recipients (or learners). That is, we need to identify and analyze the knowledge flows both at particular moments in time and over longer periods to ascertain that the transferred knowledge is picked up and received by people or repositories from where it can be made available and applied to good advantage. A general example of typical knowledge flows is shown in Figure 9-6.

Normally, we consider three levels of knowledge flows. The first level is the flow of knowledge from the primary knowledge worker to the work object when the knowledge worker performs his or her normal work task. (This is shown to the left in the figure.) Although this knowledge flow does not involve any learning, it is important since it is the flow that is associated with realizing the value of knowledge by using it to "do the job."[1]

The second-level knowledge flows are associated with bringing knowledge to the knowledge worker to make it possible to do the job better. These knowledge flows involve many types of knowledge building and learning. Perhaps the most important flow on this level is the on-the-job feedback and the learning that takes place by abstracting, generalizing, and organizing personal experiences of this kind. (Not shown in the figure are the knowledge flows to knowledge bases and secondary knowledge workers who contribute to the knowledge pool that is used to do the job.)

The third level of knowledge flows deal with learning about broader aspects of the task environment to improve the capabilities to redesign and restructure the work function. Not shown in Figure 9-6, that aspect is of great importance for an organization that focuses on changing itself to maintain its competitiveness.

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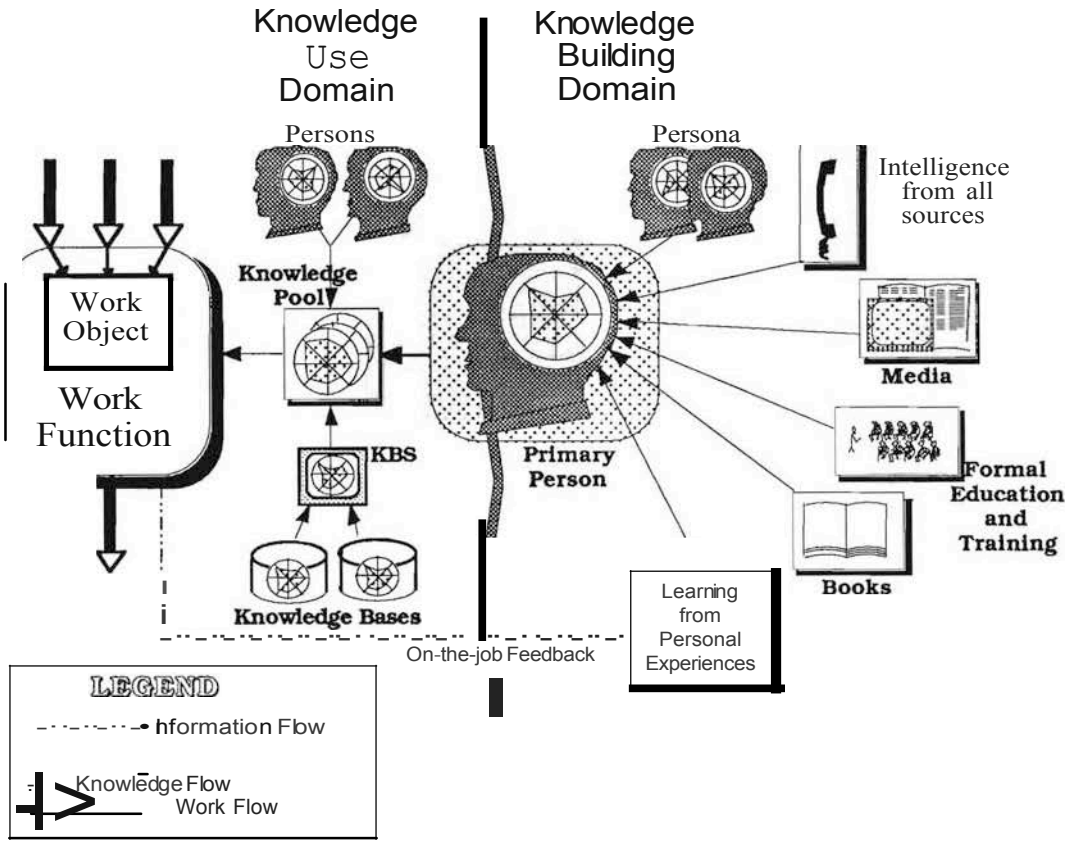
1 In practice, the "primary knowledge worker" may be a single person; a group of knowledge workers who are pooling their knowledge to perform their task; one or several people augmented with knowledge-based systems or other automated or nonautomated knowledge repositories; or it may be a fully automated function with no people involvement at all.

Figure 9-6. Direct Business Use of Knowledge with Indications of Select.eel Knowledge Flows in the Knowledge-Use and Knowledge-Building Domains.



Organizations Forget and Miss Learning Opportunities

Organizations lose good and valuable knowledge in many different ways. A typical example is found in the following experience:

A medium-sized engineering company experienced reduced demand for their services. Its business was cyclical, and its management was convinced that the setback was temporary. Nevertheless, it was decided to downsize by laying off one-third of the engineers -about 300.

The company did not have a good overview of which departments and employees possessed critical knowledge. As a result, the top managers decided that all departments were to cut their staff by 30% to achieve the desired overall reduction.

Nine months later, the company received several large orders that required more engineers with critical design expertise than were available. It was realized that over 20 such experts had been laid off from the design department -- the largest with most experienced engineers. Attempts to hire back these experts resulted in three returning, the rest were unavailable.

As a result of the shortage of experts, the company needed to team with one of its competitors with a significant loss of revenues. The management team realized that it had made a grave error by downsizing across the board and initiated a program to develop a "skill inventory" to obtain an overview of where its critical knowledge was located.

The company in this example realized that it needed to change its practices to manage the knowledge-related situations deliberately for future situations. Nevertheless, it had lost valuable expertise by not focusing on knowledge and paid a stiff price for that. This experience is shared by many companies that downsize without ascertaining that they retain critical expertise.

Many companies lose knowledge when they reorganize. Much valuable knowledge in an organization is associated how and whom to network with to perform daily work. After major reorganizations, new reporting and work relationships need to be established -- a learning process is costly and it may take the better part of one year before the organization becomes fully functional again. Knowledge may also be lost when people are promoted into new positions and are not available to offer their accumulated expertise to perform their former tasks. What makes the matter worse is that it is often bright and capable persons who are promoted, whose insights and judgments would be particularly valuable to capture.

We also encounter that a person participates in a situation that occur infrequently (ranging from accidents to "one-of-a-kind" projects), learns a great deal about it in the process, but is not debriefed to capture the knowledge and understanding acquired. Thus, the next time a similar situation occurs, the lack of knowledge is sorely regretted and valuable time and effort have to be expended again.

The Company as a Smoothly Operating Learning Organization

If we accept the premise that the organization needs to learn, we have to build knowledge in people or other repositories, and by embedding it as

indicated in Table 1. These functions must be performed as effectively and efficiently as possible. Effective and efficient organizational learning takes place when we (1) Identify which knowledge needs to be transferred and built, (2) Design the best approaches, (3) Set priorities and assign resources, and (4) Use well-designed methods to perform the different tasks that are required.

Effective and efficient organizational learning cannot be achieved by a central, top-down approach only: It is impossible to survey, analyze, design, appraise, and schedule all the learning opportunities within the organization from a central perch. A corporate perspective is required to put into place a framework, organizational practices, and incentives that will allow each department and manager throughout the organization to initiate and facilitate Selective and focused knowledge building within each local area. However, without a practical, detailed framework such as that indicated in Table 7-2, executive and middle managements cannot build the required learning environment. Upper management may have the visions, but they need the assurance that practical and useful solutions and methodologies exist before they are convinced that a learning environment should be created. Middle management must have access to practical strategies and be able to identify tactics in the form of guidelines and well-designed methodologies before they can create their part of the environment. Only when these building blocks are available is it possible to create the "tall" learning environment needed for the whole organization to learn continually and smoothly.

Can We Improve?

According to what we know today, it is a requirement that for an organization to be viable, it needs to approach its knowledge building and learning tasks in a focused and methodological manner and with perspectives that are quite different from our traditional ones!

It is quite clear that we can improve the organization's ability to learn. It is equally clear that to improve organizational learning requires a broad set of activities that includes, but goes far beyond, educating individuals or groups of people. It also goes far beyond such technical solutions as building and deploying knowledge-based systems. To improve organizational learning today requires that a comprehensive and consistent KM strategy be adopted, including a knowledge architecture designed to guide knowledge building and

knowledge cumulation activities and capabilities. These efforts must be initiated and led by the enterprise's leaders. In addition, new expertise must be acquired, such as knowledge professionals, to make possible competent delivery of the conceptual, business application, human resources, cognitive, and technical aspects of the process. The problem is that, at this time, we do not have many of these specialized professionals in the average organization.

As part of the adoption of a KM strategy, we must start considering the use and roles of the spectrum of knowledge repositories that are available within tlhe organization. Examples include the employees themselves, documents of all kinds in file cabinets and in organized libraries, and formalized computer-based knowledge repositories.

One way to improve an organization's ability to build knowledge is to identify explicitly the various learning mechanisms that traditionally are used to build knowledge within the organization. In the past, embedded knowledge was often built without realizing it. For example, systems and procedures, products and services, and so on, were "just improved" without us being explicitly aware of what that entailed from a KM perspective. To these traditional approaches we now need to add the new methods and tools that are available to build knowledge.

Another way to improve knowledge building is to reduce what the organization forgets unintentionally. That is, it needs to become better at retaining what has been learned and be less destructive when cutting budgets, reducing head-count, as well as reorganizing and promoting people.

Finally, the most important way to improve the organization's ability to learn is to install a broad learning environment with all the necessary policies, incentives, and tools. Only then will the company become a successful learning organization!

Corporate Learning -- Japanese Style

The Japanese have shown an unequaled willingness and capability to listen and learn -- to assimilate and organize new knowledge obtained from visits to other countries to see other approaches and technology solutions. Thus they have been willing to set aside their egos to a much greater extent than the majority of their Western counterparts. Their personal feelings are not dictated by their need to show off how much they already know. Instead they are reinforced by a much longer view -- by how much they will be able to

achieve compared to the rest of the world (in the face of their competitors) by learning wha t the rest of the world already has learned -- and selecting the best of that knowledge. The Japanese are willing to engage in extensive knowledge transfer and in building knowledge by adding other parties' knowledge to what they already have accumulated. They attempt to "stand on the shoulders of the rest of the world."

In this process, the Japanese are willing to think explicitly of what they plan to use the cwnulated knowledge for. They organize and arrange the new knowledge accordingly -- in their minds, and in extensive labor-intensive sessions -- to assess what has been learned. For example, when visiting foreign companies, Japanese visitors assemble to discuss in-depth what they have learned that day and to document learnings immediately while also planning for the next day's exploration. Many of them suggest that they are not very creative when engaging in this process. That, however, is arguable since building knowledge by importing it is only one approach, and they do that very creatively. That the imported knowledge is put to good use and built upon in very creative ways is quite clear -- the Japanese are awarded more patents per capita than any other nation at this time!

Rugged Individualism and the Not-Invented-Here (NIH) Syndrome

There are many cultural differences between the societies of continental Europe, Japan, and USA. One difference of importance is the value placed on personal freedom and independent behavior and that this appears to result in. In the United States, most people value self-determination very highly. In practice, this leads to rugged individualism with a tendency to "act without consultation" and to make decisions based on whatever information and knowledge is at hand at the time. Such behavior may lead to innovation, breaking with outdated traditions and old concepts and creating new ways of dloing things. But at the same time it may lead to "reinventing the wheel" and pronounced manifestations of the "Not-Invented-Here" syndrome. Besides, it frequently results in inferior practices.

What is worse, independent decision-making of this kind frequently leads to neglecting what has been previously learned and what is already known about a subject. Consequently, it may result in "ground zero" behavior or "clean-sheet design" instead of building on the experiences of others. This in turn can

lead to a plateauing of the proficiency and knowledge reached by a particular person or organization. Similarly, if instead of seeking the best knowledge available the knowledge and understanding that is accumulated for a given task includes the limited understanding and ideas of an isolated small group or on the limited experiences with a few operations or plants, the opportunities for growth of new knowledge are reduced.

On the other hand, in a culture that is open to outside ideas, where personal independence is emphasized less, and where teamwork and collaboration are the norm, the building of new knowledge may be faster and reach higher levels than in the freedom- and independence-minded societies.

American Self-Reliance

Americans, in contrast, often take a totally different path towards building knowledge. We are known to rely on our personal and independent inventiveness and creativity to generate new knowledge. In the process, we build up our own self-esteem and self-reliance with what we create. And we are often ignorant of the existence of the same or better knowledge than what we can create ourselves. Our culture -- and often our incentive systems -- reinforce this insular behavior. In some organizations it is even considered a sign of weakness to ask for assistance and admit that someone else may have a better solution. The NIH syndrome is at work again!

However, there is another side to the American way of working independently. By having different parties working in relative isolation we develop alternative solutions to similar problems. We obtain different perspectives and approaches and, therefore, generate a richer and more robust body of knowledge. It is our collected experience that this has been very valuable as it has allowed continual improvements. When the limits of one technology is about to be reached, another with greater capabilities is ready to take over as exemplified in medicine, manufacturing, and information technology, to name just a few. And research by independent units makes this process very effective.

Corporate Learning -- Advanced American Style

The Japanese are not the only ones who go out of their way to learn extensively and creatively. When advanced American companies decide to

benchmark and open their minds to learning from others, they do so with impressive results, actually better than the Japanese, in our opinion.

One superb example that has been widely published is Chaparral Steel in Midlothian, Texas. [1] Chaparral has achieved an operating performance, product quality, customer service, and internal culture that few others can match. According to those who understand this industry, Chaparral Steel is a world leader in efficiency and quality. In addition, they have created an organizational structure and worker environment that promote acquisition, cumulation, and application of the best possible knowledge.

Another example of an advanced U.S. company is a large Fortune 50 company. The top technical people and executive managers in this organization are relentlessly searching for ways better to operate and manage and apply technology in improved ways to approach the theoretical limits as closely as economically possible. This corporation undertakes benchmarking by visiting with all the "best-of-breed" practitioners throughout the world. They Conduct the same type of nightly debriefing sessions the Japanese are renowned for. In addition, they conduct extensive R&D programs in their laboratory facilities, which may be the best of their type anywhere in the world.

All these activities are driven by top management's conviction that their success is a direct function of how well the company learns -- as individuals and collectively as an organization. The interesting point is that while the two companies just mentioned may not be the American norm, they are far from isolated examples. A large number of organizations in the U.S. conduct their affairs with similar vigilance and have decided that they need to learn everything they can to stay abreast of their competitors.

One company, Teltech Resource Network Corp., capitalizes on the needs of advanced enterprises to manage knowledge better by obtaining outside expertise whenever required. Teltech provides data-bases of thousands of subject matter experts for their clients and can identify precisely how their Services assist in obtaining better KM and how that brings bottom-line value.

Frequently, we find that the organizations that are most interested in learning already are at the forefront of their industry. That means that much of their new learnings will be found in other industries and that they need to transfer the new insights to their own application areas. Such transfer is difficult and demands considerable effort and initiative beyond the creative visions that is required to see the possibilities. In particular, considerable broad technical and world knowledge must be available to envision the opportunities and perform the translations.

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[1] See Leonard-Barton (1992) and Garvin (1993).

Chapter 10

The Kno"7ledge Society and Kno"7ledge Managentent

The Knowledge Society

We have started our entry into the knowledge society -- within the U.S., Europe, the Pacific Rim, and the rest of the world. The change is global and the manifestations are many.1 But as for any societal changes, this process is gradual and does not yet affect everyone to the same degree. For example, in many developing countries in Africa and some in Latin America and Asia, most people are not directly affected by these changes although their country's economic position in the world may already have been greatly influenced.

The issues of changing to the knowledge society are in reality more social than economic and business and as for all social changes, they are often difficult. As such, they touch on us as individuals and affect our life choices -- how we educate ourselves and what work we prepare ourselves for and pursue. For many, their quality of life is also affected by the ramifications of the knowledge society. The way business, commerce, and industry are affected is disruptive and very rewarding at the same time. Social values are

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1See Gemot Behme & Nico Stehr (1986) The Knowledge Society, Harlan Cleveland (1985) The Knowledge Executive, Sveiby & Lloyd (1987) Managing Knowhow , Peter Drucker (1989) The New Realities, Taichi Sakaiya (1991) The knowledge value revolution, Joseph Badaracco, Jr. (1991) The Knowledge Link, Tom Peters (1992) Liberation Management, and Peter Drucker (1993) Post-Capitalist Society.

Behme & Stehr (pp. 7-30) discuss social impacts. Cleveland provides broad views of knowledge's role in all aspects of society. Sveiby & Lloyd (pp.187-201) present a number of the changes that are taking place, including the paradigm shift that many need to experience. Sakaiya focuses on how knowledge reshapes products and services and customer demands. Peters focuses on the new roles of companies and management in the knowledge society. Drucker (particularly in Post-Capitalist Society) places the whole concept of the knowledge society into historical perspectives.

changed; economic bastions are ruined; new power centers are emerging; and tantalizing opportunities are pursued with success.

The prospect of the knowledge society has been contemplated by social scholars for several decades. An early and significant perspective was provided 20 years ago by Daniel Bell,1 who proposed that we were about to emerge into the knowledge society from the industrial society already then. The knowledge society (his term: "Post-Industrial Society"), Bell suggested, was already recognizable by two characteristics:

1. "the sources of innovation are increasingly derivative from research and development (and more directly, there is a new relation between science and technology because of the centrality of *theoretical* knowledge)"; and
2. "the weight of society -- measured by a larger proportion of Gross National Product and a larger share of employment -- is increasingly in the knowledge field."2

These were notable changes from the industrial society where innovation mainly resulted from evolution and GNP was mostly generated by production of physical products.

In the years since Bell's statement, these characteristics have become more pronounced, particularly in highly developed nations to such an extent that knowledge in one form or another, but particularly as te chnology and individually possessed expertise, has become the economic and competitive differentiator.

As more corporations become knowledge companies, we see a power shift away from financial capital to knowledge capital. "The hegemony of financial capital is coming to an end. It is being replaced by knowhow capital which is mobile and heterogeneous" as Sveiby and Lloyd state it.3

Gernot Bohme and Nico Stehr suggested that the new type of society we have entered into is extensively dependent upon thoroughly researched and validated knowledge -- "scientific knowledge"4 -- and that it penetrates all aspects of life. Their notion is that everyday knowledge and knowledge used in industry and business is increasingly based on systematic knowledge instead of arbitrary experiences and unsubstantiated beliefs.

Increasingly, new power structures and personal social standing also are

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1 Published in The Coming of Post-Industrial Society, Bell (1973).
2 Ibid., p. 216, as quoted by Bohme & Stehr (1986) The Knowledge Society, p. 9.
3 Sveiby & Lloyd (1987). Managing Knowhow, p.39.
4 Behme & Stehr used the term "scientific knowledge" to denote what we think of as Systematic Knowledge or theoretical knowledge.

based on such knowledge. Knowledge-based power starts to dominate the old power bastions of property (including financial wealth) and labor only to end up becoming the major productive force in the knowledge society. In many sectors this has already happened, as evidenced by the information industry and its effect upon organizations of all kinds. However, there are problems with our understanding of what goes on. As an example we find that in the U.S., we still cannot account properly for intellectual deliverables as part of industrial output. Yet, within the computer industry, more than 80% of a computer's cost is software -- intellectual deliverables or captured knowledge -- while the remainder is physical goods, or hardware.1

WE SEEK IMPORTANT CHANGES

Rather than a "supply push," the knowledge society is caused by "demand pull." As customers of goods and services and members of society, we are increasing our demands in many ways, thereby changing the requirements that our suppliers must meet to satisfy us. We ask for many changes to:

- Obtain improved quality of life in all areas
- Receive individualized products and services that will fit more closely our particular situation
- Improve the cost-effectiveness of all operations to increase the goods and services available to each individual -- to obtain progress for all
- Create and use more complicated and sophisticated products
- Run our lives in more sophisticated ways with more attention to health, the food we eat, and more effective nurturing environments for our children
- Make better and less damaging but much more comprehensive and, therefore, more complex, decisions about social and environmental choices, and the way we govern

Consumers are becoming highly educated and much more discriminating. In the knowledge society, buyers at all levels -- including consumers -- are increasingly demanding quality and individualized goods and services. The days of the black Model-T Ford are long gone. They want whatever they acquire to match their needs to the largest extent possible, and they tend to reject anything that is not of excellent quality. But still, buyers want to pay as little as possible and that requires diligent application of our best knowledge of how to be efficient in production and service delivery. Taichi Sakaiya discusses

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[1]Robert Reich (1992) The Work of Nations, p. 83.

the changes that are taking place in the marketplace as do Stan Davis and Jim Botkin.1

These demands place new requirements on suppliers of goods and services, forcing them to become more flexible and versatile. Customer situations often present new conditions to be addressed. They require suppliers in the knowledge society to act intelligently, with extensive knowledge of customer situations, their driving forces, potential solutions to the individual requirements, as well as their own operations. Further, in order to provide the desired product or service with agreeable response and costs, the supplier must also be highly efficient and effective.

As customers become more knowledge, their sophistication increases which, in turn, increases their discrimination and special requirements. To meet these demands suppliers must acquire more knowledge and sophistication which, again, serves to educate customers even further -- hence twisting the progress spiral another revolution.

LET US NOT RESIST CHANGE!

Many -- if not most(!) -- knowledge workers and managers in Europe and North America tend to adopt a low-risk, conservative perspective and approach to their work, their personal life, and even to their visions and dreams. There is almost a tradition, that it is socially acceptable to wish for the world to come to a relative stand-still to make it possible to continue practicing what one has become good at over the years. Under this model, the goal is to continue exercising the judgments that have proven reliable and to maintain the contacts and relations with others that have so painstakingly been developed. People who adopt this model hate change and avoid growth in any direction -- personal, professional, and organizational. People and societies that adopt this model appear to have grown old! The conservative behavior that makes many of us abhor change is often rooted in fear. We do not have knowledge to project what may happen and how to deal with the new situations and are, therefore, unwilling to deal with the insecurity of uncertainty.

What is needed in progressive business are the youthful traits of risk-taking, curiosity, venture, and progress. These traits must also be married to compassion, long-term perspectives (that is, a view of the future and a wish to

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1Sakaiya (1991) The Knowledge Value Revolution, and Davis & Botkin (1994a) The Monster Under the Bed: How Business Is Mastering the Opportunity of Knowledge for Profit.

also live for tomorrow), and the take-charge optimism that is founded on the conviction that by acting it is possible to change the course of events.

If youthful traits such as these are exercised without knowledge, however, the results are usually disastrous. Without knowledge, judgments are often nonexistent, or at least arbitrary and limited, and the ability to create workable options is severely curtailed. With improved knowledge, on the other hand, it is possible to reduce risks, embark on progressive and nontraditional paths, and have considerable chances for success.

OLD VALUES LEAD TO WRONG DECISIONS

Another issue in the new knowledge society environment that has caught many by surprise is that old values and judgments often become invalid -- or are even wrong. One such judgment is the old notion that "labor" is a variable cost that can be turned on and off as demand requires.

In the knowledge society, the knowledge-intensive industries' major knowledge assets reside within the minds of workers at all levels. Thus, a great deal of the assets reside in the highly trained workforce that execute the tasks necessary to create and deliver end products and services. In the past, it may have been possible to train workers to perform competently in a few weeks, or months at most. However, in the present, more sophisticated, work environments with their requirements of greater intelligent-acting behavior, it takes much longer -- often years -- to bring entrants up to acceptable performance levels. In addition, if workers are furloughed for months and then brought back, experience shows that their need for retraining is often excessive. Besides, highly trained workers may be in demand in competitive environments, making it difficult to hire the same people back once they have been let go. Skilled and educated workers are not interchangeable the way they were often thought of earlier. They are not a commodity. Given these factors, it is not possible to "peak-shave" with labor by terminating and rehiring as demand changes.

Many other older judgments may also be inappropriate in the new environment, which movements such as TQM have started to make apparent. For example, values and judgments based solely on costs and financial considerations have given way to an understanding that quality and other factors play important roles as driving forces. High-technology industries have long understood that their technology positions were part of their real assets -- if not always part of their book values. Yet, very few companies

understand the full extent of, and have developed judgments for, the values of their knowledge assets and how they should be handled to the organization's best advantage.

Knowledge Concerns Emerge in National Plans

Having realized that knowledge is the driving force in the new world society, several nations have incorporated specific steps into their national plans for pursuing knowledge and knowledge-based industries. Singapore, for example, in her national plan has emphasized steps to buHd knowledge, support of the knowledge industry with research centers, and grants for grass roots enterprises and education. In addition, Singapore has explicitly expressed support for knowledge-intensive industries, ranging from high-technology firms to sophisticated financial institutions. Similarly, in Europe, France and the Scandinavian countries also emphasize goals for knowledge-intensive activities in their long-term plans, although not as explicitly as Singapore.

Such steps on behalf of sophisticated nations indicate that they not only are aware of the importance of knowledge in their countries and in international competition. The steps also suggest that the leaders are convinced about the necessity -- and feasibility -- of strengthening their country's knowledge-base and allocate significant resources to achieve that goal.

In the U.S., we have also recognized the need to strengthen our educational system, improve the preparation of our children and youth, and support specific high-technology industries that, in fact, are knowledge-intensive. However, we do not have the same explicit focus on activities and economic sectors that must be emphasized. Nor have we outlined the specific action steps of other nations.

The Emerging Knowledge Management Culture: Putting It All Together

The KM methods, options, viewpoints, and effects we have discussed so far represents a broad and varied machinery, designed to provide a different and important approach to managing the organization's fundamental resources to ascertain viability and success. Putting all the pieces together

- Yields powerful opportunities to manage the organization in ways never before attempted
- Makes it possible to tackle issues that CEOs unanimously express must be addressed, but which they also agree they do not know how to approach
- Provides management teams the tools for making their organizations survive and thrive in the competitive environment of the emerging knowledge society

When we look at the whole issue of KM -- how nowled ge affects the effectiveness of all organizations, what the options are for creating, organizing, keeping, transforming, disseminating, and using knowledge, and what the potential business values are from pursuing KM -- we realize that it all is interconnected in ways that previously may not have been appreciated. Not only are the knowledge-related functions and activities interrelated, when pursued effectively (with everyone focusing on how to act intelligently now and to position themselves to do so in new and different situations), KM becomes integral to most of what happens -- it becomes part of the culture. And the KM culture is by its very nature both reactive and proactive. It is reactive in that it observes and learns from, and adapts to, external and internal changes. It is proactive in that it prepares for anticipated needs by building, organizing, and keeping important knowledge and placing it where it is expected to be useful.

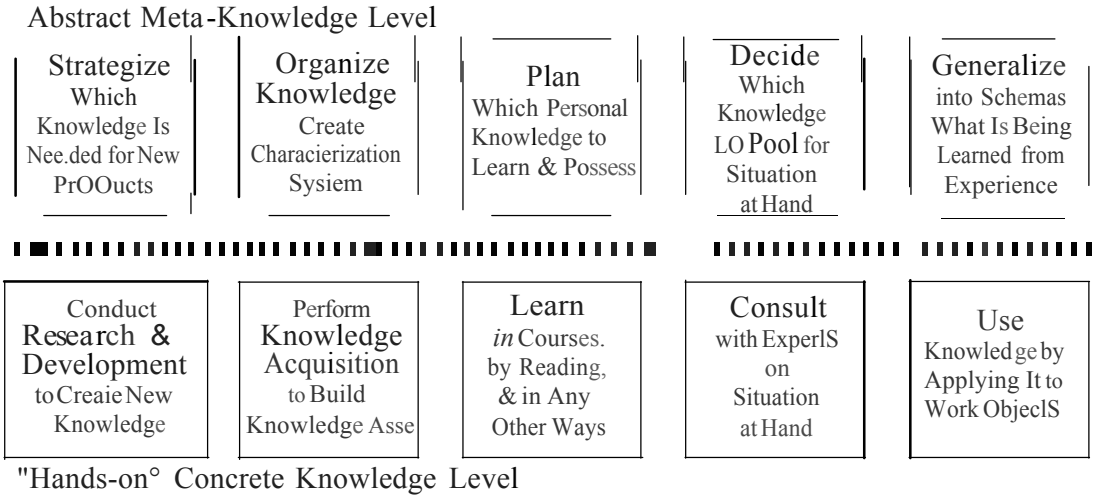
The KM culture operates on two abstraction levels. It operates on a concrete and tangible level when it deals "hands-on" with the knowledge assets -- whether building or using them. Perhaps more importantly, it operates on an abstract meta-knowledge level when it deals with issues that touch on "knowledge about knowledge." A few examples of activities at both levels are shown in Figure 10-1.

Most proactive and successful organizations have already for quite some time emphasized excellence and the need to ascertain the availability of top-notch professional knowledge. These changes have been gradual over the last fifty years. Thus, most agree that initiatives which rely implicitly on expertise, such as TQM, have great merit in the survival struggles of the international competitive environment. However, to our awareness, few organizations to date, exhibit an understanding of broad KM practices. The few that do, like Chaparral Steel, have created cultures that emphasize most aspects of effective KM in ways that touch every employee -- from the CEO to the most recent apprentice.

The major driving force behind KM lies in everyone's understanding and belief that they personally benefit from building and using the best knowledge

to act as intelligently as at all possible. The KM culture is created and maintained by its business successes and the consistency of policies, management practices, incentives, and peer values. And it is made practically possible by operating practices that rest upon effective approaches and methods that are well-understood and followed.

Figure 10-1. Examples of Activities at Abstract and Concrete Knowledge Levels.



There Literally Is No Choice!

There is no doubt that the knowledge society is here and is expanding, and that more and more organizations and individuals throughout the world are affected. With this development firmly underway, any entity whose goal it is to remain viable and successful may have little choice but to pursue effective KM. This includes corporations, public institutions, and even individuals who are considering how to achieve their lifestyle choices. All will need to perform competitively in the knowledge society and ascertain that their "village" is successful. All will need to build and organize their knowledge assets and make sure that they are available and used effectively whenever situations demand it so they can act intelligently to perform to their best advantage!

Appendices

Appendix A

Selected Kno-wledge Categories

This appendix contains brief overviews of the following knowledge categories and dimensions that are referred to throughout the text:

- Conceptual Knowledge levels
- Forms and Types of knowledge
- Proficiency levels
- Knowledge Detail dimension

The appendix also provides examples of concept hierarchies and associative networks. At the end, an overview of five knowledge dimensions is presented. Further discussions of these and additional categories may be found in Knowledge Management Foundations (Wiig, 1993).

Conceptual Knowledge Levels

Goal-Setting or Idealistic Knowkdge or Vision and Paradigm. Knowledge.
Part of this knowledge is well known to us and explicit -- we work consciously with it. Most of it, our visions, is not well known, however; instead, it is tacit and only accessible nonconsciously. *We use this knowledge to identify what is possible and to create our goals and values.* ("Knowledge of WHY" the ideal is desirable and obtainable.)

Systematic Knowkdge or Syst.em, Schema, and Reference Methodology Knowledge.
Our theoretical knowledge of underlying systems, general principles, and related problem-solving strategies is to a large extent explicit and well known to us. *We use this knowledge to analyze and reason in-depth and to synthesize new approaches and alternatives.* ("Knowledge THAT" it is possible, methodologies exist, and it can be achieved.)

Pragmatic Knowkdge or Decision-Making and Factual Knowledge (Know-How).
Decision-making knowledge is practical and mostly explicit; it is often based on scripts that we know well. *We use this knowledge to perform our daily work and make explicit decisions.* ("Knowledge HOW" it can be achieved.)

Automatic Knowkdge or Routine Working Knowledge.
We know this knowledge so well that we have automated it -- most of it has become tacit. *We use it to perform tasks automatically without conscious reasoning.*

Forms and Types of Knowledge

F	FACTUAL Knowledge Facts, Data, Known Causal Chains	CONCEPTUAL Knowledge Perspectives, Concepts, Gestalts	EXPECTATIONAL Knowledge Judgments, Hypotheses, Expectations	METHODOLOGICAL Knowledge Reasoning Strategies, Methodologies
Public Knowledge	Textbook Knowledge, Mathematical Models, & Publlc Computer Models	Generally Accepted Points of Views, Concepts, & Perspectives	Commonly Accepted Working Hypotheses & Implications	Methodobgies & Strategies Taught in Classrooms
Shared Expertise	Specialized Understandings for "What 11 Is" & "How t Works"	Expert Concepts, Perspectives, & Overviews of Complex Situations	Expert Judgments & Expectations for Narrowly Understood Situations	Expert Strategies to Investigate, Analyze, Synthesize, & Manage
Personal Knowledge	Personally Held Observations, Information, & Understandings of "How It Operates"	Private Ways of Viewing Situations from Single or Multiple Perspectives	Personal Value Judgements, Expectations, Beliefs, & Misconceptions	Intuitive Notions about What to Do, How to Proceed & How to Arrive at Conclusions

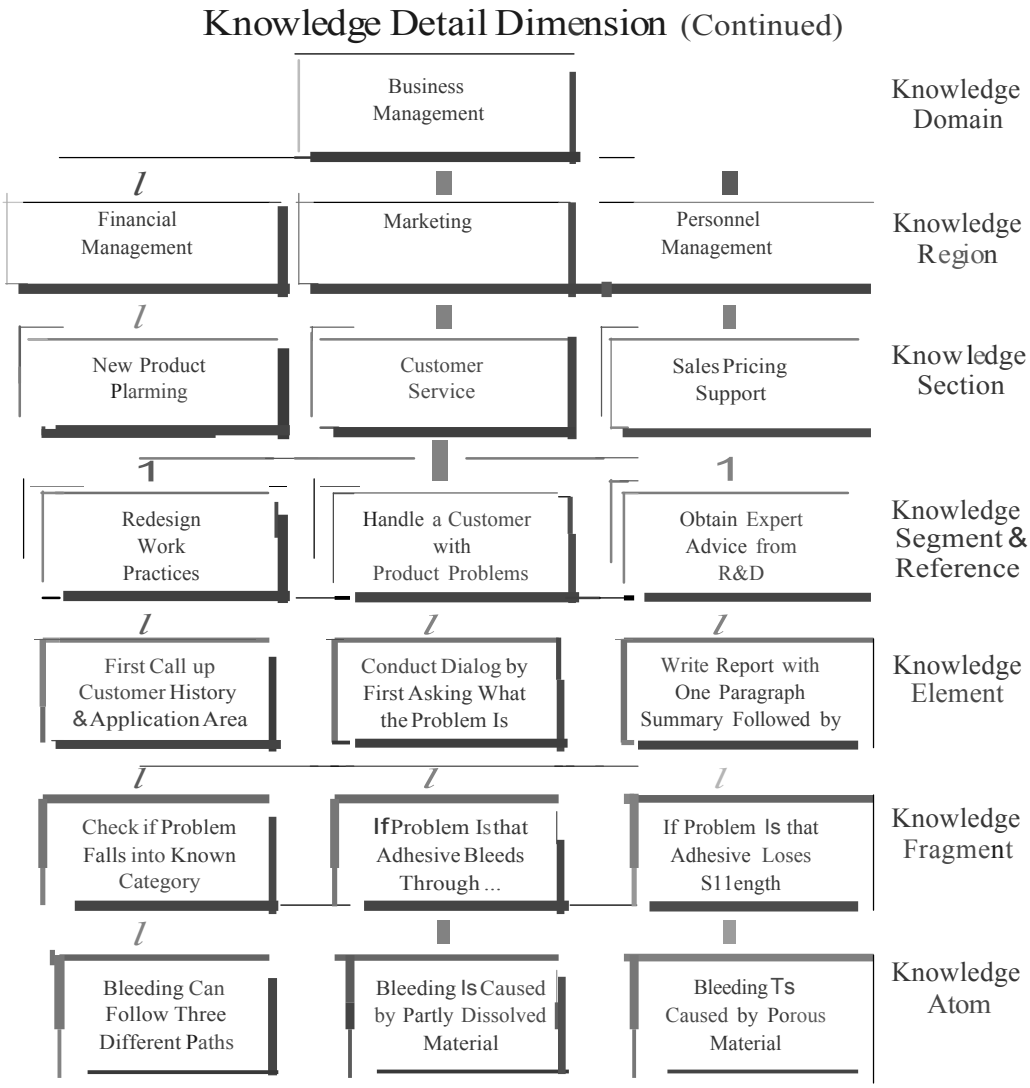
Proficiency Levels

Profidency Level,s	*ExplanatWn*
Ignorant	Totally unaware, with no understan rung or judgment Totally unaware -- does not know even the existence of the area
Beginner	Vaguely aware of field -- innocent with no real experience Vaguely aware, innocent with little and arbitrary understanding. Lacks experience and competence (amateurish)
Advanced Beginner	Aware and partially informed but relatively unskilled Aware, informed but relatively incompetent in broad areas. Cannot work alone but beginning to develop skills in narrow areas ("novice")
Competent Performer	Begi nning deeper understanding -- narrowly skilled Beginning to develop an understanding although narrowly skilled. Trusted to perform certain tasks alone. Learning by practical experience under skilled supervision ("apprentice")
Proficient Performer	Competent and broadly skilled -- knowledgeable in selected areas Competent and broadly skilled with a few areas of deeper knowledge. A team leader. A worker who has learned a trade and works for another person. An experienced and reliable worker or performer, especially as distinguished from one who is brilliant or colorful ("journeyman")
Expert	Highly proficient in a particular area -- generally knowledgeable Highly proficient in a particular area and generally knowledgeable. Provides leadership and crucial expert insights. Demonstrates the special skill or knowledge that is representative of mastery of a particular subject
Master	Highly expert in many areas and broadly knowledgeable Highly expert in many areas and broadly knowledgeable. Is normally the principal and leading force in the knowledge area both within and outside the organization. A revered leader, a qualified teacher of both proficient performers and experts, a performer of consummate skill
Grand Master	World class expert in all areas of the knowledge domain World-class expert who is both knowledgeable and wise in all areas of the domain and enjoys wide recogn ition. Very few exist

Knowledge Detail Dimension

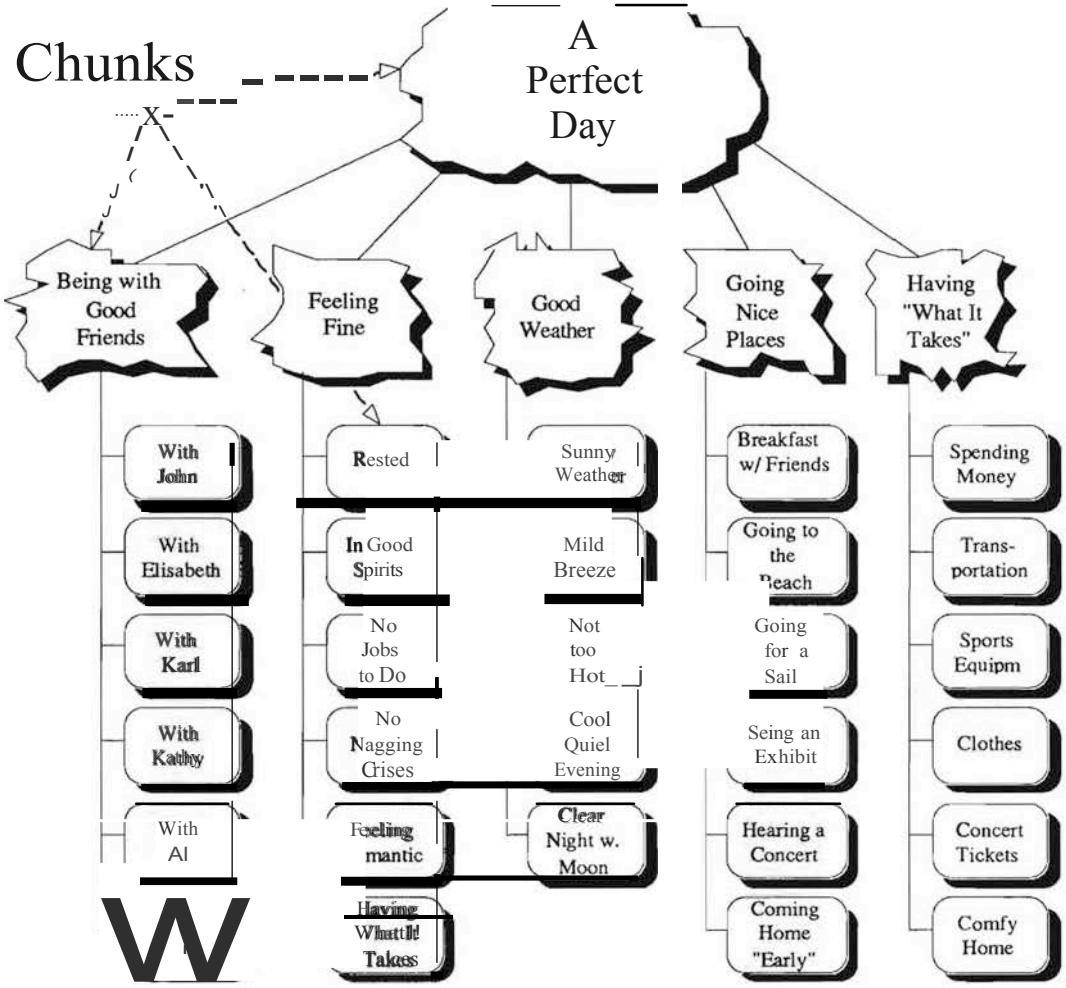
Knowledge Span	*Examples*
Knowledge Domain	Domains *of:* • Internal Medicine • Mechanical Engineering • Business Mana_g_ement; etc.
Knowledge Region	Regions *of:* • Urology • Automotive Mechanical Design and Engineering • Product Marketing; etc.
Knowledge Section	Sections *of:* • Kidney Diseases • Transmission Design • New Product Planni etc.
Knowledge Segment or Reference Case	Segments *or* "Cases" *of:* 1 • Diagnosis of Kidney Diseases • Gear Train Specification and Design • Product Marketability Evaluations; etc. *Specific* Reference Case *of:* • Diagnosing Mrs. Smith's kidney stone with its complications; etc.
Knowledge Element	Elements *of:* • Diagnostic Strategies (such as "When considering which disease is present, first collect all symptoms, then try to explain as many of them as possible with one disease candidate") • Gear Train Contact Force and Energy Loss Calculations • Customer Acceptance Estimations; etc.
Knowledge Fragment	Fragments *of:* "If the symptom is excruciating pain, then consider kidney stone" "When there are too many gears in the transmission, the energy loss will be excessive" "When there are many comparable and competitive products already in the marketplace, a new product must offer very special and attractive features to be highly competitive"; etc.
Knowledge Atom	Atoms *of:* "One symptom is excruciating pain" "Use case hardening of gear surfaces in pressure range 4" "Price is a negative competitive factor in most cases," etc.

1A case is a knowledge entity that describes an episode, which is abstracted by its characteristics and when applicable, with indications of how the episode was handled and interpreted, and what the oμt<;omes were. We often refer to these cases as "referen ce cases."


Knowledge Detail Dimension (Continued)
Business Management
Financial Management
Marketing
Personnel Management
New Product Plarming
Customer Service
Sales Pricing Support
Redesign Work Practices
Handle a Customer with Product Problems
Obtain Expert Advice from R&D
First Call up Customer History & Application Area
Conduct Dialog by First Asking What the Problem Is
Write Report with One Paragraph Summary Followed by
Check if Problem Falls into Known Category
If Problem Is that Adhesive Bleeds Through ...
If Problem Is that Adhesive Loses S11ength
Bleeding Can Follow Three Different Paths
Bleeding Is Caused by Partly Dissolved Material
Bleeding Ts Caused by Porous Material
Knowledge Domain
Knowledge Region
Know ledge Section
Knowledge Segment & Reference
Knowledge Element
Knowledge Fragment
Knowledge Atom

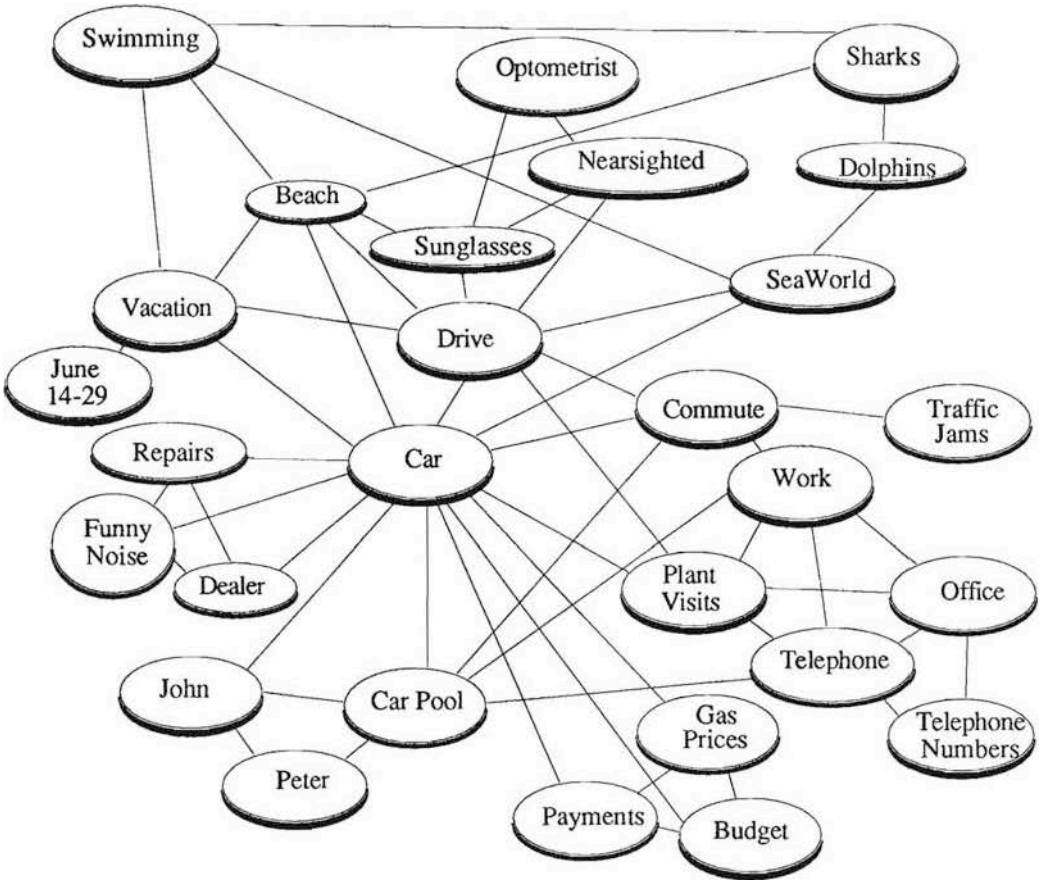
Concept Hierarchies

Concept Hierarchy - Chunking of Concepts and Other Objects to Create the Chunk "A Perfect Day."

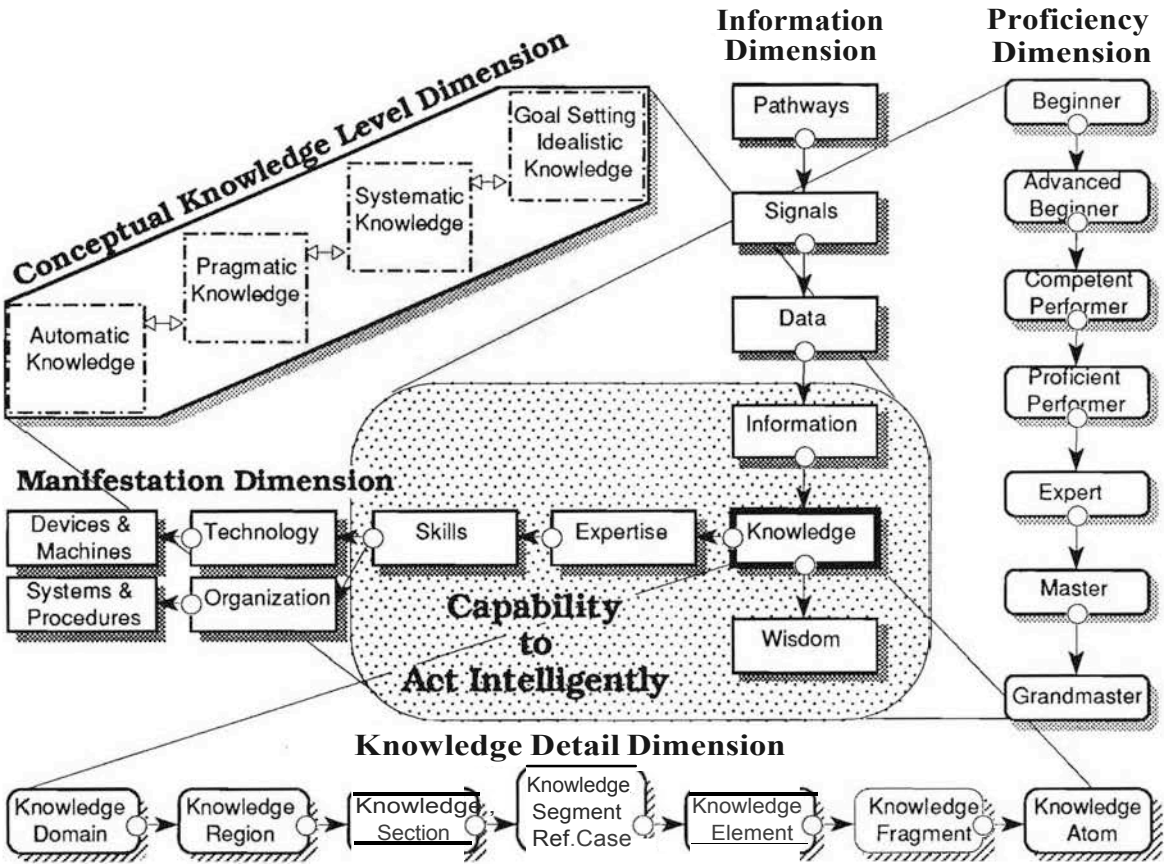


Associative Networks -- Concept Relatedness

Example of Concept Relatedness and Relational Knowledge Represented as Concept Relationship or Associative Network.



Overview of Five Knowledge Dimensions



Appendix B

Reference Models for the Kno ledge Managentent Teant

When knowledge management professionals and teams perform their work, they must be guided by four different sets of models in mind. Further, tlhe team must be competent in the areas covered by the models to be able to understand the meaning of what they observe and subsequently create appropriate solutions. The team collects material and analyzes it, synthesizes new approaches, and supports implementation -- all for the purpose of changing knowledge-related aspects of how the organization is currently operated and functions.

The first two sets of models, which pertain to goals for the changes that may result from the work, focus on traditional operations and management analysis and related disciplines. The last two sets of models focus on the organization's knowledge assets, adding the new perspectives provided with tlhis discipline. The areas covered by the models are as follows:

1. Models for how any organization should function from an ideal perspective. This includes: (1) How markets operate, financial aspects affect organizations, people work together, work functions are organized, and individuals are motivated; (2) What constitutes quality work and what it means to be creative; and (3) The value of creativity, how work, knowledge, and information flows should be arranged, how decisions are made, and so on.
2. Models of the target business process in terms of what its role and effective functionalities should to be, from ideal perspectives, to best serve the organization and its general purpose, within its particular environment and industry. These models require familiarity with, and visions for, how such business (and often knowledge-intensive) functions should operate.

3. Models of knowledge and its use in knowledge-intensive work. From the business perspective, these models involve perspectives of how knowledge is used in problem-solving, decision-making, and general knowledge work, as well as in creative behavior to achieve quality results. The models also relate to how new knowledge is generated through learning, teaching, and "acquainting" through browsing, exploration, and even socializing with coworkers and others.

   Part of these models concern themselves with the roles of the resources required for quality intellectual work such as:

   -- availability of time to act
   -- information to reduce uncertainty
   -- lack of interruptions to pennit undisturbed reasoning, etc.

   Another group of these models concern themselves with characterizing knowledge *per se* -- how people acquire, store, share, and use knowledge at various levels of proficiency and how these functions can be identified and characterized.

4. Models for how knowledge management opportunities can be implemented effectively, Some of these models are based on a knowledge management framework using approaches and techniques such as:

   -- knowledge de-bottlenecking programs
   -- building knowledge in personnel by sharing "lessons learned"
   -- knowledge profiling of individuals and job requirements; etc.
   -- knowledge required to be able to provide appropriate judgment and decisions

   Other models are based on conventional perspectives of education, learning, support of knowledge workers with computer-based performance support systems, and so on.

With these models to support perspectives and insights, knowledge management professionals and teams can direct interviews to elicit information about the important aspects of knowledge resources, knowledge development and flows, and knowledge work *as these pertain to the potentials for improved operation of the enterprise.* Thus, these professionals will be in position to analyze the obtained information and, as part of that analysis, identify those opportunities that can be considered to improve the operations.

Since it is impossible for a single professional to be sufficient proficient in all these areas, collaboration between team members is required to achieve the desired results.

Appendix C

Detailed Survey Responses:
Important Knowledge Management Activities

Table C-1. Prepare for Management of Knowledge[1]

Conventional Activities	Important Already Now	Important Later -- In 5 Years
• Issue guidelines an policies for education and training	56%	44%
Industry Group A[2]	All	-
Industry Group B	Most	Few
Industry Group C	-	All
• Prepare training program plans	72%	28%
Industry Group A	All	-
Industry Group B	Most	Few
Industry Group C	Many	Many
• Provide policies for succession planning	58%	44%
Industry Group A	Most	Few
Industry Group B	Most	Few
Industry Group C	Few	Most
• Provide policies for personnel evaluation	67%	33%
Industry Group A	All	-
Industry Group B	Most	Few
Industry Group C	Few	Most

New and Advanced Activities	Important Already Now	Important Later -- In 5 Years
• Survey critical knowledge areas to find which knowledge exists, who possesses it, what value it has, and opportunities for use	50%	50%
Industry Group A	Most	Few
Industry Group B	Many	Many
Industry Group C	Few	Most
• Create plans for strategic use of key knowledge in products, services, and operations	76%	33%
Industry Group A	Most	Few
Industry Group B	Most	Few
Industry Group C	Many	Many
• Assemble action plans for how to manage knowledge throughout the company	33%	67%
Industry Group A	Most	Few
Industry Group B	Few	Most
Industry Group C	-	All
• Develop relevant KM frameworks to chart and describe knowledge in pertinent operations and functions	11%	89%
Industry Group A	Few	Most
Industry Group B	-	All
Industry Group C	Few	Most
• Determine methods to evaluate strategic and operational values of critical knowledge	17%	83%
Industry Group A	Few	Most
Industry Group B	Few	Most
Industry Group C	-	All

Observation: The majority of the respondents indicated that conventional activities are important at this time. Most also felt that it is important to create plans for use of key knowledge

1 These tables are reproduced from Wiig (1989).

2: Industry groups are defined in Figure 2-1.

Table C-2. Build and Produce Knowledge

Observation: *Most respondents thought it important to build knowledge using conventional activities. Some also felt it important to use new and advanced activities at this time.*

Conventional Activities			New and Advanced Activities		
	Important Already Now	Important Later -- In 5 Years		Important Already Now	Important Later -- In 5 Years
i. Develop new knowledge through R&D and special studies	72%	28%	• Elicit knowledge using "Knowledge Engineeringn techniques	38%	62%
Industry Group A	Most	Few	Industry Group A	Few	Most
Industry Group B	Most	Few	Industry Group B	Few	Most
Industry Group C	Most	Few	Industry Group C	Few	Most
• Hire knowledgeable individuals	78%	22%	• Codify knowledge in knowledge models	33%	67%
Industry Group A	Most	Few	Industry Group A	Many	Many
Industry Group B	All	-	Industry Group B	Few	Most
Industry Group C	Many	Many	Industry Group C	Few	Most
• Obtain new knowledge by Joint Venturing	56%	44%	• Assemble "Knowledge Basesn	38%	62%
Industry Group A	Most	Few	Industry Group A	Few	Most
Industry Group B	Most	Few	Industry Group B	Few	Most
Industry Group C	Few	Most	Industry Group C	Few	Most
• Develop training programs	78%	22%	• Build automated Knowledge-Based Systems (KBSs)	32%	68%
Industry Group A	All	-	Industry Group A	Few	Most
Industry Group B	Most	Few	Industry Group B	Few	Most
Industry Group C	Many	Many	Industry Group C	Few	Most
• Write procedures manuals	39%	61%			
Industry Group A	Many	Many			
Industry Group B	Most	Few			
Industry Group C	-	All			
• Educate and train employees	78%	22%			
Industry Group A	All	-			
Industry Group B	All	-			
Industry Group C	Many	Many			

C-3. Use and Apply Knowledge

Observation: The majority of executives felt that it is important to put knowledge to use now in all areas presented as examples -even when some of the areas are new and advanced. Over two-thirds of the respondents thought it important to embed knowledge in products, designs, and services and to use knowledge-based systems to support organizational fiattening.

Conventional Activities	Important Already Now	Important Later In 5 Years
• Reassign staff and distribute procedure manuals to deploy knowledge to points-of-use	61%	39%
Industry Group A	All	-
Industry Group B	Most	Few
Industry Group C	-	All
• Embed operational and functional knowledge in procedures and organizational systems	61%	39%
Industry Group A	All	-
Industry Group B	Most	Few
Industry Group C	-	All
• Embed knowledge in products, designs, and services	78%	22%
Industry Group A	All	-
Industry Group B	Most	Few
Industry Group C	Many	Many

New and Advanc.ed Activities	Important Already Now	Important Later - In 5 Years
• Install knowledge-based systems to deploy knowledge to points-of-use	56%	44%
Industry Group A	Most	Few
Industry Group B	Most	Few
Industry Group C	Few	Most
• Flatten organization and distribute responsibilities by relying on automated knowledge	67%	33%
Industry Group A	Most	Few
Industry Group B	All	-
Industry Group C	Few	Most
• Redesign job functions to take advantage of better knowledge management	56%	44%
Industry Group A	Many	Many
Industry Group B	Most	Few
Industry Group C	Few	Most

C-4. Control and Safeguard Knowledge

Observation: *Most executives indicated the need to compensate very knowledgeable employees well. They also felt that control of knowledge is very important. The majority indicated that it is important now to ascertain that appropriate knowledge is used and about half thought that should be done after the knowledge has been codified.*

Conventional Activities	Important Already Now	Important Later -- In 5 Years
• Compensate very knowledgeable employees	83%	17%
Industry Group A	AD	–
Industry Group B	AD	–
Industry Group C	Many	Many
• Ascertain that appropriate knowledge is used	78%	22%
Industry Group A	Most	Few
Industry Group B	Most	Few
Industry Group C	Few	Most
• Control knowledge loss to competitors	83%	17%
Industry Group A	AD	–
Industry Group B	AD	–
Industry Group C	Many	Many

New and Advanced Activities	Important Already Now	Important Later -- In 5 Years
• Examine, validate and choose appropriate knowledge after it has been codified	44%	56%
Industry Group A	Many	Many
Industry Group B	Most	Few
Industry Group C	Few	Most
• Control knowledge base access and distribution	61%	39%
Industry Group A	Most	Few
Industry Group B	Most	Few
Industry Group C	Few	Most

Appendix D

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Appendix D

Glossary and Definitions

Abductive Reasoning: A special case of inductive reasoning resulting in specific assertions that imply the available information in context of the background knowledge without logical certainty. Example: *Premise:* "Those dogs are mastiffs." *Background knowledge:* "All Erik's dogs are Mastiffs." *Hypothesis:* "Perhaps those dogs are Erik's."

Acquisition: (See Knowledge Acquisition) Knowledge may be acquired and represented for inclusion in a knowledge model. Acquisition can be performed by eliciting knowledge from a domain expert, inducing knowledge from examples, porting knowledge from data bases, and by other methods.

AI Technologist: A professional with good applied knowledge of basic AI techniques and selected tools used in the professional's environment. AI technologists are capable encoders of knowledge from codified knowledge and may be proficient AI programmers.

Artificial Intelligence (AI): "A subfield of computer science concerned with pursuing the possibility that a computer can be made to behave in ways that humans recognize as 'intelligent' behavior in each other."[1] (The Fifth Generation, Feigenbaum and McCorduck (1983)). Applied AI becomes a broader field than AI, including cognitive, social and management sciences.

Codification: Knowledge codification deals with obtaining, characterizing, and validating knowledge. It includes of elicitation or acquisition, analysis, and synthesis (rational reconstruction) of knowledge to generate internally consistent knowledge models that are congruent with domain knowledge as held by experts or existing as previously codified bodies of knowledge.

Cognitive Engineering: A recently coined term to denote the professional field concerned with analysis and synthesis of systems that interact with human cognitive functions. They encompass: Human behavior in the real target world; Ecological aspects of that world; Semantic contents of the target domain; Behavior and performance; and Implications of changing cognitive-related aspects of the target domain.

Cognitive Science: The field that investigates the details of the mechanics of human intelligence to determine the process that produces that intelligence.

Cognitive Style: An individual's mental approach and reasoning style. Cognitive styles include preferences for graphic or verbal representations of concepts, hemispheric dominance, and so on.

Concept: An abstract or general idea often generalized from specific instances. A concept can be a mental model and be tied to other concepts through associations.

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[1] Feigenbaum and McCorduck (1983) The Fifth Generation.

Database: Information stored in a computer for subsequent retrieval. Databases are structured to support data architectures; modern databases are relational databases. Data bases may be "flat," relational, or object-oriented.

Declarative Knowledge: Facts about, and relations between, objects (such as abstract concepts or physical objects), events, and situations stated in some representation such as rules or clauses.

Deductive Reasoning: Reasoning to deduce information about the situation under analysis such as deducing facts or premises from hypotheses and rules given the background or domain knowledge.

Domain: A bounded part of a larger system. May be a specific area of knowledge such as "the domain of financial knowledge." May at times be the knowledge or expertise area of a knowledge-based system.

Domain Expert: A person with expertise in the domain of the target knowledge area such as a knowledge-based system being developed. The domain expert often works closely with the knowledge engineer (particularly the knowledge professionals) to allow capturing of the expert's knowledge for codification into a knowledge model that can then be encoded into a knowledge base.

Elicitation: The process of obtaining domain knowledge from experts through one of several elicitation methods such as interviews, observation, simulation, and so on.

Encoding: Encoding of knowledge involves translating codified knowledge models to a representation such as that required for an expert system tool or shell. Encoding is similar to "programming", and may in many instances include computer programming to augment tools or shells. Encoding may fully be a programming task as when an expert system is directly implemented in LISP Prolog, or another computer language.

Expert System: A knowledge-based computer program containing expert domain knowledge about objects, events, situations, and courses of action that emulates the reasoning process of human experts in the particular domain. The components of an expert system include: 1. The Knowledge Base; 2. Inference Engine; and 3. User Interface. Types of expert systems include rule-based systems and model-based systems.

Explicit Knowledge: Knowledge that "is not tacit or implicit" that is, it has been made available for inspection by being explicated through oral or written language, expert system rules, computer programs, diagrams, or in any other manner.

Fuzzy Logic: A formal type of logic that is defined to work with fuzzy operations.

Fuzzy Reasoning: A reasoning method that is based on fuzzy logic. It is similar to Qualitative Reasoning.

Fuzzy Systems: Knowledge-based systems that employ fuzzy reasoning.

Implicit Knowledge: Knowledge that is contained implicitly in oral or written language, actions (also when videotaped or provided as part of a hyper-media system), trained neural networks, embedded in technology, culture, practices, and so on.

Inductive Reasoning: Reasoning to generate hypotheses based on background or domain knowledge and information such as premises, statements, or facts. Example: *Premise:* "The engine is powerful. " *Background knowledge:* "Engine is part of a car. " *Hypothesis:* "The car is powerful." Induction can also be used to generate hypotheses from background knowledge and other hypotheses. Rules are often used to perform inductive inference.

Information: Information describes a particular circumstance or case. Information consists

of facts or data and may take on any one of several forms, levels of abstractions, and degrees of certainties. Information is used by *knowledge* to interpret or reason about a particular circumstance or case.

Knowledge: Many relevant definitions:

A. Formal Language Use Definition :! 1. Cognizance; 2 a (1): The fact or condition of knowing something with familiarity gained through experience or association; (2): acquaintance with or understanding of a science, art or technique; b (1): the fact or condition of being aware of something; (2): The range of one's information or understanding; c: The circumstance or condition of apprehending truth or fact: Cognition; d: The fact or condition of having information or of being learned; 4 a: The sum of what is known; the body of truth, information, and principles acquired by mankind.

B. Epistemological Definition :

The body of internalized data, concepts, perspectives, judgments, strategies, and so on, *that a person believes to be true.*

C. *Operational Definition for this book:*

Truths, perspectives, judgments, and methodologies that are available to handle specific situations. Knowledge is used to interpret *information* about a particular circumstance or case to handle the situation. Knowledge is about what the facts and information means in the context of the situation.

Knowledge about Knowledge: Understanding what knowledge is about; how it is created, used, and structured -- as studied by the field of epistemology (also see Meta Knowledge).

Knowledge Base (KB): The component of a knowledge-based system that contains the system's domain knowledge in some representation suitable for the system to reason with. Knowledge in knowledge bases is typically represented in a standard format.

Knowledge-Based System (KBS): A computer-based system that contains explicit domain knowledge used specifically for reasoning about specific situations. An expert system is a special kind of KBS.

Knowledge Engineer: Specialists responsible for analyzing knowledge-intensive functions to design appropriate Knowledge Management Activities such as technical development of a knowledge-based system. Knowledge Engineers may be "Knowledge Technologists" focusing on the content and functionality of knowledge use in a knowledge-based function or "AI Technologists" focusing on implementation of a knowledge-based system. Only rarely is a Knowledge Engineer both an AI Technologist and a Knowledge Technologist.

Knowledge Engineering: The professional activities associated with eliciting (or acquiring), codifying, and encoding knowledge, conceptualizing- and implementing knowledge-based systems, and engaging in activities to formalize knowledge and its use -- particularly through application of artificial intelligence.

Knowledge Holder: The person (domain expert) who holds the knowledge of interest. Knowledge holders can behave in different ways and can be classified as a: "Professional Practitioner;" "Practical Knowledge-worker;" "Performer;" or "Communicating Negotiator. "

Knowledge Management: The field of deliberately and systematically analyzing, synthesizing, assessing, and implementing knowledge-related changes to attain a set of objectives.

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1 Webster's Ninth New Collegiate Dictionary.

Knowledge Management Activity: Distinct knowledge-related changes to manage knowledge.

Knowledge Model: Knowledge models take many forms. They may be documentation of domain knowledge on paper, in computer-based knowledge base, or videotaped "show-and-tell" for performing a particular task. Knowledge models may be represen ted using a formal "knowledge representation," it may be in natural language as a narrative, a set of diagrammatic representations, and so forth.

Knowledge Profession al: A professional who focuses on optimal creation, organization, availability, and use of *knowledge* in a domain or within a business function. Knowledge professionals have applied understandi ng of task environmen t analysis, va rious knowledge management approaches, business use of knowledge, and support of knowledge-workers with automated reasoning and other mea ns. Knowledge professionals may be trained in cogn itive sciences, artificial intelligence, philosophy, and managemen t sciences.

Knowledge Representation: The formal structures used to store information in a knowledge base in a form that supports the reasoni ng approach to be employed. Knowledge representation techniques include "production rules" ("if-then rules"), logic (often "first order logic"), semantic networks, frames, and scripts.

Knowledge Technologist: A professional who focuses on codification and automation of *knowled ge content* in a domain. The knowledge tech nologist must have applied understandi ng of k nowledge elicitation, analysis, and modeli n g, and support of k nowledge-workers with automated reasoning. Knowledge technologists may be trained in cognitive sciences or artificial intelligence.

Knowledge Technology: Technology - physical and methodological -- for support of knowledge management activities.

Knowledge worker: Individual who makes her/his con tributions through exercising of intellectual expertise and understandi ng.

Meta Knowledge: Knowledge about knowledge (in contrast to knowledge about things in the world).

Meta Reasoning: Allows a person (or an inanimate system) to know what it k nows -and what it does not know.

Natural Language Processing: An area of AI research that allows computers to use a natural language. Natural language processing is divided into natural language u nderstanding and natural language generation.

Natura l Language Understanding: The part of natural language-processing research that investigates methods of allowing computers to understand a natural language.

Object Oriented System: A system buil t around "objects " that are independent computer procedures that perform one of its operations when passed a message. Object oriented systems also employ "inheritance" of characteristics, and "encapsulation." Most KBS tools and shells are implemented as object-oriented systems.

Planning and Decision Support: An area of AI research that applies AI techniques to planning and Decision-making processes, primarily to assist managers who have Decision-making responsibil ities.

Planning Systems: A type of AI-based systems used to reason about sequential situations such as scheduling, resolution of time conflicts, and so on. Plan ning systems may use nonmonotonic reasoning.

Procedural Knowledge: Knowledge and information about courses of action that may be sequential in nature.

Proficiency: Capability to perform.

Qualitative Reasoning: A reasoning method that is based on qualitative relations. Example: *Background Knowledge:* "All attractive products while priced slightly high will sell well." *Premise:* "The present product is *very* attractive and priced slightly high." *Conclusion:* "The present product will sell *very* well."

Routine: A regular, often *unvarying procedure* for what to expect and how to handle a *specific kind of situation.* A routine is detailed, concrete, and inflexible. It consists of numerous and relatively deterministic, rigid steps that might cover many of the tasks in the process. Other tasks may still require explicit reasoning (they are still part of the script that underlies the routine).

Rule-Based Knowledge-Based Systems: A type of knowledge-based system where the domain knowledge is represented in the form of production rules.

Schema: A broad and conceptual *plan or scheme* for a *class of situations*. Schemas are concepts or mental models by which a static or dynamic situation can be characterized and understood. Schemas are typically abstract models of a generalized situation. Scripts -- often several -- can be generated from schemas to form more definite expectations for evolutions of specific situations. It is a generalized concept that defines our understanding of the underlying structure, nature, or principles of a general type of story, situation, or "system."

> "A spatially and/or temporarily organized structure in which the parts are connected on the basis of contiguities that have been experienced in space or time. A schema is formed on the basis of past experience with objects, scenes, or events and consists of a set of (usually nonconscious) expectations about what things look like and/or the order in which they occur. The parts, or units, of a schema consists of a set of variables, or slots, which can be filled, or instantiated, in any given instance by values that have greater or lesser degrees of probability of occurrence attached to them. Schema vary greatly in their degree of generality -- the more general the schema, the less specified, or the less predictable, are the values that satisfy them."
>
> (Adapted from Mandler (1979, p. 263)

Script: A *general event sequence* that underlies a *referenced type of situation.* Scripts are flexible, somewhat abstract, and include general expectations and directions. Typically, scripts consist of several steps made up of episodes and events.

Scripts are in many ways similar to *routines.* The main difference is that scripts and their steps are general, broad, and flexible compared to the routines' specific and unvarying steps. Accordingly, hiring scripts, for example, may cover a range of positions -- not only competent professionals as covered by a routine.

Technologically: A technique for representing knowledge that stores in a series of "slots" the events and expectations for situations that evolve over time.

Semantic Network: A knowledge representation method for representing associations between objects using a network of nodes with arcs between the nodes. The nodes represent objects (or events or concepts) and the arcs represent the relations between the objects.

Symbolic Processing: Symbolic processing is the basis of AI programming. It uses computers to manipulate symbols, in contrast to conventional numeric processing.

Symbolic Reasoning: The use of symbolic processing to solve reasoning problems using strategies and heuristics to manipulate the symbols.

Tacit Knowledge: Knowledge that a person does not make explicit. Tacit knowledge may be inaccessible to conscious recall and reasoning because it: (1) Is not well understood; or (2) Is highly routinized and automatic and has transgressed the recall barrier.

Text Understanding: The area of natural language understanding that allows computers to recognize the content of written text.

Thinking about Thinking: Being consciously able to engage in meta reasoning and understand mental processes such as strategies and models.

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