

Capitalizing on intellectual assets

by K.-T. Huang

Knowledge is power—the power that has become the driving force in our economy. Knowledge powers our customers' ability to adapt and innovate. It powers our ability to deliver value to clients. It powers the ability of our professionals to be their best. When knowledge is shared, its power grows exponentially. This essay discusses IBM's utilization of knowledge through the Intellectual Capital Management program.

As we approach the twenty-first century, the business environment is experiencing a tremendous change. Globalization, technological innovations, and competition are forcing companies to shift the fundamentals of how business is conducted. Increasingly, companies are moving rapidly from labor-based business to knowledge-based business. Companies are seeking to leverage vast stores of information and expertise to capitalize on this emerging knowledge-based global economy, while embracing the ideas of “knowledge management” to further define and facilitate this new knowledge revolution. They realize that the benefits of institutionalized knowledge management are broad in scope. Individuals from different disciplines, teams, and sites are working together to share and improve their collective knowledge, so that this knowledge can be applied worldwide in a repeatable and sustainable manner.

Companies working to capitalize on their own knowledge focus on sharing a wide variety of intellectual content among units, ranging from processes to business patterns, design experiences, and beyond. They learn the importance of embedding technology into effective business designs so that markedly different patterns of sustained value growth can be achieved.

The advent of high-capability intranet technologies makes possible the collaboration that is critical to rapidly transform customer needs into deliverable value. These new capabilities can strip away the corporation boundaries that have traditionally inhibited the ability to tap the wellsprings of knowledge¹ that often exist in isolated pockets of the company.

To survive and excel in this rapidly changing global economy, a new emphasis on innovation, competency, and collaboration is needed. The goal of managing knowledge as a strategic asset is not only to seek the short-term returns, but also to maximize the long-term advantage over competitors. The ability to learn, collaborate, and innovate faster than one's competitors becomes the only sustainable source of competitive advantage in the coming knowledge-based economy. To stay competitive, companies need to capitalize on their intellectual assets, rather than their infrastructure.¹

In the late 1980s, Peter Drucker predicted, “the factory of tomorrow will be organized around information rather than automation.”² Today his insight is becoming a reality. Business developments such as a networking economy and enterprise expansions are compelling corporations to manage knowledge as an asset. Yesterday's strong organizational hierarchies and strict work rules are no longer economically rewarding. As the economy of tomorrow emerges, a company's prosperity is becoming increasingly dependent on the intellectual capacity of its workers.

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and their ability to change in a dynamic business environment.³ Consequently, finding and applying methodologies to generate and use knowledge faster and more effectively is becoming one of the most promising and valuable new management practices.

Competition in the twenty-first century

The world in which we live is changing in a fundamental way. Markets are increasingly international, tariff barriers have disappeared, and the economy is becoming more information based. To succeed, an enterprise must meet the challenge of global competition for markets. Four "change drivers" that most concern today's chief executive officers (CEOs) are: innovation, responsiveness, productivity, and competency.⁴ While these present a challenge to today's enterprises, they also open the door to a wealth of opportunities.

The solutions and methodologies that support information and knowledge management have been available for quite some time. Today, however, trends in the marketplace and new technology are redefining their use, making them more critical than ever before to intellectually intensive companies. A knowledge management program needs to focus on addressing these four change drivers.

Innovation. In today's business, one of the critical success factors for enterprises is the ability to innovate: to quickly develop the products, processes, and services customers want, at a competitive price; to find new solutions to old problems; to adapt solutions to changing circumstances; and to apply the lessons of experience, the technology solutions, and the wellspring of creativity to the new challenges presented in a changing world. More importantly, no enterprise is self-sufficient, not even a company as large as IBM. The innovation process now extends outside the enterprise. In many industry sectors, individual companies are really part of a broader business system. One example is in automobile production, with its networks of designers, material suppliers, parts manufacturers, assemblers, and dealers. The computer industry is another, involving chip designers, component manufacturers, assemblers, system software manufacturers, application software manufacturers, and distributors of all kinds, ranging from mail-order houses to superstores.

Many smart CEOs know that business performance is ultimately limited by the external environment. An enterprise's ability to compete depends on interac-

tions with suppliers, customers, banks, shareholders, the educational system, and government regulators, among others. The more effective a company's interactions with these external players, the better it will perform. An enterprise needs to extend the knowledge-sharing network beyond its own knowledge workers to its customers, business partners, and suppliers.

Responsiveness. Hockey superstar Wayne Gretzky once said that his success was due to his ability to skate "not where the puck is but where it will be."⁵ An enterprise needs to have the same instincts to provide customer services. In today's world of open information architectures, customers have many choices, and enterprises have to move quickly and efficiently so they can not only react to, but also anticipate customer needs. In this fast-moving business environment, product availability is essential. Enterprises have to ensure that customers can get the products they want, with the features they are looking for, at the places where they want to buy. The key measure of cycle time—from placing a customer purchase order to delivering a ready-to-use product—is a major yardstick of responsiveness.

Speed of implementation has always been an important determinant for successful companies. The integration of electronic commerce and other technologies in the business mainstream has made this factor even more important. Today, neither IBM nor its clients can afford to wait long for the implementation of global solutions. Therefore, the processes for developing these solutions must make optimal use of available knowledge resources. In order to streamline these processes, it is imperative to establish a means for eliminating the costs associated with re-invention and to alleviate the frustrations endured by practitioners when they cannot benefit from lessons learned by others.

Today's workforce with its sophisticated technology is more mobile than ever before. In the past, when a new employee came on board, he or she would simply ask, "Where is my office? What personal computer will I have?" Today, workers want to know what kind of network facilities are available for dialing up and working globally. They constantly need access to knowledge from diverse locations. This requires truly interactive, transaction-intensive, on-line support enabling them to accomplish real work—to reshape the way products are designed, the way customers are supported, and the way decisions are made.

Productivity. Robert Reich⁶ describes three emerging categories of work and competitive positions: routine production services, in-person services, and symbolic-analytic services. Routine production work can be performed anywhere in the world. Most in-person services receive the minimum wage, which has been declining in real terms in the United States. The symbolic-analytic services, which are essentially provided by knowledge workers, are the key competitive advantage for the new economy. Providers of these services solve, identify, and broker problems by manipulating symbols. They have the best jobs, with rising real incomes. The intellectual capital-intensive business gives opportunity for growth.

Globalization, privatization, and alliances are progressively changing the face of the competitive market landscape. While these trends reveal an abundance of new opportunities for companies, they also press the question of how to manage global businesses effectively and efficiently. Today, globalization is less about where one goes and more about how one can provide services from there. Companies need to generate practices that can be tailored to accommodate regional differences, which involves creating a framework and culture for global collaboration.

Continuous improvement in operation efficiency and productivity is essential to long-term earnings growth and is a key determinant of an enterprise's competitiveness. With this in mind, the emphasis for an enterprise is not simply on cost reduction, but also on maximizing global resource productivity in the context of long-term growth and profitable operations. Intellectual capital plays a key role in the increase of productivity. Effective measurement of this increase in productivity and new business opportunity is vital.

Competency. A company as big as IBM has to focus on its core competencies. A competency is a logical grouping of productive resources (human, technical, and intellectual) that represent leading-edge and differentiated thinking that is valued in the marketplace. A competency can foster the rapid transfer of experience and ideas that can be applied in a consistent manner across organizational and geographic boundaries. A competency is focused—it does not try to be “all things to all people.” It is designed to accumulate knowledge wealth, reusing abilities and shedding irrelevancies. Because competencies are difficult to duplicate, they enhance a company's competitiveness.⁷

The key word for today's business environment is change. The new competitive advantages include: timeliness of information and intelligence, quality of customer services, and customer self-service resulting from the electronic commerce revolution. To prepare employees to anticipate, drive, support, or respond to change, enterprises need complete and objective information about their core competencies—knowledge, attitudes, skills, abilities, and traits—in order to accelerate business growth and stay competitive. The first step is intensive information collection and analysis procedures to identify the critical competencies needed to meet the enterprise's goals and its expectations to sustain leadership in the marketplace.

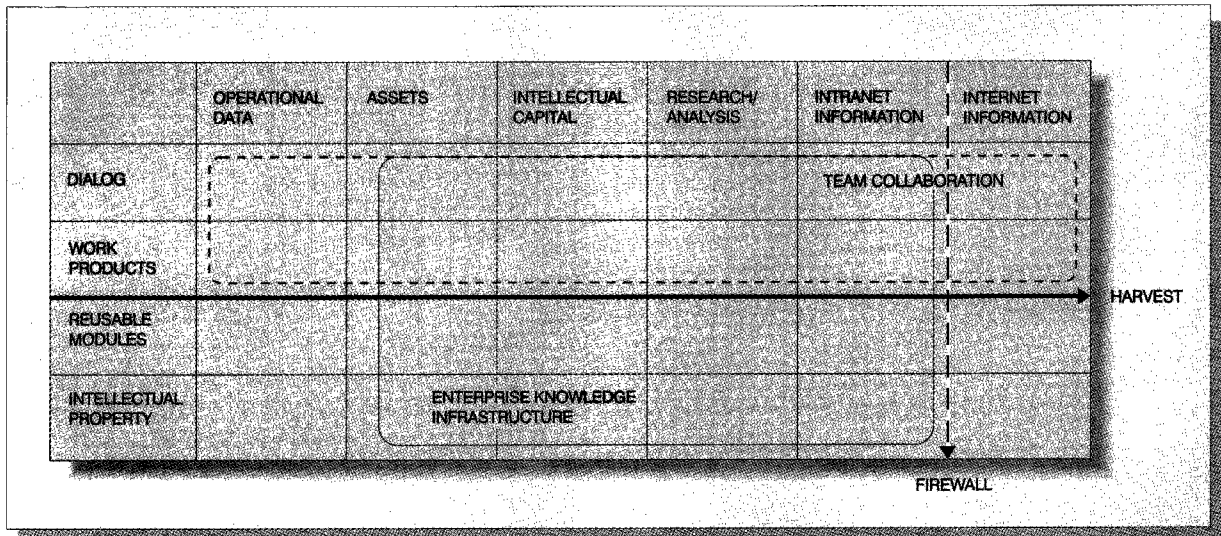
The increasing importance of time

As enterprises engage in a new form of global competition, expedience is increasingly important. Not only is the Internet shortening the distance between customers, suppliers, and business partners, it is also reducing, for all participants in the marketplace, the time needed to acquire information. The Internet provides a convenient medium for customer self-service and is reducing the level of intermediation in the marketplace. Businesses therefore need to renovate their customer services and seek to achieve customer loyalty and retention. Visionary companies are undergoing customer-driven realignment of their demand and supply value chains. Companies need to have mechanisms in place to capture and communicate the thoughts and feelings of customers. They need to have systems to quickly transform this knowledge into products and services for customers. Timeliness in acquiring information and efficiency in transforming it into deliverable solutions are the differentiators for today's product and service organizations.

Information and knowledge

Information consists of data passed through a person's mind and found meaningful. Information is something that happens as a person mentally “decodes” the data from audible or visible expression. The actual decoding process must take place in time. It may happen in the interaction between minds, or between mind and objects or other pieces of information. The quality of information rapidly degrades over time and in distance from the source of production. Moreover, its value is highly subjective and conditional. For example, last year's newspapers are quite valuable to the historian; on the other hand,

Figure 1 Categories of information and knowledge



news that occurred more than an hour ago may have lost any relevance to a stockbroker. Therefore, information is experienced, not possessed.

Knowledge is defined by Davenport and Prusak⁸ as “a fluid mix of framed experience, values, contextual information, and expert insights that provides a framework for evaluating and incorporating new experiences and information.” Knowledge has different value to different people. Knowledge cannot be measured, but one can measure its activities and results. Knowledge results include judgment, expertise, rapid pattern recognition, error avoidance, reuse, and innovative thinking.

Within a business organization, there are three broad sets of activities interlinked in a cycle: business management, project management, and intellectual capital management. Each set has its own goals, processes, roles, constraints, and types of information or knowledge that must be manipulated and supported. Within IBM we categorize the information or knowledge generated from these activities into six areas (Figure 1): (1) operational data from business management, (2) assets, (3) intellectual capital, (4) research and analysis, (5) intranet information, and (6) Internet information, all “harvested” from projects and shared through the enterprise knowledge infrastructure. Work products and deliverables are artifacts derived from projects. They are the documented records of knowledge, generated by

project teams, that provide tangible building blocks for knowledge sharing.

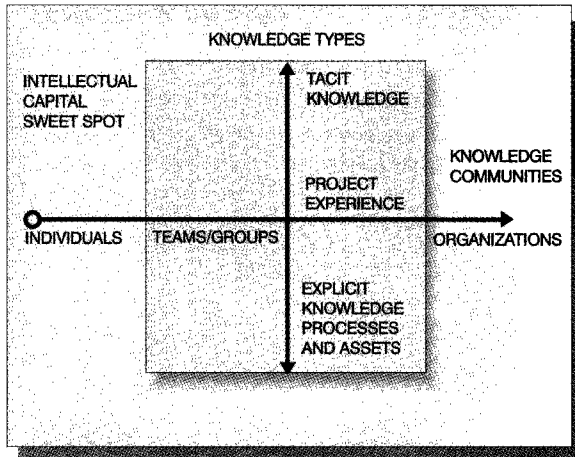
Cultural change and increasing knowledge intensity

Knowledge management requires addressing both cultural and technical issues. The way in which knowledge is transferred is very different from the transfer of physical goods. Goods are transferred through distribution, propagation, and interaction. Knowledge can be transferred without leaving the possession of the original owner. The value of the output resulting from the transferred knowledge can be far greater than that from the original knowledge—it is dependent on the individual mental processes and application contexts. Our vision is to embed knowledge management into the fabric of IBM's business operations. There are four major processes that we are using for knowledge sharing and collaboration. These are: (1) making knowledge visible, (2) increasing knowledge intensity, (3) building knowledge infrastructure, and (4) developing a knowledge culture. Increasing knowledge intensity and addressing cultural change are the most challenging issues.^{8,9}

Capitalizing on collective knowledge

Today, staying in the game is not enough. To win, a company must be poised, ready to meet customers' challenges and to provide a winning solution

Figure 2 Knowledge dimensions and intellectual capital "sweet spot"



ahead of the competition. Knowledge sharing occurs naturally in a mutually dependent community. Knowledge transfer occurs through human interaction and social processes. Knowledge management targets two dimensions (Figure 2). One dimension is knowledge types: from tacit knowledge, through project experiences, to explicit knowledge.² The other dimension is knowledge communities: from individuals, through teams and groups, to enterprise organizations. Tacit knowledge represents what works, discovered over time and through the experience of an individual or team. It normally resides in the minds of individuals and is a tremendously valuable corporate asset. Explicit knowledge is tacit knowledge that is documented and externally visible.

Capturing team agility and tacit knowledge. There has been emphasis on the importance of teamwork in the workplace. Whether one is delivering services or merely wanting to increase effectiveness and employee morale, developing effective and cohesive teams is a good tactic. A team is generally composed of a highly communicative group of people. Poor communication means that the group is not a team. Frequent dialogs and discussions among the team members generate a wellspring of tacit knowledge. This dialog along with work products, form the tacit knowledge generated by the team. This is the source for collecting and recording explicit knowledge for sharing and reuse. A team with diverse members from different backgrounds and with varying skills

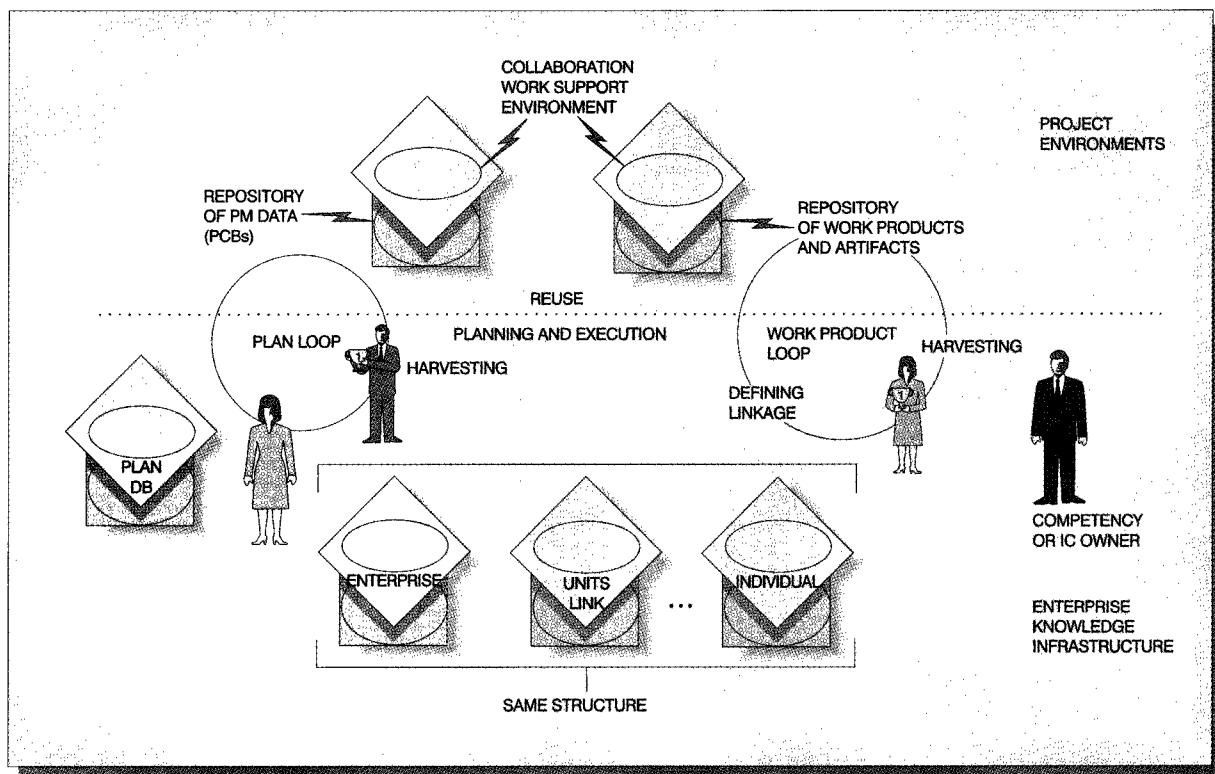
and abilities has better agility and can more effectively generate valuable tacit knowledge and an innovative learning environment. More importantly, it must have a shared sense of mission and clearly identified goals to be able to generate knowledge that is focused and intensive. Goals help the team to gauge its success and to know what it is trying to accomplish. At IBM, we believe that the team or group environment, fostering dialog and common goals, is the "sweet spot" for sharing both tacit and explicit knowledge.

The contest between individual and collective knowledge. "You lost, man" said the *Boston Herald*,¹⁰ after chess master Garry Kasparov's defeat in a seven-game series against IBM's Deep Blue* supercomputer. While the epic chess rematch was indeed a contest between human and computer, more fundamentally it proved to be a contest between individual and collective efforts. On one side, Kasparov's knowledge was based on his individual intuition, emotions, skills, and experiences—his tacit knowledge. Deep Blue's know-how came from recorded, programmed, and collectively constructed information from many individuals. Its knowledge was explicit.

What can firms learn from the fact that explicit knowledge overcame tacit knowledge in a chess match? The embodiment of Deep Blue clearly departs from the traditional perspective on knowledge. Deep Blue was not an artificially intelligent machine, but rather a number-crunching dynamo that was able to calculate more than 200 million potential chess moves each second, then tap into a vast knowledge bank of how past chess games were played to evaluate and choose the most promising option. It demonstrated the power of applying today's advanced information technology to assist in collaborative efforts and knowledge sharing to generate winning results. As an audience member observed, "It is striking how far technology has gone in replicating human thought." With the assistance of today's information technology, firms can capture and reproduce the tacit knowledge of their workers, to be reused at different times and in different locations, through different media, to create solutions more efficiently. In turn, this allows more time for individuals to use their intuitive strengths, defining and solving problems more creatively.

The knowledge cycle: From project information to intellectual capital. Reuse of intellectual capital is one of the most effective ways of improving speed

Figure 3 Intellectual capital examples from engagement projects



of response and encouraging innovation. Context-sensitive linkage between the project management environment and intellectual capital management is critical. The knowledge cycle is the process, for knowledge creation, use, and reuse with continuous improvements, that the professionals are sharing. The scope of the knowledge cycle is the context boundary of the users. In a business context, it is linked to the complexity and evolving nature of the marketplace. In a project environment, a collaborative work support environment is needed to capture dialog and work products. Figure 3 shows two examples of intellectual capital generated from consulting engagement projects: work products or artifacts and project control books (PCBs).

The flow of the cycle is shown by the loops going from the project environment to the enterprise knowledge infrastructure of multiple kinds of intellectual capital (IC) to the engagement or solution-development context and back. Numerous kinds of IC must be brought to bear (or created) in the proj-

ect context, including proposals, methods, project control books, work-product descriptions, work-product examples, and "best practice" materials of all types.

Typically, the IC must be situated and adapted in the new context, with changes, if needed, as determined by intensive discussion and decision making on the project as it evolves. A large volume of project-specific information and knowledge will be generated (or possibly adapted) and must be managed—hence the need for project management (PM) support processes and tools. As a project progresses, and certainly at its conclusion, project knowledge is "harvested" and placed in the long-term IC repository, hence the need for the intellectual capital management (ICM) framework and toolset. Finally, both PM and ICM occur within the encompassing business environment of an enterprise that generates its own operational and financial information, knowledge types, and management requirements—hence the

need for business management support processes and tools.

This view of the knowledge cycle shows the need to support the complex interlinking of information and knowledge from project level to enterprise knowledge infrastructure. The knowledge cycle is also part of the business processes for operations and interactions. There are other nested cycles of communication and collaboration that must occur among people in a wide variety of roles and levels in conjunction with the development, delivery, documentation, transfer, harvest, generalization, storage, retrieval, and so on, of the essential knowledge flow within the business.

Collaboration is the process of shared creation. Shared creation is at the heart of the generation, use, and reuse of knowledge and assets. Issue-based resolution can help to facilitate and capture the dialogue and decision making that must always take place when situating and adapting a part of the IC to a new project context.

Creating a wealth of intellectual capital. The Internet can be considered a gold mine of information for some persons, and at the same time a junkyard to others. It all depends on the content quality of the information found and how the information is presented. Recently, the *Wall Street Journal*¹¹ reported that thousands of Web sites are not updated for long periods of time, resulting in the devaluation of their information content. This condition provides a clear picture of how information can become useless if not managed through a quality life cycle.^{12,13} Maintaining high-quality content and frequently refreshing it with new information is critical for attracting visitors to a Web site. Likewise, companies need to manage both tacit and explicit information and knowledge as dynamically as possible to maintain its value.

However, having access to quality information alone is not sufficient for success in knowledge management. Once intellectual capital is captured, institutions and practices must be established to compel its dissemination throughout the firm to increase productivity and foster innovation. Many companies still operate under the mistaken assumption that employees automatically share their knowledge. Moreover, as companies expand to become more global, the assumed opportunities for spontaneous face-to-face exchanges of tacit knowledge diminish. These factors provide compelling reasons to create frameworks for

promoting what is learned at the individual level to the organizational level.

Finally, the effectiveness and value of knowledge management depends on the active participation of every professional. Employees need to make it a habit to contribute their ideas and knowledge for reuse, and to attentively refine existing intellectual capital. Every knowledge community should promote and encourage other communities to use and submit intellectual capital. Each employee's willingness to share knowledge is critical. The time that one spends contributing will be more than compensated for when tapping the reservoirs of intellectual capital to provide efficient, high-quality service to customers. Teamwork is key to successful knowledge management.

Knowledge management at IBM

As an intellectual capital-intensive company, IBM has knowledge management at the core of its business. In the 1997 IBM Annual Report, Chairman and CEO Lou Gerstner wrote, "behind the scenes we've been re-engineering IBM from top to bottom, with one goal: to foster a high-performance culture and turn IBM into the world's premier knowledge management company."¹⁴ At IBM, our knowledge management program is called "Intellectual Capital Management" (ICM). In order for the company to remain competitive, it must become more agile, innovative, and responsive to the demands of customers. IBM Global Services is transforming "from big iron to big intellects."¹⁵ To achieve this end, Lou Gerstner observed,¹⁶ "We have to win through brilliant execution that can only be done with teamwork." His words have subsequently defined the three fundamentals of IBM's knowledge management effort: teamwork, execution, and winning.

Since 1994, IBM Global Services has employed intellectual capital management (ICM) to support intellectual capital and asset reuse for consulting engagement teams. The idea of ICM has been to institutionalize and make knowledge management more formal. Our effort has involved taking practical steps to acquire, create, share, and transfer knowledge, to use knowledge to continually develop and grow, and to anticipate and adapt to changing conditions. The project has established a foundation for knowledge sharing and reuse at IBM.

Using the power of technology. Technology is changing the way we do things. Whether that change re-

sults in increased productivity is a question often left unanswered. In itself, technology does not produce improvement. That requires changes to processes and organizations. There is a tendency to take productivity improvements for granted. Unless productivity is measured before and after implementing technological innovation, it is difficult to know whether the new system is working as desired, or how and where to improve it. In today's knowledge-based economy, the importance of shortening the time to acquire information and gain intelligence makes technology a key factor in increasing the productivity of knowledge workers.

Solutions and technology allow sharing, reuse, and management of intellectual capital in a networked team environment. To increase knowledge intensity, an organization needs solutions to support team interaction, knowledge synthesizing, and knowledge management infrastructures. Our team at IBM has created solutions based on user requirements and deployed them on IBM's worldwide network computing infrastructure. These solutions are based on Lotus Notes** Domino,** the IBM intranet, electronic mail, and linked telephone systems. Some of these technologies are new, and although they are not yet fully in place, we are working toward a global implementation. Keeping up with technology is difficult, but these tools will help us transform IBM's business to be knowledge and asset based. The ICM AssetWeb, our enterprise knowledge infrastructure, and its related solutions, Knowledge Café for team dialog and collaboration, and Knowledge Cockpit for business intelligence and knowledge discovery, are examples of such tools.

Enterprise knowledge infrastructure—ICM AssetWeb. The ICM AssetWeb provides the infrastructure for IBM's knowledge management solutions. This strategic knowledge and asset management collaboration system is used by IBM groups to "team, execute, and win" customer engagements by creating, sharing, and reusing intellectual capital. Intellectual capital consists of information, know-how, experiences, wisdom, ideas, objects, code, models, and technical architectures that are structured to enable sharing for reuse to deliver value to customers and shareholders. The ICM AssetWeb provides organizational support centering around competencies, asset management support, and structured collaboration support. This tool, along with our ongoing work in the area of knowledge management, has helped us to serve IBM's customers while making IBM a smarter and more nimble organization. The ICM As-

setWeb recently won the Gold Medal of the 1998 Giga Excellence Award on Knowledge Management, a prestigious industry award, for its implementation excellence and innovation.^{17,18}

The ICM AssetWeb contains four major features: (1) content management for evaluating and structuring intellectual capital; (2) collaboration and teamwork

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to support community building and to energize intellectual creation; (3) engagement configuration management to support a consistent and intuitive methodology for selecting the best resources to use in generating client solutions; and (4) content management to support the information architecture, version management, and information workflow and process defined for the business unit and enterprise. In addition, there is a strong demand to focus on customer knowledge management as the business adapts to customer-centered operation. The objective is to capture customer data from several sources, both internal and external, and utilize the critical data and information in context in areas such as distribution, field services, customer service, inside sales, and data mining for marketing and management.

Several comprehensive tools are built into the ICM AssetWeb, such as version management, automatic multidatabase searching, "yellow pages," and user-preference configurators. Add-ons such as new navigational mechanisms can also be easily incorporated into the system. Moreover, the ICM team has built an automatic tracking tool that allows us to continually monitor the knowledge activity and intensity of competency networks to help identify patterns of reuse and the most useful intellectual capital. With the evolution of technology, content improvements, application upgrades, and end-user feedback, the ICM AssetWeb is always under refinement.

Competency networks. Competency networks are an integral part of IBM's ICM program. A competency

network is a community of subject knowledge experts within the company that represents a *core competency*. It generally consists of a core team and an extended team. A major responsibility of the competency network is to enable the effective and efficient collection and sharing of intellectual capital pertaining to the competency, and to make it available to practitioners throughout IBM. Each competency network is responsible for creating, evaluating, and structuring the intellectual capital that goes into its own database and then sharing it with interested practitioners. By increasing the breadth and depth of our competencies and sharing intellectual capital created by these competencies, IBM is able to provide greater value and faster delivery to our clients.

Each competency network creates an intellectual capital database containing the most current thinking and research and the best client examples, techniques, education, and marketing materials related to that competency's expertise. These databases are available to consulting, solution, and services practitioners. The competency network database supports advanced features such as structured collaboration, forums, group configuration, different levels of security control, reconfigurable categories and subcategories, and a document repository.

Asset management in ICM AssetWeb is designed to support the development of the best practices for asset-based services business, through understanding gained from the experiences of practicing consultant and solution groups. Support in asset management includes the support of the competency networks to transform IBM and its services and solution organizations into asset-based businesses. This is accomplished by developing a worldwide community of practitioners who are aware of, and execute the best practices of, asset-based services. Best practices include codification of methods, techniques, and processes for asset-based services into a methodology, software reuse libraries that manage the software-related assets, and collaboration utilities to connect the distributed community through a global network. The software reuse library provides a set of functions that supports reasoning-driven workflow for submitting, requesting, and distributing the software-related assets. Optionally, the owner of an asset can choose to have an encrypted string of the requester's information stored into the asset for future tracking. The security control of the assets is at the individual asset level for flexibility and security.

Issue-based structured collaboration is a model of discussion that has been around in theory for years, but has not been utilized in major applications. By linking structured collaboration to the competency network and asset management process, we created a flexible, easy-to-use, and robust discussion forum that enables practitioners to focus on the resolution of issues by displaying the process of collaboration and resolution in a structured view. The tool enforces the discussion discipline, but provides an easy-to-use interface and dynamic group configuration along with security control. The action items created in the collaboration are tracked to ensure that issues are moved toward closure and that follow-up actions are carried out.

ICM AssetWeb's Navigator view (Figure 4) gives access to a vast web of information. This view provides clear, intuitive pathways to every item in the system. In a few clicks, the powerful search feature helps the user to find the facts needed and the individuals who can help.

Idea generation and team collaboration. Innovation is key to the success of a business.¹ The culture of creativity and idea generation needs to be linked to the daily activities of employees as a "mind spring." Recognizing the importance of this undertaking, the ICM AssetWeb provides discussion forums as well as the issue-based structured collaboration tool through Knowledge Café, a Lotus Notes application.

One can think of forums as an informal meeting place where ideas, comments, and thoughts are shared. On the ICM AssetWeb, discussion threads are preserved in an easy-to-follow main topic/response format. Users can browse through the topics that are open for discussion and review the responses that others have contributed. They can also take a more active role in discussions by composing their own responses and proposing new main topics for discussion.

As a Lotus Notes application, Knowledge Café supports teams whose members are geographically distributed and sometimes unable to be connected to their computer network. It supports calendar and event functions, team configuration, document management, issue-based structured collaboration, team discussion forums, and document management for individual team members (see Figure 5). Knowledge Café provides a way for teams and larger groups to customize intellectual capital or select a subset or

Figure 4 ICM AssetWeb Navigator



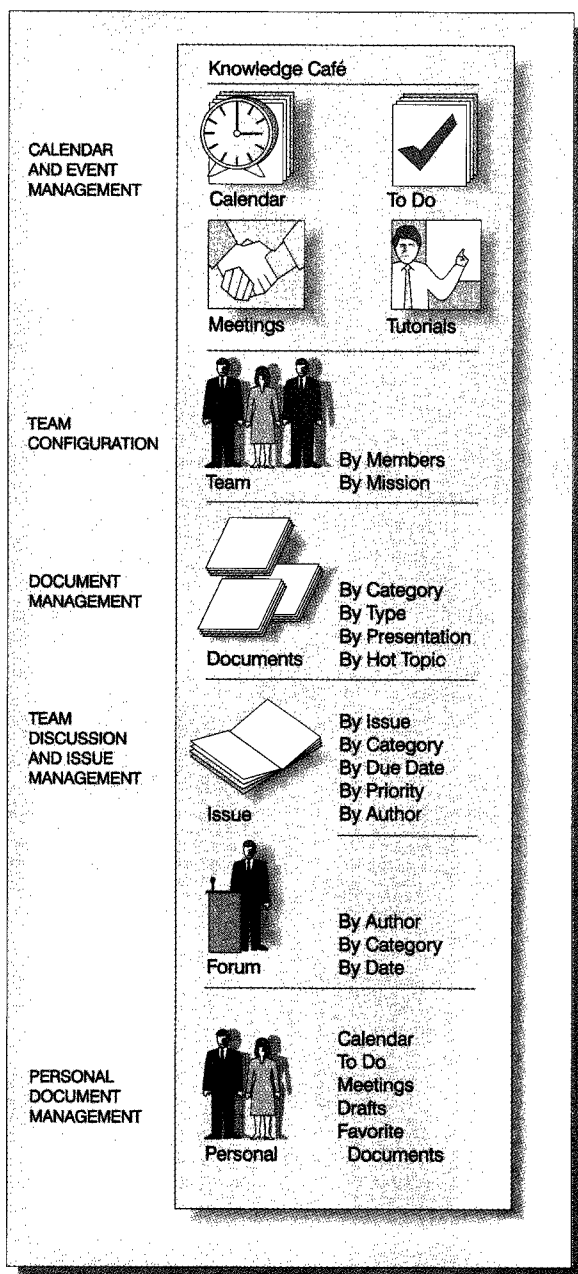
path of the methodology to instantiate to fit their unique needs. It includes the following:

- Shared central repository. Information is maintained in a shared central repository, making access and retrieval more effective. It is more efficient to post team information once, rather than numerous times to specific individuals. Knowledge Café's configurable categories and subcategories make knowledge transfer more efficient and effective.
- Issue-based structured collaboration. As men-

tioned earlier, structured collaboration provides a flexible, easy-to-use, and robust discussion forum that allows the user to focus on the resolution of issues and display the process of collaboration and resolution in a structured view.

- Team knowledge management. The team leader has total responsibility for structuring the team configuration. This responsibility corresponds to the role of helping to manage the goals and tasks of the team. The team leader manages both the structure of the team and the way team members use Knowledge Café.

Figure 5 Knowledge Café for team collaboration



Examples of activities made easier and more efficient with Knowledge Café include:

- Raising and discussing issues and concerns
- Creating collaborative products: memos, presentations, and other documents

- Brainstorming
- Preparing for meetings
- Tracking meeting agendas and resulting action items
- Posting events and schedules

Teams are more likely to do their best when they are committed to a common purpose, with clear, specific goals, and have a well-defined plan as individuals and as a team on how to achieve these goals. Knowledge Café assists the team in defining its mission, understanding its goals, and managing activities and tasks.

Knowledge discovery. Knowledge Cockpit, a framework for knowledge mining, is available to subject matter experts. By giving them the power to mine information, Knowledge Cockpit helps to revolutionize the way these employees do their jobs, providing:

- Business-related information and knowledge
- Mobile agents that collect relevant information throughout the Internet, which becomes a massive knowledge gold mine
- Intellectual capital and asset management integrated into everyday tasks and business operations

Knowledge Cockpit captures information from a wide range of sources and funnels the information to one location, saving time and money. It utilizes advanced knowledge mining techniques to process, discover, and synthesize knowledge, then transforms information from these different sources into a consistent network of knowledge. Decision support components utilize the network of knowledge to assess the information's quality and to translate the knowledge into a compact, comprehensible format. The following high-level examples show how Knowledge Cockpit might be used by a supermarket chain.

Example 1: Specific customer information. A supermarket offers a price saving card to its customers. Each time the customer makes a purchase, this card is presented to the cashier and a record of the customer's transaction is captured in the store's database. Knowledge Cockpit could utilize this information to provide the purchase history of all regular customers and specific knowledge on each individual's shopping habits, such as shopping frequency, brand preferences, amount spent, utilization of in-store services and promotions, and any coupons redeemed. Using Knowledge Cockpit to analyze this information, the supermarket could provide discount

coupons to its best customers and incentives to other customers to shop more frequently.

Example 2: Business information. A supermarket chain needs access to up-to-date information on all of its competitors. If one rival suddenly begins to offer larger than normal discounts to its shoppers, perhaps the rival is trying to capture more of the market share. Knowledge Cockpit could gather and provide analysis information on competitors from all available sources (trade journals, Internet/intranet, financial and news services). The results may indicate that the rival is having financial problems because it opened too many new stores and now must cut back by closing the poor performers and liquidating the stock in each. A supermarket utilizing this information could then understand the reason for the lower pricing by its competitor, and not rush to match it, cutting its own profits. Instead, it could benefit by promoting its own longevity and its desire to welcome the other chain's customers.

Example 3: Business experiences. Information on business experiences might include lessons learned from different types of store floor plans, aisle layouts, and item locations, identifying what specialized departments should be included, such as a bakery, deli, prime meat or fresh fish counter, etc. This information is sometimes gained through trial and error. Capturing and storing information on business experience is a valuable source of intellectual capital that can be applied and reused in other situations.

Our approach to knowledge management includes: linking intellectual capital with strategy, building an infrastructure and processes for creating and sharing knowledge, creating a knowledge-based enterprise and culture, leveraging technology for global collaboration and knowledge sharing, and measuring the effectiveness and value of intellectual asset sharing.

We have addressed these items through the implementation of competency networks—informal networks of practitioners—supported by common processes, tools, and other aids that allow IBM professionals to create, identify, store, and efficiently reuse intellectual capital. We have implemented asset management processes that identify, harvest, and harden structured assets with high potential in customer solutions. Moreover, we have established a program to promote user participation. The efforts of the ICM team culminated in the creation of the ICM AssetWeb, a dynamic Lotus Notes-based col-

laboration system that gives practitioners in IBM the power to leverage intellectual capital.

Lesson learned

ICM encompasses a system of policies, processes, personnel, values, and technology that enables IBM's professionals to identify, store, and efficiently reuse intellectual capital. The critical success factor for ICM is to embed it into the fabric of IBM's business operations. The management framework addresses the elements that are critical for establishing a successful system of intellectual capital management and for initiating cultural and behavioral changes. It has allowed the ICM team to create a foundation and culture of networked communities that help practitioners to provide the best possible solutions to clients.

We at IBM use a systems approach to managing knowledge, defined by the ICM framework. Each part of the framework is an essential element for successful operation of the entire system for managing knowledge. The ICM team's experience tells us that personnel, processes, and technology are the most critical enablers.⁸

At the heart of the ICM effort are individuals. The establishment and nurturing of strong, committed, interlinked communities is what enables effective and efficient intellectual capital management throughout IBM. Knowledge sharing has to be valued and practiced for ICM to work. Everyone must contribute. Individuals also have to be committed to helping each other. There has to be a sense of urgency in responding when someone calls for help.

To effectively capture and reuse intellectual capital, there are two structured processes: the knowledge management process and the asset management process. The goal of each of these processes is to ensure that users and practitioners are able to access the current and relevant intellectual capital users need, whenever they need it.

Technology is not a solution in itself. Technology can help to provide solutions that meet the users' requirement for sharing, reusing, and managing intellectual capital in a networked team environment. The success of technology solutions depends on the active contribution of the communities to increase the quality and content of relevant knowledge. Solutions must support all three levels: enterprise, team or business unit, and individual. Our technology solutions include the enterprise knowledge management infra-

structure (ICM AssetWeb), team and business unit collaboration (Knowledge Café), and knowledge discovery and intelligence (Knowledge Cockpit). All were designed with global users in mind.

In summary, the lessons learned from IBM's experience are:

- Knowledge is first of all a business issue—but technology can help tremendously.
- Knowledge management is central to the business, and it becomes part of the fabric of the business.
- Knowledge management involves human behavior.
- Knowledge management requires investment in order to gain benefits.
- Successful knowledge management requires a systemic approach.

The bottom line: Intellectual assets add value to the enterprise

Knowledge management provides benefits to an enterprise's professionals, customers, and business partners, as well as its business. Sharing and reusing intellectual capital increases effectiveness, productivity, and quality in many ways. Constant and systematic approaches for tracking successes and their real impact on business operations is critical to the long-term success of a knowledge management program. An organization needs to be continuously aware of these dynamics and to consciously apply proven strategies in everyday tasks. Investment in enterprise knowledge management should lead to improvements such as:

- *Efficient use of time.* Leveraging the knowledge gained from experience enables new professionals to add value to client projects sooner. It allows experienced professionals to expand and update their expertise more quickly than ever before.
- *Enhanced client satisfaction.* The enterprise can deliver the right solution to clients more quickly than before by custom-tailoring solutions, rather than creating each one from scratch. The quality of those solutions may be better than before, because the most current "best practices" can be obtained from within and across industries, locally and globally.
- *Wiser use of resources.* The time saved by reusing proven solutions can be used to develop high-quality proposals, improving the win-loss ratio.
- *Generation of new business.* We can harvest the intellectual capital generated from customer engage-

ments and the knowledge gained from customer interactions to create new solutions.

Armed with managed intellectual capital, the possibilities are limited only by our imagination.

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Cited references

1. D. Leonard-Barton, *Wellsprings of Knowledge: Building and Sustaining the Sources of Innovation*, Harvard Business School Press, Boston, MA (1995).
2. P. Drucker, *Post Capitalist Society*, Butterworth Heineman, Oxford, UK (1993).
3. I. Nonaka and H. Takeuchi, *The Knowledge-Creating Company*, Oxford University Press, New York (1995).
4. Lotus, IBM, and Knowledge Management, available at <http://www.lotus.com/home.nsf/welcome/institute>.
5. W. Gretzky, *Gretzky: An Autobiography*, Soho Press Inc., New York (1994).
6. R. B. Reich, *The Work of Nations*, Alfred A. Knopf, New York (1991).
7. M. Porter, *Competitive Strategy*, The Free Press, New York (1980).
8. T. H. Davenport and L. Prusak, *Working Knowledge: How Organizations Manage What They Know*, Harvard Business School Press, Boston, MA (1998).
9. T. H. Davenport and L. Prusak, *Information Ecology: Mastering the Information and Knowledge Environment*, Oxford University Press, New York (1997).
10. *Boston Herald* (April 12, 1997).

11. J. Sandberg, "At Thousands of Web Sites, Time Stands Still," *Wall Street Journal* (March 11, 1997).
12. D. M. Strong, Y. W. Lee, and R. Y. Wang, "Data Quality in Context," *Communications of the ACM* **40**, No. 5, 103–110 (May 1997).
13. R. Y. Wang, "A Product Perspective of Total Data Quality Management," *Communications of the ACM* **41**, No. 2, 58–65 (February 1998).
14. IBM 1997 Annual Report, available at <http://www.ibm.com/AnnualReport/1997>.
15. *IBM Global Services: From Big Iron to Big Intellects?*, Meta Group Inc. Report—Advanced Information Management, Feb. 6, 1998.
16. Lou Gerstner, communication to IBM employees.
17. IBM Global Services Wins Top Honor for Its Knowledge Management Innovations, available at <http://www.ibm.com/services/pressrel/pr.889566539.html>.
18. WARIA and Giga Information Group Announce the Finalists of 1998 Giga Excellence Awards for Excellence in Document/Knowledge Management and Workflow/Process Management in North America, available at <http://www.waria.com/awards98.html>.

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