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Working Knowledge: How Organizations Manage What They Know

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In the end, the location of the new economy is not in the technology, be it the microchip or the global telecommunications network. It is in the human mind.
-- Alan Webber

What Do We Talk about When We Talk about Knowledge?

KNOWLEDGE is neither data nor information, though it is related to both, and the differences between these terms are often a matter of degree. We start with those more familiar terms both because they are more familiar and because we can understand knowledge best with reference to them. Confusion about what data, information, and knowledge are -- how they differ, what those words *mean* -- has resulted in enormous expenditures on technology initiatives that rarely deliver what the firms spending the money needed or thought they were getting. Often firms don't understand what they need until they invest heavily in a system that fails to provide it.

However basic it may sound, then, it is still important to emphasize that data, information, and knowledge are not interchangeable concepts. Organizational success and failure can often depend on knowing which of them you need, which you have, and what you can and can't do with each. Understanding what those three things are and how you get from one to another is essential to doing knowledge work successfully. So we believe it's best to begin with a brief comparison of the three terms and the factors involved in transforming data into information and information into knowledge.

A Working Definition of Knowledge

A word of qualification before we proceed with our definitions. We're aware that some researchers identify more than the three entities of data, information, and knowledge -- going on, for example, to describe wisdom, insight, resolve, action, and so forth. Since we've noticed that firms have enough difficulty distinguishing among three related concepts, however, we're not inclined to address more. For practical purposes, we'll lump higher-order concepts such as wisdom and insight into knowledge. And things like "resolve" and "action," while desirably pointing to

the need to do something with knowledge, we'd put into a different category of "things you do with knowledge" rather than a variation on knowledge itself. With that caution, let's proceed to some definitions.

Data

Data is a set of discrete, objective facts about events. In an organizational context, data is most usefully described as structured records of transactions. When a customer goes to a gas station and fills the tank of his car, that transaction can be partly described by data: when he made the purchase; how many gallons he bought; how much he paid. The data tells nothing about why he went to that service station and not another one, and can't predict how likely he is to come back. In and of themselves, such facts say nothing about whether the service station is well or badly run, whether it is failing or thriving. Peter Drucker once said that information is "data endowed with relevance and purpose," which of course suggests that data by itself has little relevance or purpose.

Modern organizations usually store data in some sort of technology system. It is entered into the system by departments such as finance, accounting, and marketing. Until recently it has been managed by central information systems departments that respond to requests for data from management and other parts of the company. The current trend is for data to be somewhat less centralized and available on demand from desktop PCs, but the basic structure of what it is and how we store and use it remains the same.

Quantitatively, companies evaluate data management in terms of cost, speed, and capacity: How much does it cost to capture or retrieve a piece of data? How quickly can we get it into the system or call it up? How much will the system hold? Qualitative measurements are timeliness, relevance, and clarity: Do we have access to it *when* we need it? Is it *what* we need? Can we make sense out of it?

All organizations need data and some industries are heavily dependent on it. Banks, insurance companies, utilities, and government agencies such as the IRS and the Social Security Administration are obvious examples. Record keeping is at the heart of these "data cultures" and effective data management is essential to their success. Efficiently keeping track of millions of transactions is their business. But for many companies -- even some data cultures -- more data is not always better than less. Firms sometimes pile up data because it is factual and therefore creates an illusion of scientific accuracy. Gather enough data, the argument goes, and objectively correct decisions will automatically suggest themselves. This is false on two counts. First, too much data can make it harder to identify and make sense of the data that matters. Second, and most fundamentally, there is no inherent meaning in data. Data describes only a part of what happened; it provides no judgment or interpretation and no sustainable basis of action. While the raw material of decision making may include data, it cannot tell you what to do. Data says nothing about its own importance or irrelevance. But data is important to organizations -- largely, of course, because it is

essential raw material for the creation of information.

Information

Like many researchers who have studied information, we will describe it as a *message,* usually in the form of a document or an audible or visible communication. As with any message, it has a sender and a receiver. Information is meant to change the way the receiver perceives something, to have an impact on his judgment and behavior. It must inform; it's data that makes a difference. The word "inform" originally meant "to give shape to" and information is meant to shape the person who gets it, to make some difference in his outlook or insight. Strictly speaking, then, it follows that the receiver, not the sender, decides whether the message he gets is really information -- that is, if it truly informs him. A memo full of unconnected ramblings may be considered "information" by the writer but judged to be noise by the recipient. The only message it may communicate successfully is an unintended one about the quality of the sender's intelligence or judgment.

Information moves around organizations through hard and soft networks. A hard network has a visible and definite infrastructure: wires, delivery vans, satellite dishes, post offices, addresses, electronic mailboxes. The messages these networks deliver include e-mail, traditional or "snail" mail, delivery-service packages, and Internet transmissions. A soft network is less formal and visible. It is ad hoc. Someone's handing you a note or a copy of an article marked "FYI" is an example of information transmission via soft network.

Quantitative measures of information management tend to include connectivity and transactions: How many e-mail accounts or Lotus Notes users do we have? How many messages do we send in a given period? Qualitative measures measure informativeness and usefulness: Did the message give me some new insight? Does it help me make sense of a situation and contribute to a decision or the solution to a problem?

Unlike data, information has meaning -- the "relevance and purpose" of Drucker's definition above. Not only does it potentially shape the receiver, it *has* a shape: it is organized to some purpose. Data becomes information when its creator adds meaning. We transform data into information by adding value in various ways. Let's consider several important methods, all beginning with the letter *C:*

Contextualized: we know for what purpose the data was gathered

Categorized: we know the units of analysis or key components of the data

Calculated: the data may have been analyzed mathematically or statistically

Corrected: errors have been removed from the data

Condensed: the data may have been summarized in a more concise form

Note that computers can help to add these values and transform data into information, but they can rarely help with context, and humans must usually help with categorization, calculation, and condensing. A problem we will deal with throughout this book is the confusion of information -- or knowledge -- with the technology that delivers it. From Marshall McLuhan's *The Medium Is the Message,* with its assertion that television would bind humanity into a global village and end world conflict, to recent statements about the transforming power of the Internet, we have heard that information technology will change not only how we work but who we are. One important point we will make in this book is that the medium is *not* the message, though it may strongly affect the message. The thing delivered is more important than the delivery vehicle. Having a telephone does not guarantee or even encourage brilliant conversations; owning a state-of-the-art CD player is pointless if you use it only to listen to polkas played by a kazoo ensemble. In the early days of television, many commentators said that the new medium would raise the level of cultural and political discourse in the nation, a prediction that clearly did not come true. The corollary for today's managers is that having more information technology will not necessarily improve the state of information.

Knowledge

Most people have an intuitive sense that knowledge is broader, deeper, and richer than data or information. People speak of a "knowledgeable individual," and mean someone with a thorough, informed, and reliable grasp of a subject, someone both educated and intelligent. They are unlikely to talk about a "knowledgeable" or even a "knowledge-full" memo, handbook, or database, even though these might be produced by knowledgeable individuals or groups.

Since epistemologists spend their lives trying to understand what it means to know something, we will not pretend to provide a definitive account ourselves. What we offer is a working definition of knowledge, a pragmatic description that helps us communicate what we mean when we talk about knowledge in organizations. Our definition expresses the characteristics that make knowledge valuable and the characteristics -- often the same ones -- that make it difficult to manage well:

Knowledge is a fluid mix of framed experience, values, contextual information, and expert insight that provides a framework for evaluating and incorporating new experiences and information. It originates and is applied in the minds of knowers. In organizations, it often becomes embedded not only in documents or repositories but also in organizational routines, processes, practices, and norms.

What this definition immediately makes clear is that knowledge is not neat or simple. It is a mixture of various elements; it is fluid as well as formally structured; it is intuitive and therefore hard to capture in words or understand completely in logical terms. Knowledge exists within people, part and parcel of human complexity and unpredictability. Although we traditionally think of assets as definable and "concrete," knowledge assets are much harder to pin down. Just as an atomic particle can appear to be

either a wave or a particle, depending on how scientists track it, knowledge can be seen as both process and stock.

Knowledge derives from information as information derives from data. If information is to become knowledge, humans must do virtually all the work. This transformation happens through such *C* words as:

Comparison: how does information about this situation compare to other situations we have known?

Consequences: what implications does the information have for decisions and actions?

Connections: how does this bit of knowledge relate to others?

Conversation: what do other people think about this information?

Clearly, these knowledge-creating activities take place within and between humans. While we find data in records or transactions, and information in messages, we obtain knowledge from individuals or groups of knowers, or sometimes in organizational routines. It is delivered through structured media such as books and documents, and person-to-person contacts ranging from conversations to apprenticeships.

Knowledge in Action

One of the reasons that we find knowledge valuable is that it is close -- and closer than data or information -- to action. Knowledge can and should be evaluated by the decisions or actions to which it leads. Better knowledge can lead, for example, to measurable efficiencies in product development and production. We can use it to make wiser decisions about strategy, competitors, customers, distribution channels, and product and service life cycles. We'll describe the characteristics of knowledge-intensive organizations later in this chapter and throughout the book. Of course, since knowledge and decisions usually reside in people's heads, it can be difficult to trace the path between knowledge and action.

We've observed and analyzed over a hundred attempts to manage knowledge in organizations. To the managers of most of them we've posed the question, "How do you make the distinction between data, information, and knowledge?" Many make no hard distinction in practice, and most of these initiatives involve a mixture of knowledge and information, if not some data as well. Many pointed out that they just tried to add value to what they had -- to move it up the scale from data toward knowledge.

Chrysler, for example, stores knowledge for new car development in a series of repositories called "Engineering Books of Knowledge." The goal of these "books," which are actually computer files, is to be an "electronic memory" for the knowledge gained by automobile platform teams. The manager of one such "book" was given a series of crash test results for inclusion in the repository. However, he classified the results as data and encouraged the submitter to add some value. What was the context of the results -- why were the crash tests performed? How about

comparisons to the results of other models, previous years, and competitors' cars? What consequences did the results suggest for bumper or chassis redesign? It may be difficult to note the exact points at which data becomes information or knowledge, but it's easy to see how to move it up the chain.

Knowledge can also move down the value chain, returning to information and data. The most common reason for what we call "de-knowledging" is too much volume. As one Andersen Consulting knowledge manager told us, "We've got so much knowledge (not to mention a lot of data and information too) in our Knowledge Xchange repository that our consultants can no longer make sense of it. For many of them it has become data." Aeschylus made a similar point clearly twenty-five centuries ago: "Who knows useful things, not many things, is wise."

Because knowledge is such a slippery concept, it's worth reflecting a bit on some of its key components, such as experience, truth, judgment, and rules of thumb.

Experience

Knowledge develops over time, through experience that includes what we absorb from courses, books, and mentors as well as informal learning. Experience refers to what we have done and what has happened to us in the past. "Experience" and "expert" are related words, both derived from a Latin verb meaning "to put to the test." Experts -- people with deep knowledge of a subject -- have been tested and trained by experience.

One of the prime benefits of experience is that it provides a historical perspective from which to view and understand new situations and events. Knowledge born of experience recognizes familiar patterns and can make connections between what is happening now and what happened then. The application of experience in business may be as simple as an old hand's identifying a down-turn in sales as a seasonal phenomenon and therefore no cause for alarm. It may be as complex as a manager's noticing subtle signs of the corporate complacency that led to problems in the past, or a scientist's having a sense of which new avenues of research will likely lead to useful results. These experience-based insights are what firms pay premiums for; they show why experience *counts*.

Ground Truth

Experience changes ideas about what *should* happen into knowledge of what *does* happen. Knowledge has "ground truth," to borrow the phrase the U.S. Army's Center for Army Lessons Learned (CALL) uses to describe the rich truths of real situations experienced close up: on the ground, rather than from the heights of theory or generalization.

For obvious reasons, effective knowledge transfer is a critical issue for the army. Knowing what to expect and what to do in military situations can be literally a life-or-death matter. Ground truth means knowing what really works and what doesn't. Experts from CALL take part in real military operations as learning observers and disseminate the knowledge they gather through photos, video

tapes, briefings, and simulations. Lessons learned in Somalia and Rwanda in the early '90s, for example, were passed on to the troops involved in the 1994 Haitian mission. The experiences of the first units in Haiti that went from house to house looking for weapons were also videotaped to provide guidance to those who followed.

A key aspect of the army's success at knowledge management was its "After Action Review" (AAR) program. This exercise involves an examination of what was supposed to happen in a mission or action, what actually happened, why there was a difference between the two, and what can be learned from the disparities. Enlisted soldiers and officers meet together in a climate of openness, collaboration, and trust. Results from the AAR are quickly incorporated into army "doctrine," or its formally documented procedures, and training programs. The AAR program was developed not as a knowledge management vehicle but rather as a means to return to values of integrity and accountability. These values had suffered considerably during the Vietnam War, and army leaders adopted the AAR and an orientation to ground truth to restore them -- initially in training missions, and later for all types of missions. Over the past few years the army has realized that it had a knowledge and learning tool in the AAR.

Another breakthrough in the army's extensive knowledge experience grew out of the reflections of a senior officer who, late in his career, read Tolstoy's *War and Peace*. He was struck by the difference between Tolstoy's depictions of Napoleonic War battles and the way those battles were taught in classes at military academies. How rich, true, and grounded were Tolstoy's descriptions (he had actually interviewed veterans of those campaigns) compared with the bloodless, rational abstractions taught in the classroom! The gap between ground truth and rational analysis prompted such innovations as CALL.

We could make a similar distinction between how business strategy actually happens and how it is taught in business schools. However, we believe that managers recognize the importance of real-life knowledge or ground truth. This is suggested by some of the language they use. They exchange "war stories" and talk about "life in the trenches." In other words, they share the detail and meaning of real experiences because they understand that knowledge of the everyday, complex, often messy reality of work is generally more valuable than theories about it.

Complexity

The importance of experience and ground truth in knowledge is one indication of knowledge's ability to deal with complexity. Knowledge is not a rigid structure that excludes what doesn't fit; it can deal with complexity in a complex way. This is one essential source of its value. Although it is tempting to look for simple answers to complex problems and deal with uncertainties by pretending they don't exist, knowing more usually leads to better decisions than knowing less, even if the "less" seems clearer and more definite. Certainty and clarity often come at the price of ignoring essential factors. Being both certain and wrong is a common occurrence. In *Sensemaking in Organizations,* Karl

Weick observes that "it takes a complex sensing system to register and regulate a complex object," and elsewhere he remarks:

The illusions of accuracy can be created if people avoid comparison . . . , but in a dynamic, competitive, changing environment, illusions of accuracy are short-lived, and they fall apart without warning. Reliance on a single, uncontradicted data source can give people a feeling of omniscience, but because those data are flawed in unrecognized ways, they lead to nonadaptive action.

Knowledge is aware of what it doesn't know. Many wise men and women have pointed out that the more knowledgeable one becomes, the more humble one feels about what one knows. Since what you don't know *can* hurt you, this awareness is extremely important. Recently, a genetic-engineering firm created a new tomato that farmers could pick and ship later than current varieties and that therefore would be more flavorful than the tomatoes available in supermarkets. The firm's scientists had all the expertise needed to develop the new tomato but didn't know enough about farming to know that there were essential things they didn't know. For instance, any farmer with experience growing tomatoes could have told them that any given single variety does not do equally well in all climates. Their new tomato was derived from only one variety. It grew successfully in some areas but not in others, and their scientific triumph was a commercial failure.

Judgment

Unlike data and information, knowledge contains judgment. Not only can it judge new situations and information in light of what is already known, it judges and refines itself in response to new situations and information. Knowledge can be likened to a living system, growing and changing as it interacts with the environment.

Of course, everyone has met "experts" whose knowledge seems to consist of stock responses and who offer the same old answer to any new question: every problem looks like a nail to a person who has only a single conceptual hammer in his toolbox. We would argue that the expertise of these experts ceases to be real knowledge when it refuses to examine itself and evolve. It becomes opinion or dogma instead.

Rules of Thumb and Intuition

Knowledge works through rules of thumb: flexible guides to action that developed through trial and error and over long experience and observation. Rules of thumb (or, in the language of the artificial-intelligence community, heuristics) are shortcuts to solutions to new problems that resemble problems previously solved by experienced workers. Those with knowledge see known patterns in new situations and can respond appropriately. They don't have to build an answer from scratch every time. So knowledge offers speed; it allows its possessors to deal with situations quickly, even some very complex ones that would baffle a novice.

Roger Schank, a computer scientist at Northwestern University, calls these internalized responses "scripts." Like play scripts (or

computer program codes), they are efficient guides to complex situations. Scripts are patterns of internalized experience, routes through a maze of alternatives, saving us the trouble of consciously analyzing and choosing at every step along the way. Scripts can be played so quickly that we may not even be aware of them: We arrive at an answer intuitively, without knowing how we got there. That does not mean the steps do not exist -- intuition is not mystical. It means we have so thoroughly learned the steps that they happen automatically, without conscious thought, and therefore at great speed. Karl Weick calls intuition "compressed expertise," a phrase that vividly suggests how knowledge works and what it can do.

The skill of an experienced driver provides an example of this kind of intuition. She *knows* how to drive, rapidly accomplishing a series of complex actions without having to think about them, as a beginner would. The veteran driver also develops an intuitive sense of what to expect on the road. Hundreds of hours of driving have led her to "know" that another driver is going to pull out of a side street or change lanes without looking. Experience has made her aware of minute signs that the beginning driver would almost certainly miss and that may be too subtle to verbalize. Like an experienced businessperson, she sizes up a situation quickly without going through a definable process or even being able to explain her "reasoning."

Values and Beliefs

It may seem odd to include values and beliefs in a discussion of knowledge in organizations. Many people assume that organizations are objective and neutral; their purpose is to create a product or provide a service, and that goal may seem unrelated to values. In fact, people's values and beliefs have a powerful impact on organizational knowledge. Organizations are, after all, made up of people whose values and beliefs inescapably influence their thoughts and actions. The organizations themselves have histories, derived from people's actions and words, that also express corporate values and beliefs.

Values and beliefs are integral to knowledge, determining in large part what the knower sees, absorbs, and concludes from his observations. People with different values "see" different things in the same situation and organize their knowledge by their values. Someone who values the bustle of urban life may find energy and variety in a crowded city street. Someone who prefers rural quiet may see only chaos and danger in the same scene. A publishing executive who values risk and change may see a new opportunity in the same online technology that a competitor views as a threat to traditionally successful print products.

Nonaka and Takeuchi say that "knowledge, unlike information, is about *beliefs* and *commitment*." The power of knowledge to organize, select, learn, and judge comes from values and beliefs as much as, and probably more than, from information and logic.

Knowledge as a Corporate Asset

People in organizations have always sought, used, and valued knowledge, at least implicitly. Companies hire for experience

more often than for intelligence or education because they understand the value of knowledge that has been developed and proven over time. Managers making difficult decisions are much more likely to go to people they respect and avail themselves of their knowledge than they are to look for information in databases. Studies have shown that managers get two-thirds of their information and knowledge from face-to-face meetings or phone conversations. Only one-third comes from documents. Most people in organizations consult a few knowledgeable people when they need expert advice on a particular subject. As we have said, knowledge is what makes organizations go. Knowledge is not new.

Explicitly recognizing knowledge as a corporate asset is new, however, as is understanding the need to manage and invest it with the same care paid to getting value from other, more tangible assets. The need to make the most of organizational knowledge, to get as much value as possible from it, is greater now than in the past.

The Changing Global Economy

Fifty years ago, the United States accounted for about 53 percent of the world GDP. The demand for American goods at home and abroad was so great that almost any product could find a market. Today, the U.S. share of the world GDP is approximately 18 percent. Although the "pie" is much bigger than it was, American companies no longer dominate the world market. There is fierce international competition for every marginal dollar of profit. A rapidly globalizing economy unified by improved communication and transportation gives consumers an unprecedented choice of goods and services and an endless cavalcade of new and better offerings from global companies.

In short, companies can no longer expect that the products and practices that made them successful in the past will keep them viable in the future. Pricing pressures leave no room for inefficient production. The cycle time for developing new products and getting them on the market is becoming more and more compressed. Companies now *require* quality, value, service, innovation, and speed to market for business success, and these factors will be even more critical in the future.

Increasingly, companies will differentiate themselves on the basis of what they know. A relevant variation on Sidney Winter's definition of a business firm as "an organization that knows how to do things" would define a business firm that thrives over the next decade as "an organization that *knows* how to do new things well and quickly."

In their search for new efficiencies, global corporations have outsourced much of the labor of manufacturing to countries where the cost of labor is still relatively low. Clearly, the knowledge-based activities of developing products and processes are becoming the primary internal functions of firms and the ones with the greatest potential for providing competitive advantage.

Product and Service Convergence

Increasingly, knowledge and related intangibles not only make businesses go but are part or all of the "products" firms offer. Old distinctions between manufactured objects, services, and ideas are breaking down. Not surprisingly, distinctions between manufacturing and service firms are disappearing too. Alan Webber described the change in a 1993 article:

Not so long ago, observers predicted with confidence the arrival of a "postindustrial" service economy, where the central role played by manufacturing in the economy would be steadily replaced by new service industries and service jobs. Now we know that the real impact of the information economy is to explode the distinction between manufacturing and services altogether.

Fortune magazine recognized the same trend in 1993, when it replaced its separate Fortune 500 industrial-firm and service-firm issues with a combined issue. The decision to make that change resulted from an internal debate about whether Microsoft was an "industrial" or a "service" firm, and furthermore, whether it mattered. The editors saw that it was no longer meaningful or even possible to decide which firms fit which category.

Software companies sell products that are essentially ideas -- intellectual property -- embodied in lines of code. We can classify software as a service: a set of functions delivered in digital form. It's no wonder that Microsoft works so diligently to hire smart workers. The software business is a new kind of knowledge-based industry, but even traditional manufacturing firms are increasingly both users and sellers of knowledge. Once-traditional manufacturing firms differentiate themselves from competitors by offering "smart" products ranging from automatic breadmakers to cars that sense driver habits and adjust to them. Xerox calls itself "the document company," not "the copier/printer company." It sells solutions to business problems, not just office machinery. Ford focuses on "quality." IBM markets "industry-solution units." 3M calls itself a knowledge company, and Steelcase, the office equipment firm, has placed full-page ads touting itself as selling "knowledge." These self-definitions are not just market hype but a genuine recognition of the type of value these firms need to offer their customers.

These changes and pressures make knowledge vital to organizations. As James Brian Quinn points out, the intangibles that add value to most products and services are knowledge-based: technical know-how, product design, marketing presentation, understanding the customer, personal creativity, and innovation. The powers of knowledge that we have described -- speed, complexity, a sense of history and context, judgment, and flexibility -- are precisely those needed in a rapidly changing, increasingly competitive global economy.

A small but telling case in point: The NEC factory in Honjo, Japan, has been replacing assembly-line robots with human workers, because human flexibility and intelligence make them more efficient at dealing with change. Assembling a new model of mobile phone, humans reached target efficiency after making 8,000 units (compared with the 64,000 units robots needed) and were 45 percent more productive than the machines after both reached peak efficiency. The cost of a model change fell from

$9.5 million to between $1 million and $2 million, a significant savings given that NEC is making model changes every six months rather than every two years, as in the past. Tomiaki Mizukami, president of NEC's Saitama plant, says, "Before, we ended up using people as robots. But now we must use their intelligence. Using robots was good, but now we're discovering that using people is actually faster." Even assembly-line work, often considered merely mechanical, benefits from the experience, skill, and adaptability of human expertise.

Similarly, firms that have replaced some accounts-payable personnel with computers are finding that overpayments have increased because automated systems don't catch errors that would be obvious to experienced employees. Although the financial cost of additional overpayments is in many cases more than offset by the savings in salaries and benefits, the errors can cause strained relationships between firms and suppliers. Again, the human dimensions -- the knowledge dimensions -- of a supposedly mechanical task become apparent when machines try to accomplish them. Richard Loder, president of Loder Drew & Associates, a payables consulting firm, comments, "Payable clerks are blessed with intuition, memory recognition and the ability to make educated guesses. Computers are dumb and dumber in these areas."

Konosuke Matsushita, founder of Matsushita Electric, Ltd., has said, "Business, we know, is now so complex and difficult, the survival of firms so hazardous in an environment increasingly unpredictable, competitive and fraught with danger, that their continued existence depends on the day-to-day mobilization of every ounce of intelligence." Managers around the world have come to realize that they need to understand what they know how to do well and take advantage of that knowledge as effectively as possible.

Sustainable Competitive Advantage

Centuries ago, manufacturers and nations maintained commercial supremacy by keeping material and processes secret. Guilds protected their special knowledge; governments prohibited the export of economically important skills. France, for instance, made exporting lace-making expertise a capital crime: Anyone caught teaching the skill to foreigners could be put to death. Today, real trade secrets are a rarity. There are a few well-known examples (like the formula for Coca-Cola) and a few specialized ones (the Zildjian cymbal company, owned by the same family since its origin in alchemical experiments centuries ago, still guards the formula for the exact composition of the alloy used in its cymbals). For the most part, though, it is virtually impossible to prevent competitors from copying and even improving on new products and production methods fairly quickly in an era characterized by mobility, the free flow of ideas, reverse engineering, and widely available technology.

Alan Webber, the editor of *Fast Company* magazine, has referred to this phenomenon as the "self-canceling technological advantage." "As technology transforms the logic of competition," he explains, "technology disappears as a sustainable source of competitive advantage." Because essentially the same technology is

available to everyone, it cannot provide a long-term edge to anyone. A global marketplace for ideas has developed and there are very few concepts and formulae that are not generally available. Competitors can quickly duplicate most products and services. When only Citibank and Chemical had automated teller machines, they briefly had a significant advantage over their competitors, offering a service that customers wanted and they alone could provide. But ATMs soon became available throughout the industry, and what had been a competitive advantage was simply a baseline requirement for consumer-oriented banks. There is no way to make the ATM or any other piece of technology a trade secret for long -- even if you build it yourself, as Citibank did.

The advantages of new products and efficiencies are more and more difficult to sustain. VF, the company that sells Lee Jeans and other apparel, has experienced 20 percent annual growth for five years, thanks in part to technical innovations. These include an electronic market response system that informs both the company's shipping and manufacturing departments of every sale made within hours. But Jerry Johnson, VF's chief financial officer, says, "The half-life of innovation is getting shorter and shorter. A couple of years ago we thought we had established a definitive lead in service to our customers. Now it's become the industry standard." Robert Stasey, the director of quality improvement for Analog Devices, another growing company, expresses a similar idea when he says that Analog "is basically a new product engine. Life cycles are short and we want to obsolete our own products before the competition does."

Knowledge, by contrast, can provide a sustainable advantage. Eventually, competitors can almost always match the quality and price of a market leader's current product or service. By the time that happens, though, the knowledge-rich, knowledge-managing company will have moved on to a new level of quality, creativity, or efficiency. The knowledge advantage is sustainable because it generates increasing returns and continuing advantages. Unlike material assets,which decrease as they are used, knowledge assets increase with use: Ideas breed new ideas, and shared knowledge stays with the giver while it enriches the receiver. The potential for new ideas arising from the stock of knowledge in any firm is practically limitless -- particularly if the people in the firm are given opportunities to think, to learn, and to talk with one another. Paul Romer, who has worked at the leading edge of knowledge economics, argues that only knowledge resources -- ideas -- have unlimited potential for growth:

In a world with physical limits, it is discoveries of big ideas (for example, how to make high-temperature superconductors) together with the discovery of millions of little ideas (better ways to sew a shirt), that make persistent economic growth possible. Ideas are the instructions that let us combine limited physical resources in arrangements that are ever more valuable.

And, he goes on to say, the number of potential combinations of the steps that make up processes or the components of a product is virtually inexhaustible.

Corporate Size and Knowledge Management

At a time when firms need to "know what they know" and must use that knowledge effectively, the size and geographic dispersion of many of them make it especially difficult to locate existing knowledge and get it to where it is needed. In a small, localized company a manager probably knows who has experience in a particular aspect of the business and can walk across the hall and talk to him. Our studies have shown that the maximum size of an organization in which people know one another well enough to have a reliable grasp of collective organizational knowledge is two hundred to three hundred people. The stock of knowledge in a global enterprise with scattered offices and plants and a complex mix of products and functions is vast, but that potential boon is part of the problem. How do you find what you need? The mere existence of knowledge somewhere in the organization is of little benefit; it becomes a valuable corporate asset only if it is accessible, and its value increases with the level of accessibility. Managers in large corporations know how common it is to reinvent the wheel, solving the same problems from scratch again and again, duplicating effort because knowledge of already developed solutions has not been shared within the company. This was one of Chrysler's motivations in formulating its "Engineering Books of Knowledge"; the company had forgotten some things it had previously learned about building cars. If there is no system in place to locate the most appropriate knowledge resources, employees make do with what is most easily available. That knowledge may be reasonably good, but in today's competitive environment reasonably good is not good enough. Hence the attempts by many companies, including one described below by the worldwide oil firm BP, to apply technology to the problem of global knowledge transfer.

Computer Networks and Knowledge Exchange

The low cost of computers and networks has created a potential infrastructure for knowledge exchange and opened up important knowledge management opportunities. The computational power of computers has little relevance to knowledge work, but the communication and storage capabilities of networked computers make them knowledge enablers. Through e-mail, groupware, the Internet, and intranets, computers and networks can point to people with knowledge and connect people who need to share knowledge over a distance. Desktop videoconferencing and multimedia computing that transmits sound and video as well as text make it possible to communicate some of the richness and subtlety of one person's knowledge to another.

What we must remember is that this new information technology is only the pipeline and storage system for knowledge exchange. It does not create knowledge and cannot guarantee or even promote knowledge generation or knowledge sharing in a corporate culture that doesn't favor those activities. The proverbial phrase "if we build it, they will come" does not apply to information technology. The availability of Lotus Notes does not change a knowledge-hoarding culture into a knowledge-sharing one, alas. The medium turns out not to be the message and does not even guarantee that there will *be* a message.

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