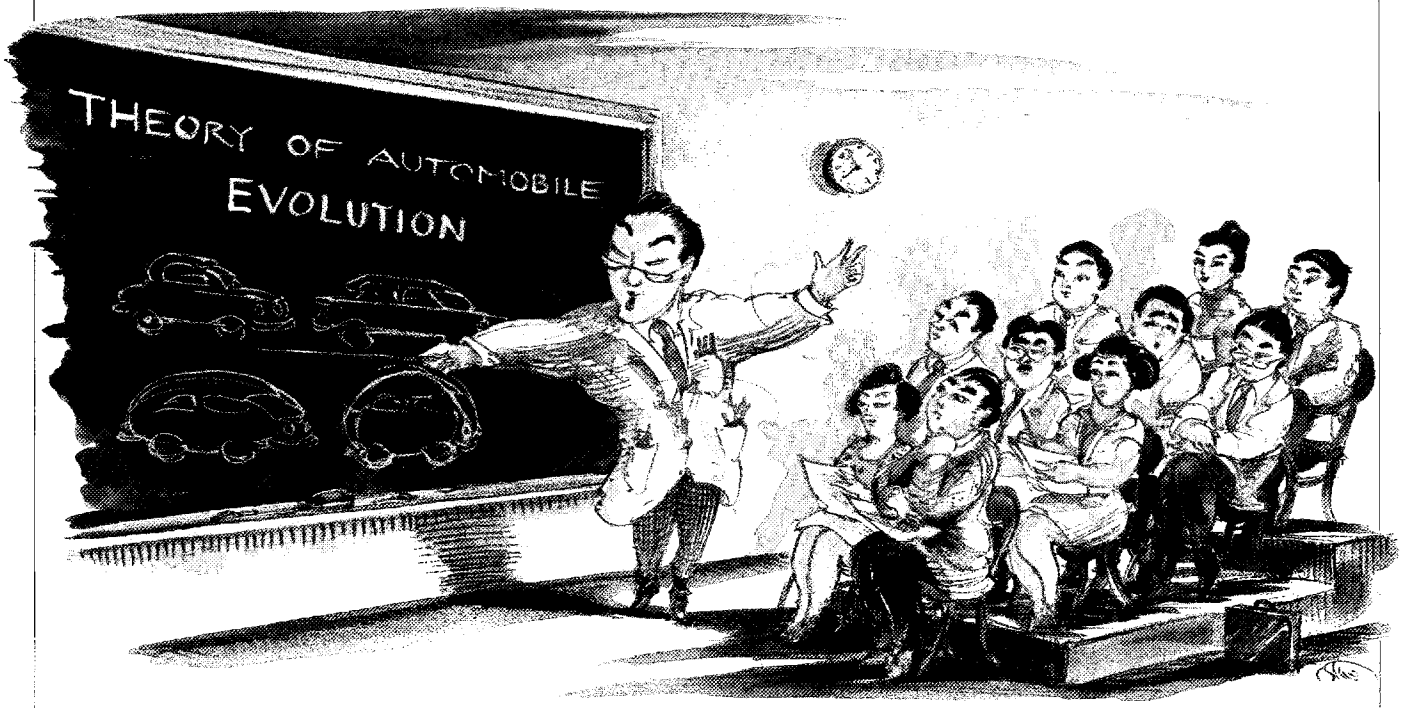
The best Japanese companies offer a guide to the organizational roles, structures, and practices that produce continuous innovation.

The Knowledge-Creating Company



by Ikujiro Nonaka

In an economy where the only certainty is uncertainty, the one sure source of lasting competitive advantage is knowledge. When markets shift, technologies proliferate, competitors multiply, and products become obsolete almost overnight, successful companies are those that consistently create new knowledge, disseminate it widely throughout the organization, and quickly embody it in new technologies and products. These activities define the "knowledge-creating" company, whose sole business is continuous innovation.

And yet, despite all the talk about "brainpower" and "intellectual capital," few managers grasp the true nature of the knowledge-creating company – let alone know how to manage it. The reason: they misunderstand what knowledge is and what companies must do to exploit it.

Deeply ingrained in the traditions of Western management, from Frederick Taylor to Herbert Simon, is a view of the organization as a machine for "information processing." According to this view, the only useful knowledge is formal and systematic – hard (read: quantifiable) data, codified procedures, universal principles. And the key metrics for measuring the value of new knowledge are similarly hard and quantifiable – increased efficiency, lower costs, improved return on investment.

But there is another way to think about knowledge and its role in business organizations. It is found most commonly at highly successful Japanese competitors like Honda, Canon, Matsushita, NEC, Sharp, and Kao. These companies have become famous for their ability to respond quickly to customers, create new markets, rapidly develop new

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products, and dominate emergent technologies. The secret of their success is their unique approach to managing the creation of new knowledge.

To Western managers, the Japanese approach often seems odd or even incomprehensible. Consider the following examples:

☐ How is the slogan "Theory of Automobile Evolution" a meaningful design concept for a new car? And yet, this phrase led to the creation of the Honda City, Honda's innovative urban car.

☐ Why is a beer can a useful analogy for a personal copier? Just such an analogy caused a fundamental breakthrough in the design of Canon's revolutionary mini-copier, a product that created the personal copier market and has led Canon's successful migration from its stagnating camera business to the more lucrative field of office automation.

☐ What possible concrete sense of direction can a made-up word such as "optoelectronics" provide a company's product-development engineers? Under this rubric, however, Sharp has developed a reputation for creating "first products" that define new technologies and markets, making Sharp a major player in businesses ranging from color televisions to liquid crystal displays to customized integrated circuits.

In each of these cases, cryptic slogans that to a Western manager sound just plain silly – appropriate for an advertising campaign perhaps but certainly not for running a company – are in fact highly effective tools for creating new knowledge. Managers everywhere recognize the serendipitous quality of innovation. Executives at these Japanese companies are *managing* that serendipity to the benefit of the company, its employees, and its customers.

The centerpiece of the Japanese approach is the recognition that creating new knowledge is not simply a matter of "processing" objective information. Rather, it depends on tapping the tacit and often highly subjective insights, intuitions, and hunches of individual employees and making those insights available for testing and use by the company as a whole. The key to this process is personal commitment, the employees' sense of identity with the enterprise and its mission. Mobilizing that commitment and embodying tacit knowledge in actual technologies and products require managers who are as comfortable with images and symbols – slogans such as Theory of Automobile Evolution, analogies like that between a personal copier and a beer can, metaphors such as "optoelectronics" – as they are with hard numbers measuring market share, productivity, or ROI.

The more holistic approach to knowledge at many Japanese companies is also founded on another fundamental insight. A company is not a machine but a living organism. Much like an individual, it can have a collective sense of identity and fundamental purpose. This is the organizational equivalent of self-knowledge – a shared understanding of what the company stands for, where it is going, what kind of world it wants to live in, and, most important, how to make that world a reality.

In this respect, the knowledge-creating company is as much about ideals as it is about ideas. And that fact fuels innovation. The essence of innovation is to re-create the world according to a particular vision or ideal. To create new knowledge means quite literally to re-create the company and everyone in it in a nonstop process of personal and organizational self-renewal. In the knowledge-creating company, inventing new knowledge is not a specialized activity – the province of the R&D department or marketing or strategic planning. It is a way of behaving, indeed a way of being, in which everyone is a knowledge worker – that is to say, an entrepreneur.

The reasons why Japanese companies seem especially good at this kind of continuous innovation and self-renewal are complicated. But the key lesson for managers is quite simple: much as manufacturers around the world have learned from Japanese manufacturing techniques, any company that wants to compete on knowledge must also learn from Japanese techniques of knowledge creation. The experiences of the Japanese companies discussed below suggest a fresh way to think about managerial roles and responsibilities, organizational design, and business practices in the knowledge-creating company. It is an approach that puts knowledge creation exactly where it belongs: at the very center of a company's human resources strategy.

The Spiral of Knowledge

New knowledge always begins with the individual. A brilliant researcher has an insight that leads to a new patent. A middle manager's intuitive sense of market trends becomes the catalyst for an important new product concept. A shop-floor worker draws on years of experience to come up with a new process innovation. In each case, an individual's personal knowledge is transformed into organizational knowledge valuable to the company as a whole.

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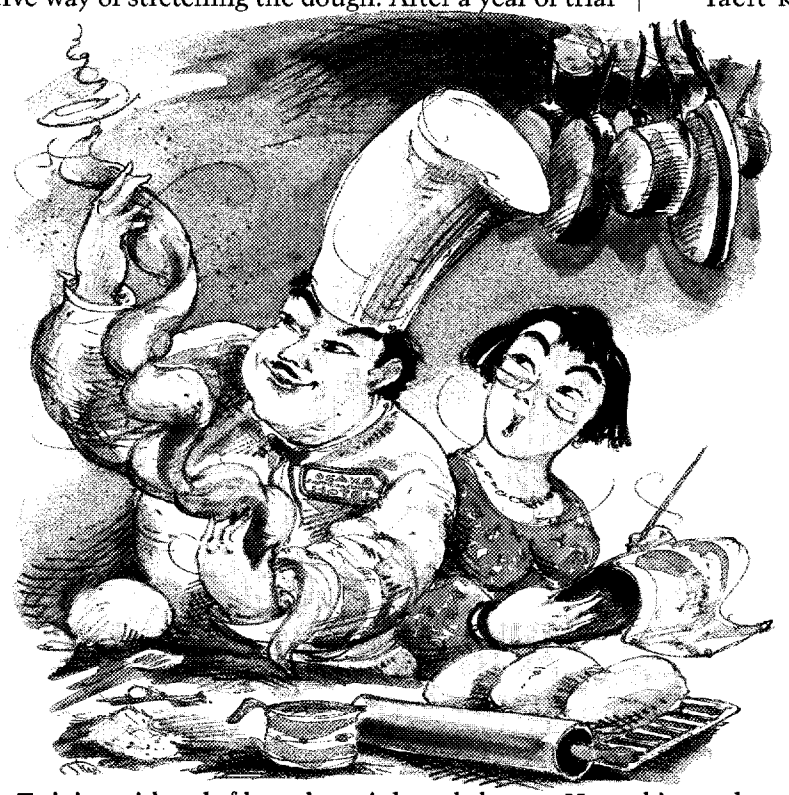
Making personal knowledge available to others is the central activity of the knowledge-creating company. It takes place continuously and at all levels of the organization. And as the following example suggests, sometimes it can take unexpected forms.

> Creating new knowledge is as much about ideals as it is about ideas.

In 1985, product developers at the Osaka-based Matsushita Electric Company were hard at work on a new home bread-making machine. But they were having trouble getting the machine to knead dough correctly. Despite their efforts, the crust of the bread was overcooked while the inside was hardly done at all. Employees exhaustively analyzed the problem. They even compared X rays of dough kneaded by the machine and dough kneaded by professional bakers. But they were unable to obtain any meaningful data.

Finally, software developer Ikuko Tanaka proposed a creative solution. The Osaka International Hotel had a reputation for making the best bread in Osaka. Why not use it as a model? Tanaka trained with the hotel's head baker to study his kneading technique. She observed that the baker had a distinctive way of stretching the dough. After a year of trial and error, working closely with the project's engineers, Tanaka came up with product specifications – including the addition of special ribs inside the machine – that successfully reproduced the baker's stretching technique and the quality of the bread she had learned to make at the hotel. The result: Matsushita's unique "twist dough" method and a product that in its first year set a record for sales of a new kitchen appliance.



Training with a chef brought tacit knowledge to a Matsushita product.

Ikuko Tanaka's innovation illustrates a movement between two very different types of knowledge. The end point of that movement is "explicit" knowledge: the product specifications for the bread-making machine. Explicit knowledge is formal and systematic. For this reason, it can be easily communicated and shared, in product specifications or a scientific formula or a computer program.

But the starting point of Tanaka's innovation is another kind of knowledge that is not so easily expressible: "tacit" knowledge like that possessed by the chief baker at the Osaka International Hotel. Tacit knowledge is highly personal. It is hard to formalize and, therefore, difficult to communicate to others. Or in the words of the philosopher Michael Polanyi, "We can know more than we can tell." Tacit knowledge is also deeply rooted in action and in an individual's commitment to a specific context – a craft or profession, a particular technology or product market, or the activities of a work group or team.

Tacit knowledge consists partly of technical skills – the kind of informal, hard-to-pin-down skills captured in the term "know-how." A master craftsman after years of experience develops a wealth of expertise "at his fingertips." But he is often unable to articulate the scientific or technical principles behind what he knows.

At the same time, tacit knowledge has an important cognitive dimension. It consists of mental models, beliefs, and perspectives so ingrained that we take them for granted, and therefore cannot easily articulate them. For this very reason, these implicit models profoundly shape how we perceive the world around us.

The distinction between tacit and explicit knowledge suggests four basic patterns for creating knowledge in any organization:

1. From Tacit to Tacit. Sometimes, one individual shares tacit knowledge directly with another. For example, when Ikuko Tanaka apprentices herself

to the head baker at the Osaka International Hotel, she learns his tacit skills through observation, imitation, and practice. They become part of her own tacit knowledge base. Put another way, she is "socialized" into the craft.

But on its own, socialization is a rather limited form of knowledge creation. True, the apprentice learns the master's skills. But neither the apprentice nor the master gain any systematic insight into their craft knowledge. Because their knowledge never becomes explicit, it cannot easily be leveraged by the organization as a whole.

2. From Explicit to Explicit. An individual can also combine discrete pieces of explicit knowledge into a new whole. For example, when a comptroller of a company collects information from throughout the organization and puts it together in a financial report, that report is new knowledge in the sense that it synthesizes information from many different sources. But this combination does not really extend the company's existing knowledge base either.

But when tacit and explicit knowledge interact, as in the Matsushita example, something powerful happens. It is precisely this exchange *between* tacit and explicit knowledge that Japanese companies are especially good at developing.

3. From Tacit to Explicit. When Ikuko Tanaka is able to articulate the foundations of her tacit knowledge of bread making, she converts it into explicit knowledge, thus allowing it to be shared with her project-development team. Another example might be the comptroller who, instead of merely compiling a conventional financial plan for his company, develops an innovative new approach to budgetary control based on his own tacit knowledge developed over years in the job.

4. From Explicit to Tacit. What's more, as new explicit knowledge is shared throughout an organization, other employees begin to internalize it – that is, they use it to broaden, extend, and reframe their own tacit knowledge. The comptroller's proposal causes a revision of the company's financial control system. Other employees use the innovation and eventually come to take it for granted as part of the background of tools and resources necessary to do their jobs.

In the knowledge-creating company, all four of these patterns exist in dynamic interaction, a kind of spiral of knowledge. Think back to Matsushita's Ikuko Tanaka:

1. First, she learns the tacit secrets of the Osaka International Hotel baker (socialization).

2. Next, she translates these secrets into explicit knowledge that she can communicate to her team members and others at Matsushita (articulation).

3. The team then standardizes this knowledge, putting it together into a manual or workbook and embodying it in a product (combination).

4. Finally, through the experience of creating a new product, Tanaka and her team members enrich their own tacit knowledge base (internalization). In particular, they come to understand in an extremely intuitive way that products like the home bread-making machine can provide genuine quality. That is, the machine must make bread that is as good as that of a professional baker.

This starts the spiral of knowledge all over again, but this time at a higher level. The new tacit insight about genuine quality developed in designing the home bread-making machine is informally conveyed to other Matsushita employees. They use it to formulate equivalent quality standards for other new Matsushita products – whether kitchen appliances, audiovisual equipment, or white goods. In this way, the organization's knowledge base grows ever broader.

Articulation (converting tacit knowledge into explicit knowledge) and internalization (using that explicit knowledge to extend one's own tacit knowledge base) are the critical steps in this spiral of knowledge. The reason is that both require the active involvement of the self – that is, personal commitment. Ikuko Tanaka's decision to apprentice herself to a master baker is one example of this commitment. Similarly, when the comptroller articulates his tacit knowledge and embodies it in a new innovation, his personal identity is directly involved in a way it is not when he merely "crunches" the numbers of a conventional financial plan.

Indeed, because tacit knowledge includes mental models and beliefs in addition to know-how, moving from the tacit to the explicit is really a process of articulating one's vision of the world – what it is and what it ought to be. When employees invent new knowledge, they are also reinventing themselves, the company, and even the world.

When managers grasp this, they realize that the appropriate tools for managing the knowledge-creating company look very different from those found at most Western companies.

From Metaphor to Model

To convert tacit knowledge into explicit knowledge means finding a way to express the inexpressible. Unfortunately, one of the most powerful management tools for doing so is also among the most frequently overlooked: the store of figurative lan-

guage and symbolism that managers can draw from to articulate their intuitions and insights. At Japanese companies, this evocative and sometimes extremely poetic language figures especially prominently in product development.

In 1978, top management at Honda inaugurated the development of a new-concept car with the slogan, "Let's gamble." The phrase expressed senior executives' conviction that Honda's Civic and the Accord models were becoming too familiar. Managers also realized that along with a new postwar generation entering the car market, a new generation of young product designers was coming of age with unconventional ideas about what made a good car.

The business decision that followed from the "Let's gamble" slogan was to form a new-product development team of young engineers and designers (the average age was 27). Top management charged the team with two – and only two – instructions: first, to come up with a product concept fundamentally different from anything the company had ever done before; and second, to make a car that was inexpensive but not cheap.

This mission might sound vague, but in fact it provided the team an extremely clear sense of direction. For instance, in the early days of the project, some team members proposed designing a smaller and cheaper version of the Honda Civic – a safe and technologically feasible option. But the team quickly decided this approach contradicted the entire rationale of its mission. The only alternative was to invent something totally new.

Project team leader Hiroo Watanabe coined another slogan to express his sense of the team's ambitious challenge: Theory of Automobile Evolution. The phrase described an ideal. In effect, it posed the question: If the automobile were an organism, how should it evolve? As team members argued and discussed what Watanabe's slogan might possibly mean, they came up with an answer in the form of yet another slogan: "man-maximum, machine-minimum." This captured the team's belief that the ideal car should somehow transcend the traditional human-machine relationship. But that required challenging what Watanabe called "the reasoning of Detroit," which had sacrificed comfort for appearance.

The "evolutionary" trend the team articulated eventually came to be embodied in the image of a sphere – a car simultaneously "short" (in length) and "tall" (in height). Such a car, they reasoned, would be lighter and cheaper, but also more comfortable and more solid than traditional cars. A sphere provided the most room for the passenger while taking up the least amount of space on the road. What's more, the shape minimized the space taken up by the engine and other mechanical systems. This gave birth to a product concept the team called "Tall Boy," which eventually led to the Honda City, the company's distinctive urban car.

The Tall Boy concept totally contradicted the conventional wisdom about automobile design at the time, which emphasized long, low sedans. But the City's revolutionary styling and engineering were prophetic. The car inaugurated a whole new approach to design in the Japanese auto industry based on the man-maximum, machine-minimum concept, which has led to the new generation of "tall and short" cars now quite prevalent in Japan.

The story of the Honda City suggests how Japanese companies use figurative language at all levels of the company and in all phases of the product development process. It also begins to suggest the different kinds of figurative language and the distinctive role each plays.

One kind of figurative language that is especially important is metaphor. By "metaphor," I don't just mean a grammatical structure or allegorical expression. Rather, metaphor is a distinctive method of perception. It is a way for individuals grounded in different contexts and with different experiences to understand something intuitively through the use of imagination and symbols without the need for analysis or generalization. Through metaphors, people put together what they know in new ways and begin to express what they know but cannot yet say. As such, metaphor is highly effective in fostering direct commitment to the creative process in the early stages of knowledge creation.

Metaphor accomplishes this by merging two different and distant areas of experience into a single, inclusive image or symbol – what linguistic philosopher Max Black has aptly described as "two ideas in one phrase." By establishing a connection between two things that seem only distantly related, metaphors set up a discrepancy or conflict. Often, metaphoric images have multiple meanings, appear logically contradictory or even irrational. But far from being a weakness, this is in fact an enormous strength. For it is the very conflict that metaphors embody that jump-starts the creative process. As employees try to define more clearly the insight that the metaphor expresses, they work to reconcile the conflicting meanings. That is the first step in making the tacit explicit.

Consider the example of Hiroo Watanabe's slogan, Theory of Automobile Evolution. Like any good metaphor, it combines two ideas one wouldn't normally think of together – the automobile, which is a machine, and the theory of evolution, which refers to living organisms. And yet, this discrepancy

is a fruitful platform for speculation about the characteristics of the ideal car.

But while metaphor triggers the knowledge-creation process, it alone is not enough to complete it. The next step is analogy. Whereas metaphor is mostly driven by intuition and links images that at first glance seem remote from each other, analogy is a more structured process of reconciling contradictions and making distinctions. Put another way, by clarifying how the two ideas in one phrase actually are alike and not alike, the contradictions incorporated into metaphors are harmonized by analogy. In this respect, analogy is an intermediate step between pure imagination and logical thinking.

Probably the best example of analogy comes from the development of Canon's revolutionary mini-copier. Canon designers knew that for the first personal copier to be successful, it had to be reliable. To ensure reliability, they proposed to make the product's photosensitive copier drum – which is the source of 90% of all maintenance problems – disposable. To be disposable, however, the drum would have to be easy and cheap to make. How to manufacture a throwaway drum?

A beer can led Canon to product development by analogy.

The breakthrough came one day when task-force leader Hiroshi Tanaka ordered out for some beer. As the team discussed design problems over their drinks, Tanaka held one of the beer cans and wondered aloud, "How much does it cost to manufacture this can?" The question led the team to speculate whether the same process for making an aluminum beer can could be applied to the manufacture of an aluminum copier drum. By exploring how the drum actually is and is not like a beer can, the mini-copier development team was able to come up with the process technology that could manufacture an aluminum copier drum at the appropriate low cost.

Finally, the last step in the knowledge-creation process is to create an actual model. A model is far more immediately conceivable than a metaphor or an analogy. In the model, contradictions get resolved and concepts become transferable through consistent and systematic logic. The quality standards for the bread at the Osaka International Hotel lead Matsushita to develop the right product specifications for its home bread-making machine. The image of a sphere leads Honda to its Tall Boy product concept.

Of course, terms like "metaphor," "analogy," and "model" are ideal types. In reality, they are often hard to distinguish from each other; the same phrase or image can embody more than one of the three functions. Still, the three terms capture the process by which organizations convert tacit knowledge into explicit knowledge: first, by linking contradictory things and ideas through metaphor; then, by resolving these contradictions through analogy; and, finally, by crystallizing the created concepts and embodying them in a model, which makes the knowledge available to the rest of the company.

From Chaos to Concept: Managing the Knowledge-Creating Company

Understanding knowledge creation as a process of making tacit knowledge explicit – a matter of metaphors, analogies, and models – has direct implications for how a company designs its organization and defines managerial roles and responsibilities within it. This is the "how" of the knowledge-creating company, the structures and practices that translate a company's vision into innovative technologies and products.

The fundamental principle of organizational design at the Japanese companies I have studied is redundancy – the conscious overlapping of company information, business activities, and managerial responsibilities. To Western managers, the term "redundancy," with its connotations of unnecessary duplication and waste, may sound unappealing. And yet, building a redundant organization is the first step in managing the knowledge-creating company.

> Managers must challenge employees to reexamine what they take for granted.

Redundancy is important because it encourages frequent dialogue and communication. This helps create a "common cognitive ground" among employees and thus facilitates the transfer of tacit knowledge. Since members of the organization share overlapping information, they can sense what others are struggling to articulate. Redundancy also spreads new explicit knowledge through the organization so it can be internalized by employees.

The organizational logic of redundancy helps explain why Japanese companies manage product development as an overlapping process where different functional divisions work together in a shared division of labor. At Canon, redundant product development goes one step further. The company organizes product-development teams according to "the principle of internal competition." A team is divided into competing groups that develop different approaches to the same project and then argue over the advantages and disadvantages of their proposals. This encourages the team to look at a project from a variety of perspectives. Under the guidance of a team leader, the team eventually develops a common understanding of the "best" approach.

In one sense, such internal competition is wasteful. Why have two or more groups of employees pursuing the same product-development project? But when responsibilities are shared, information proliferates, and the organization's ability to create and implement concepts is accelerated.

At Canon, for example, inventing the mini-copier's low-cost disposable drum resulted in new technologies that facilitated miniaturization, weight reduction, and automated assembly. These technologies were then quickly applied to other office automation products such as microfilm readers, laser printers, word processors, and typewriters. This was an important factor in diversifying Canon from cameras to office automation and in securing a competitive edge in the laser printer industry. By 1987 – only five years after the mini-copier was introduced – a full 74% of Canon's revenues came from its business machines division.

Another way to build redundancy is through strategic rotation, especially between different areas of technology and between functions such as R&D and marketing. Rotation helps employees understand the business from a multiplicity of perspectives. This makes organizational knowledge more "fluid" and easier to put into practice. At Kao Corporation, a leading Japanese consumer-products manufacturer, researchers often "retire" from the R&D department by the age of 40 in order to transfer to other departments such as marketing, sales, or production. And all employees are expected to hold at least three different jobs in any given ten-year period.

Free access to company information also helps build redundancy. When information differentials exist, members of an organization can no longer interact on equal terms, which hinders the search for different interpretations of new knowledge. Thus Kao's top management does not allow any discrimination in access to information among employees. All company information (with the exception of personnel data) is stored in a single integrated database, open to any employee regardless of position.

As these examples suggest, no one department or group of experts has the exclusive responsibility for creating new knowledge in the knowledge-creating company. Senior managers, middle managers, and frontline employees all play a part. Indeed, the value of any one person's contribution is determined less by his or her location in the organizational hierarchy than by the importance of the information he or she provides to the entire knowledge-creating system.

But this is not to say that there is no differentiation among roles and responsibilities in the knowledge-creating company. In fact, creating new knowledge is the product of a dynamic interaction among three roles.

Frontline employees are immersed in the day-to-day details of particular technologies, products, or markets. No one is more expert in the realities of a company's business than they are. But while these employees are deluged with highly specific information, they often find it extremely difficult to turn that information into useful knowledge. For one thing, signals from the marketplace can be vague and ambiguous. For another, employees can become so caught up in their own narrow perspective, that they lose sight of the broader context.

What's more, even when employees *do* develop meaningful ideas and insights, it can still be difficult to communicate the import of that information

to others. People don't just passively receive new knowledge, they actively interpret it to fit their own situation and perspective. Thus what makes sense in one context can change or even lose its meaning when communicated to people in a different context. As a result, there is a continual shift in meaning as new knowledge is diffused in an organization.

The confusion created by the inevitable discrepancies in meaning that occur in any organization might seem like a problem. In fact, it can be a rich source of new knowledge – *if* a company knows how to manage it. The key to doing so is continuously challenging employees to reexamine what they take for granted. Such reflection is always necessary in the knowledge-creating company, but it is especially essential during times of crisis or breakdown, when a company's traditional categories of knowledge no longer work. At such moments, ambiguity can prove extremely useful as a source of alternative meanings, a fresh way to think about things, a new sense of direction. In this respect, new knowledge is born in chaos.

The main job of managers in the knowledge-creating company is to orient this chaos toward purposeful knowledge creation. Managers do this by providing employees with a conceptual framework that helps them make sense of their own experience. This takes place at the senior management level at the top of the company and at the middle management level on company teams.

Senior managers give voice to a company's future by articulating metaphors, symbols, and concepts that orient the knowledge-creating activities of employees. They do this by asking the questions: What are we trying to learn? What do we need to know? Where should we be going? Who are we? If the job of frontline employees is to know "what is," then the job of senior executives is to know "what ought to be." Or in the words of Hiroshi Honma, senior researcher at Honda: "Senior managers are romantics who go in quest of the ideal."

> According to one Honda researcher, "Senior managers are romantics who go in quest of the ideal."

At some of the Japanese companies I have studied, CEOs talk about this role in terms of their responsibility for articulating the company's "conceptual umbrella": the grand concepts that in highly universal and abstract terms identify the common features linking seemingly disparate activities or businesses into a coherent whole. Sharp's dedication to optoelectronics is a good example.

In 1973, Sharp invented the first low-power electronic calculator by combining two key technologies – liquid crystal displays (LCDs) and complementary metal oxide semiconductors (CMOSs). Company technologists coined the term "optoelectronics" to describe this merging of microelectronics with optical technologies. The company's senior managers then took up the word and magnified its impact far beyond the R&D and engineering departments in the company.

Optoelectronics represents an image of the world that Sharp wants to live in. It is one of the key concepts articulating what the company ought to be. As such, it has become an overarching guide for the company's strategic development. Under this rubric, Sharp has moved beyond its original success in calculators to become a market leader in a broad range of products based on LCD and semiconductor technologies, including: the Electronic Organizer pocket notebook, LCD projection systems, as well as customized integrated circuits such as masked ROMs, ASICs, and CCDs (charge-coupled devices, which convert light into electronic signals).

Other Japanese companies have similar umbrella concepts. At NEC, top management has categorized the company's knowledge base in terms of a few key technologies and then developed the metaphor "C&C" (for "computers and communications"). At Kao, the umbrella concept is "surface active science," referring to techniques for coating the surface area of materials. This phrase has guided the company's diversification into products ranging from soap detergents to cosmetics to floppy disks – all natural derivatives of Kao's core knowledge base.

Another way top management provides employees with a sense of direction is by setting the standards for justifying the value of the knowledge that is constantly being developed by the organization's members. Deciding which efforts to support and develop is a highly strategic task.

In most companies, the ultimate test for measuring the value of new knowledge is economic – increased efficiency, lower costs, improved ROI. But in the knowledge-creating company, other more qualitative factors are equally important. Does the idea embody the company's vision? Is it an expression of top management's aspirations and strategic goals? Does it have the potential to build the company's organizational knowledge network?

The decision by Mazda to pursue the development of the rotary engine is a classic example of this more qualitative kind of justification. In 1974, the product-development team working on the engine

was facing heavy pressure within the company to abandon the project. The rotary engine was a "gas guzzler," critics complained. It would never succeed in the marketplace.

Kenichi Yamamoto, head of the development team (and currently Mazda's chairman), argued that to stop the project would mean giving up on the company's dream of revolutionizing the combustion engine. "Let's think this way," Yamamoto proposed. "We are making history, and it is our fate to deal with this challenge." The decision to continue led to Mazda's successful rotary-engine sports car, the Savanna RX-7.

> Mazda management justified the decision to develop the rotary engine as an expression of the company's "fate."

Seen from the perspective of traditional management, Yamamoto's argument about the company's "fate" sounds crazy. But in the context of the knowledge-creating company, it makes perfect sense. Yamamoto appealed to the fundamental aspirations of the company – what he termed "dedication to uncompromised value" – and to the strategy of technological leadership that senior executives had articulated. He showed how the rotary-engine project enacted the organization's commitment to its vision. Similarly, continuing the project reinforced the individual commitment of team members to that vision and to the organization.

Umbrella concepts and qualitative criteria for justification are crucial to giving a company's knowledge-creating activities a sense of direction. And yet, it is important to emphasize that a company's vision needs also to be open-ended, susceptible to a variety of different and even conflicting interpretations. At first glance, this may seem contradictory. After all, shouldn't a company's vision be unambiguous, coherent, and clear? If a vision is *too* unambiguous, however, it becomes more akin to an order or an instruction. And orders do not foster the high degree of personal commitment on which effective knowledge creation depends.

A more equivocal vision gives employees and work groups the freedom and autonomy to set their own goals. This is important because while the ideals of senior management are important, on their own they are not enough. The best that top management can do is to clear away any obstacles and prepare the ground for self-organizing groups or teams. Then, it is up to the teams to figure out what the ideals of the top mean in reality. Thus at Honda, a slogan as vague as "Let's gamble" and an extremely broad mission gave the Honda City product-development team a strong sense of its own identity, which led to a revolutionary new product.

Teams play a central role in the knowledge-creating company because they provide a shared context where individuals can interact with each other and engage in the constant dialogue on which effective reflection depends. Team members create new points of view through dialogue and discussion. They pool their information and examine it from various angles. Eventually, they integrate their diverse individual perspectives into a new collective perspective.

This dialogue can – indeed, should – involve considerable conflict and disagreement. It is precisely such conflict that pushes employees to question existing premises and make sense of their experience in a new way. "When people's rhythms are out of sync, quarrels occur and it's hard to bring people together," acknowledges a deputy manager for advanced technology development at Canon. "Yet if a group's rhythms are completely in unison from the beginning, it's also difficult to achieve good results."

As team leaders, middle managers are at the intersection of the vertical and horizontal flows of information in the company. They serve as a bridge between the visionary ideals of the top and the often chaotic market reality of those on the front line of the business. By creating middle-level business and product concepts, middle managers mediate between "what is" and "what should be." They remake reality according to the company's vision.

Thus at Honda, top management's decision to try something completely new took concrete form at the level of Hiroo Watanabe's product-development team in the Tall Boy product concept. At Canon, the company aspiration, "Making an excellent company through transcending the camera business," became a reality when Hiroshi Tanaka's task force developed the "Easy Maintenance" product concept, which eventually gave birth to the personal copier. And at Matsushita, the company's grand concept, "Human Electronics," came to life through the efforts of Ikuko Tanaka and others who developed the middle-range concept, "Easy Rich," and embodied it in the automatic bread-making machine.

In each of these cases, middle managers synthesized the tacit knowledge of both frontline employees and senior executives, made it explicit, and incorporated it into new technologies and products. In this respect, they are the true "knowledge engineers" of the knowledge-creating company.

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