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Tacit Knowledge and Knowledge Management:

The Keys to Sustainable Competitive Advantage

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The Challenge

Because competitive advantage is increasingly found in knowing how to do things, rather than in having special access to resources and markets, knowledge and intellectual capital have become both the primary bases of core competencies and the key to superior performance. This article explores how companies can best grow their knowledge resources to create not simply competitive advantage, but sustainable competitive advantage.

In recent years, the development of "hypercompetition" and shortened product lifecycles have reduced the degree to which much special knowledge can provide companies with sustained competitive advantage. Shrinking logistical and communication costs, along with new organizational designs, have enabled multinational corporations (MNCs) to function as truly global companies, rather than as conglomerations of national ones. Global companies introduce their newest products worldwide and effectively share knowledge across country units. Fueling hypercompetition, many industries now have several MNCs competing against each other on a worldwide basis, rather than a few local companies and only one MNC competing in each market. New product innovation has become the key to competing successfully. MNCs use their deep pockets to fund research and development (R&D), and they reverse engineer each other's products and turn to consultants to learn about best practices in their industry. Companies develop or acquire new knowledge so rapidly that having special knowledge is no longer a basis for sustainable competitive advantage. To provide sustained competitive advantage, one needs knowledge that is difficult for outsiders to copy as well as the ability to rapidly develop new knowledge.

In a graphic demonstration of the transient value of much knowledge, Michael Tushman began his courses at Columbia Business School by asking what the following list of products had in common: watches, cars, cameras, color TVs, hand tools, radial tires, industrial robots, machine tools, electric motors, financial services, food processors, microwave ovens, stereo equipment, athletic equipment, computer chips, optical equipment, medical equipment, and consulting services. The answer: each of these industries was initially dominated by a company with specialized knowledge, but that company rapidly lost its lead as other companies acquired the knowledge required to compete. Also illustrating the situation, fewer than 40% of the Fortune 500 companies of 1970 still existed in their original form by 1991. In today's environment, much of the

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knowledge that companies possess and value will provide only a transient competitive advantage. Moreover, core competencies can turn into core rigidities impeding performance, if changes in an industry, or advances by one's competitors, are not countered by the ability to rapidly develop and spread new knowledge.

There are two paths by which companies can use knowledge to create sustained competitive advantage. First, companies can act to internally spread knowledge that other companies will find almost impossible to copy, that is, tacit knowledge. Second, companies can create superior knowledge management capabilities and thereby foster ongoing innovation. This article discusses how both tacit knowledge and outstanding knowledge management capabilities can be the basis for sustained competitive advantage in today's economic environment.

PART 1. TACIT KNOWLEDGE AS AN INIMITABLE COMPETITIVE ADVANTAGE

There is a paradox that one must overcome to develop inimitable core competencies based in knowledge. To become the basis for a sustainable competitive advantage, knowledge must be readily spread within the firm that has it, but not readily spread to other firms. Knowledge that cannot be spread within a firm remains the property of a few people, rather than of the firm, and will have limited impact on the firm's ability to create value. On the other hand, knowledge that can spread within a company can generally also spread across its boundaries to other firms, thereby becoming industry best practice, rather than the basis for a sustainable competitive advantage. Examples include total quality management, just-in-time inventory management, employee involvement and reengineering. To escape the paradox, for knowledge to provide sustainable competitive advantage, the skills and resources that underlie a firm's core competencies must be relatively widely transferable within

the firm, but very difficult for other firms to copy or develop. Tacit knowledge fits these criteria.

Definition of Tacit Knowledge

Tacit knowledge entails information that is difficult to express, formalize, or share. It stands in contrast to explicit knowledge, which is conscious and can be put into words. An individual experiences tacit knowledge as intuition, rather than as a body of facts or instruction sets he is conscious of having and can explain to others. Tacit knowledge is "knowing how" while explicit knowledge is "knowing that."

Tacit knowledge is unconsciously acquired from the experiences one has while immersed in an environment. Tacit knowledge develops when unconscious, inductive mental processes create a representation of the structure of the environment showing the relationship between important variables. In other words, people can have unconscious abstractions, that is, people can learn about the underlying complex structure of systems without being conscious of doing so or being able to articulate their understanding.

Acquiring tacit knowledge requires having considerable experience in an activity, preferably while working with experts. Observing how experts address problems, along with having practice addressing problems and receiving feedback on our method of doing so, fosters development of tacit knowledge. These activities help us both consciously and unconsciously to absorb guidelines concerning what data to focus on, how factors are causally related, and how to address problems. These guidelines are a key part of what we refer to as judgment.

Tacit knowledge often allows us to perform at a higher level than that which our explicit knowledge does. For example, studies using computer-simulated factories have shown that people can learn to control complex systems, although they remain unable to answer questions about the system they learned to control. Novices cannot become experts simply by exposure to explicit information; they need experience with the activity itself. For these reasons, success as a manager is heavily dependent on tacit knowledge.

Categories of Tacit Knowledge

There are four categories of tacit knowledge: (a) hard to pin down skills—"know-how," (b) mental models, (c) ways of approaching problems, and (d) organizational routines. The word skill implies tacit knowledge. Many skills, from swinging a golf club to handling cells in a biology lab, cannot be fully explained in words. People need to repeatedly practice skills, receive feedback and get the *feel* for them. Many skills workers possess are based in tacit knowledge. For example, at a major airplane manufacturer, mechanics suddenly had difficulty getting doors to fit on planes. As it turned out, there was one worker who knew how to make the doors fit, and he had just left the company.

The second category of tacit knowledge concerns mental models or schema. They show us how the world is constructed, which elements are central, and how the parts are related. The schema we draw on when trying to make sense of a situation determine how we understand and analyze situations, that is, how we understand cause-effect connections and what meaning we give to events. Mental models help us to make sense of the masses of data we are faced with, to extract those parts which are relevant, to formulate an understanding of problems, and to find solutions. The schema we use are often unconscious abstractions, rather than explicit models we consciously employ, and are therefore tacit knowledge. They affect whether or not we see people as trustworthy, whether we see opportunity in a situation, and how we judge risk. Therefore, the tacit mental models that managers have heavily impact the decisions they make.

The third category of tacit knowledge concerns how people approach problems. Tacit knowledge underlies the decision trees people use. The questions we ask ourselves

when dealing with a problem are often not part of a logically thought out, deductively rigorous plan for addressing the problem. Rather, our ways of approaching problems derive from habit and the mental patterns we develop when we see how others think through problems. In addressing a problem, one person may think of one analogous problem and accept whatever solution he or she remembers using to deal with it. Another person will think of solutions he has seen for several similar problems, and select whichever seems to fit best. A third person may use a more complex approach and systematically think through the pros and cons of the various solutions generated. A fourth person may look at the components of the problematic situation, analyzing how the parts of the problem form a system, and then create a way to disrupt the system. The decision tree one uses to address a problem will markedly affect the solution one selects.

Much of the tacit knowledge of a firm is stored in its routines, the fourth category of tacit knowledge. The word routine refers to regular and predictable behavior patterns. Routines solidify as standard operating procedures and roles are developed and enforced. Routines include ways of producing things, ways of hiring and firing personnel, ways of handling inventory, decision-making procedures, advertising policy, and R&D procedures. Knowledge becomes embedded in the routines of organizations as managers develop the routines based on their judgment of how issues should be addressed. The tacit knowledge embedded in routines includes an intuitive grasp of what data to focus on and of the relative priority of competing demands. In time the managers leave, and the routines remain as a legacy to their knowledge. For example, a chief executive officer (CEO) may believe that having line management and workers heavily involved in hiring decisions affects the quality and cohesiveness of the workforce. This may become the company's routine, and continue to affect the company's culture and the skills of its people, long after the person who implemented it left the firm.

The difficulty of expressing, codifying and transmitting tacit knowledge makes it easier for a company to protect than explicit knowledge. Acquiring another company's tacit knowledge requires hiring away its people. However, even this is generally inadequate. A single expert is unlikely to possess all of the knowledge needed to reestablish the desired organizational routines in the new company, since the knowledge underlying a routine is held by a number of people whose individual knowledge is incomplete. Moreover, tacit knowledge may only be effective when embedded in a particular firm culture, structure and set of processes and routines. The difficulty of copying tacit knowledge enables tacit knowledge to be the basis of an inimitable competitive advantage.

Turning Tacit Knowledge into Core Competencies

Because tacit knowledge is much harder for competitors to copy than explicit knowledge, the ability to capture and transfer tacit knowledge is the key to developing sustainable competitive advantage. This section discusses ways to spread tacit knowledge within a company so that it becomes a core competence.

People acquire tacit knowledge when they observe or participate in a situation and see how their actions, and the actions of others, affect the outcome. For example, a manager could try various methods of convincing people to carry out decisions, including being dictatorial, explaining the reasons for decisions, or encouraging people to participate in making the decisions. Similarly, one could try a variety of steps and materials for constructing a product. Moreover, a company could put a number of products on the market and see which ones sell. This trial and error learning is valuable, but it is also slow and costly. The individual will make many potentially costly mistakes in the process. In addition, it will take the individual a very long time to develop a sense of which factors to look at, which to ignore, and what the relationships are between key factors. Fur-

thermore, the individual may never conceive of some of the best solutions without the assistance of experts. In each of these cases, the assistance of an expert who gathered experience and developed judgment in that area could greatly facilitate learning.

Traditional supervision arrangements, in which the supervisor periodically critiques the protege's work, are better than trial-and-error learning, but very limited in the power to transmit tacit knowledge. The learning that occurs in this situation is still largely trial and error. Periodically the initiate receives advice on what is likely to work and what is not. This speeds the rate of learning somewhat, but is a much less powerful learning tool than frequent contact with a mentor.

Working with experts and coaches. Coaching arrangements, and opportunities to observe experts, are more efficient at conveying tacit knowledge than is trial and error learning. People slowly build know-how (mental models of the world) and problem solving decision trees by having experience under supervision formulating and solving problems, and by observing the thought/work processes of experts. In coaching arrangements, the supervisor asks his protege to relate how he thinks through situations. In this way, the protégé's mental models become evident, and the coach has a chance to correct inaccuracies and to add greater complexity to the protégé's mental models. Moreover, by asking the protégé the questions that the coach asks himself when dealing with a given problem he can help the protégé to build better decision-making trees.

The opportunity to observe experts work through problems is another way to learn tacit knowledge. The more the expert thinks out loud and permits protégés to see how he analyzes and judges situations, the more tacit knowledge the protégé will absorb. Thinking out loud involves more than informing others of one's decisions. Thinking out loud involves sharing one's perspective and insights, noting what factors (variables) one thinks are most important, and commenting on possible causal relationships between factors. Thinking out loud also includes discussing a variety of possible ways to handle the situation, and the pros and cons of each possible course of action. The most educational situation exists when a protégé has an opportunity to try his or her hand at conceptualizing a situation and suggesting a course of action, while under the watchful eye of an expert who can comment on the protégé's perceptions and decisions. This allows the coach to help the protégé build more useful models of the system.

Coaching and mentoring are most effective when managers understand exactly which skills lead to superior performance and can therefore help their workers to develop these particular skills. Experts are, however, often unaware of what they do which is key to their success. Research conducted with successful salesmen showed that only a few correctly understood why they were successful. To find out which skills are crucial to a particular job, it is useful to bring together a group of experts. The group should draw up a list of the key tasks for their work, and then create a list of the skills needed to perform the tasks. Ideally, one would then observe both experts and average performers to discover which capabilities are actually crucial for superior performance.

In business, managers can sometimes find mentors with whom they can discuss problems. Mentoring in business, however, tends to be irregular, relatively infrequent, and carried out by whoever one's manager is, rather than by experts. A dearth of experts, combined with the time pressures of the business world, has markedly limited the optimal use of this method. It is unlikely that businesses will ever develop the intensive mentoring-based training that exists, for example, in medicine. However, companies can strive to improve access to this key method of transmitting tacit knowledge.

Several things can be done to foster mentoring-based learning in companies. First, managers can be taught how to coach. Second, their performance measures can include

their efforts to train subordinates. Third, structured group discussions can be used to serve many of the educational functions of coaching with far lower costs in terms of human resources than one-on-one mentoring. For example, in hospitals, medical departments hold regular conferences in which difficult clinical situations are shared and discussed. Each participant has the opportunity to assess how he or she would have dealt with the case, to hear what occurred, and to hear how the more senior members of the department would have dealt with it. For another example, at the Army's National Training Center, brigades of 3,000 to 5,000 soldiers engage in simulated combat and are observed by 600 instructors who hold "After Action Reviews" each evening. During the reviews, instructors help the soldiers see what was not done correctly and how to fix it for the next day's activities. Similar training methods can be developed in the business world.

Networks and work groups. In business, people often network informally with others with similar interests, or form communities of practice, to discuss their experiences, gather the ideas of others, and receive feedback on their own ideas. Communities of practice are groups of people sharing an interest in an issue who meet periodically to discuss problems, brainstorm, and share knowledge. Meetings may be in person, or virtual. Optimally, information is stored in a database for future use. Companies can significantly facilitate the transmission and spread of tacit knowledge by supporting such networks: providing the communications resources needed, allowing people the time to use them, and formally recognizing the community and its best contributors. When supported by the company, communities of practice hold considerable potential for developing and spreading the expertise of a company.

A common problem with discussion groups is that they tend to deal with explicit knowledge, rather than tacit knowledge. If discussions are limited to theoretical discussions of topics the knowledge sharing will be primarily explicit, rather than tacit. Therefore, companies need to arrange case discussions and other opportunities for individuals to exercise judgment and compare their decisions with those of experts.

Working in groups can also present a platform for sharing tacit knowledge. When people work hand in hand in teams, they have an opportunity to observe how others conceptualize situations, approach problems, and generate and evaluate solutions. The more people work together, and the more time they spend socializing and casually talking about their experiences, sharing anecdotes, and sharing impressions of each others experiences, the more tacit knowledge they will share.

There is an extra bonus to working in groups. Not only is tacit knowledge shared, but the mixing of tacit knowledge often leads to new insights and innovations. Brainstorming sessions can create considerable intellectual capital because they enable us to integrate and expand our tacit knowledge as we go back and forth in a group, tossing out ideas and impressions. The ideas generally come from intuition, rather than logical processes, and are the progeny of our tacit knowledge. Similarly, spontaneous reactions to the ideas of others also generally reflect our tacit knowledge. Iterative cycles of tossing out possibilities and receiving feedback lead to better and better ideas. As a result of this process of mixing the tacit knowledge of several people, teams are capable of developing more creative solutions to problems than individuals can.

Recording tacit knowledge. Writing and studying "learning histories" can be a very efficient way to transmit tacit knowledge. Learning histories are written narratives of critical events in a company such as a change initiative, product launch, or innovation. Unlike best practices write-ups, learning histories deal with mistakes which have been made and the logic and assumptions which underlay decisions. People involved in the events write the histories, and then consult-

ants analyze what occurred. The learning history is read and discussed by other groups facing similar challenges. The insights people gain by studying and discussing the events help them to make better decisions. When managers read the histories of projects, they can share in the experience, particularly if they have a chance to pause at key decision points, respond to questions, and get feedback from experts who critique their decisions.

Another way to spread tacit knowledge is to develop routines for dealing with situations and spreading the routines throughout the organization. Examples of such routines include: who is included in discussions of issues before decisions are made, the agenda for project kickoff meetings, the list of factors one investigates before entering into contracts with new suppliers and customers, and how one deals with client requests. Each of these routines can have significant impact on the problems a company has and where it has outstanding performance. For example, which functional areas are brought into the discussion of an issue will affect how much attention is given to different factors. In new product development, engineers will tend to focus on building the best quality possible into a product; marketing will focus on what they believe people will buy; manufacturing will look at ease of constructing the product; and finance will focus on keeping costs down. Similarly, the routine for doing due diligence before signing a contract with customers or suppliers will affect the incidence of problems, as well as the up-front costs of developing a new relationship and the speed with which one can move on a new opportunity. Finally, the routine for developing new products will have significant impact on what is produced. Specifically, which functional area does the initial screening, and which factors are used to do the initial assessment, will affect which projects may receive a full hearing and potentially come to fruition. Routines capture the tacit knowledge of those who develop them, and spread the effect of their expertise and judgment.

For routines to continue to be a way of spreading tacit knowledge, rather than an encumbrance to the development of better practices, routines need to be periodically revisited and altered as situations change. All too often, routines become stagnant and are encumbrances, rather than aids. Recording the rationale for the routines helps preserve the knowledge upon which they are based. Cognizance of the rationale helps to make the costs and benefits of the routines clearer as time goes by and makes it easier for people to redesign the routines, and thereby optimize performance, as conditions change.

A final way to increase the spread of tacit knowledge is to make it more explicit. Sometimes experts, with the assistance of those who are used to building models, such as academicians, can capture some of what they do to conceptualize the world and address problems. Doing so, making tacit knowledge more explicit and then passing the knowledge on to young managers, will speed the process of skill development. Making tacit knowledge more explicit also increases the risk that it will be copied by other firms. The risk, however, is limited because tacit knowledge can rarely be made fully explicit. As Nelson and Winter note, exhaustive attention to details and preconditions cannot produce a coherent picture because the whole is more than the sum of the parts. Our ability to describe the patterns formed by the relationships of the parts of a system is limited. Therefore, there will always be limits to our ability to make tacit knowledge explicit. Nevertheless, firms should be aware that the more they work to make knowledge explicit and more transferable, the greater the risk that the knowledge will be acquired by other companies.

Summarizing this section, tacit knowledge can be the basis for sustainable competitive advantage, because it can be spread within a firm, but it is very difficult for other firms to imitate. The predominant way that firms can facilitate the spread of tacit knowledge within themselves is by giving employees the chance to work with, and/or be men-

tored by, those who have the expertise. In addition, recording, analyzing and sharing learning/case histories of projects provides employees with the opportunity to develop their own tacit knowledge by working through the learning histories and practicing problem solving. The development and propagation of routines can also help to spread tacit knowledge. One needs to be careful to periodically revisit routines and update them lest they become more of an encumbrance than an aid. Finally, sometimes the tacit knowledge of experts can be made partly explicit if the expert works with someone skilled at building models of the world. However, this raises the risk that people outside of the firm can copy the knowledge. The most important factor for the transfer of tacit knowledge is realizing its value and allocating time and resources for it. All of the above methods require effort, but they will bring significant benefits.

PART II. SUPERIOR KNOWLEDGE MANAGEMENT CAPABILITIES AS AN INIMITABLE COMPETITIVE ADVANTAGE

Part II of this paper discusses the wide span of factors companies need to address to create first-rate knowledge-management capabilities. Few companies engage in the broad ranging changes in firm culture, communication practices, HR practices, decision-making practices, and performance measures and rewards which are needed to maximize their ability to develop, share and integrate knowledge. Those that do will therefore provide themselves with an enduring competitive advantage.

All too often, knowledge management efforts are limited to creating electronic means to foster knowledge transfer and storage. Far more needs to be done for a company to successfully leverage its knowledge. First, it is necessary to develop a knowledge-sharing culture. Second, companies need to overcome defensive routines inhibiting open communication. Third, a system of measures and rewards needs to be developed that encourages people to make full use of the electronic means of information transfer and storage. Fourth, there needs to be a knowledge-management department that not only places information in databases, but categorizes it so that people can readily find the information they seek. Finally, companies need to develop a variety of organizational levers promoting implementation of the best ideas held in the company.

Sharing and integrating the knowledge held within a firm brings a number of benefits. Spreading best practices, and bringing together different pieces of knowledge that together enable the development of new services and products, are only the most obvious. In addition, sharing and integrating knowledge enables people to understand the widespread effects of their actions and allows employees to make optimal tradeoffs between ideal goals, rather than simple compromises in which people split the difference. Moreover, with an understanding of the effects of one's actions on other parts of the company, employees can better coordinate their actions so that they support each other's work and realize synergies. Finally, with high levels of knowledge integration enabling people to deeply understand each other's work, people are able to explore the root causes of problems, question assumptions, and then develop novel solutions to problems that markedly improve on current practices.

Changes in the nature of strategic decision-making have added to the importance of knowledge management. In many industries, success in today's markets depends on the ability to learn about emerging market opportunities, and to rapidly develop and spread the knowledge necessary to exploit them, rather than on careful long term planning. Traditional approaches to strategy overemphasize the degree to which it is possible to predict which competencies and strategies will be viable in the long run. The key driver of superior performance today is the ability to change when the environment

calls for it, and to find the shifting sources of advantage. As a result of these changes, the ability to acquire, develop, and spread new knowledge has become an indispensable core competence.

Reasons for Failure of Knowledge—Management Efforts

The importance of knowledge management has received considerable attention in the last few years. Despite this attention, and the creation of knowledge-management departments in many companies, the capture and spread of the knowledge within companies still has a long way to go. For example, a study of oil refineries showed little consistency in performance across different refineries within the same company. Another study of several dozen factories doing the same tasks with similar technologies in the same company showed marked differences in productivity. A study at the highly successful Hewlett–Packard Co. showed that innovative process technologies and other sources of competitive advantage often fail to be transferred across departments. The study led an HP executive to state that he wished HP knew what HP knows. Part of the problem is that the companies failed to take the steps necessary to transfer both tacit and explicit knowledge. Another part of the problem is that the companies failed to take the steps needed to motivate people to implement what they knew.

The limited efficacy of most knowledge-management efforts is because of attention being overwhelmingly focused on creating the electronic means needed to capture and store information and improve communication. Far more attention needs to be given to the task of convincing people to effectively use information systems. For example, Arthur Anderson found that employees did not avail themselves of their AANET until promotion and compensation decisions began to consider use of the intranet, and senior managers began posing questions to employees by e-mail and expecting quick responses.

To successfully foster the sharing and implementation of a company's best ideas requires confronting powerful organizational and cultural obstacles and often requires effecting major changes in organizational structure and culture. Knowledge is a basis of power and respect, and people are often hesitant to share knowledge lest their power decrease. Moreover, sharing knowledge requires that time be taken away from other responsibilities that have higher priority.

People are not only hesitant to share what they have, but they are hesitant to use the knowledge of others. This has been referred to as the "not invented here" syndrome. In a classic example of the "not invented here" syndrome, Mobil Oil engineers in Kansas developed a way to better estimate the amount of steam needed to extract oil from the ground. This permitted considerable savings in energy expenditures. Although memoranda and reports were sent around to other oil fields, the new technique was generally ignored. Even when a case study and video were developed to promulgate the new technique, and people were given days to discuss it, after 6 months only 30% of Mobil drilling sites had adopted the new estimation technique. Thus, diligent efforts to disseminate knowledge may fail if the organization lacks a culture in which knowledge developed elsewhere is accepted.

Problems hindering knowledge sharing are very common. At one firm, the leadership realized that knowledge was key to its success and spent considerable sums on its intranet and associated databases and training classes. However, a variety of issues impaired knowledge sharing. First, although the firm used a balanced scorecard that included addition to firm knowledge, the culture placed far greater emphasis on competing activities, and failed to adequately recognize or support development of firm knowledge. Knowledge creation generally needed to be done on one's own time. Even when people were offered an assignment developing knowledge, they were repeatedly told that engaging in such work could ham-

per their career development. Second, the firm had a system of databases with large amounts of material, but several problems markedly impaired how helpful they were. Training programs gave markedly inadequate attention to informing people of their existence and helping people to learn to navigate them. People who had been at the firm for extended periods often did not know about the existence of databases containing information relevant to their area. Moreover, inadequate categorization and quality control made finding state-of-the-art information held in the database very time-consuming.

At another large corporation that spent considerable efforts to develop optimal technological means for communication and knowledge transfer, knowledge creation and transfer often failed. At one point the need to develop a crucial new product was proselytized throughout the company. Efforts to develop the necessary technology occurred throughout the firm with little coordination. As a result, there was considerable duplication of effort. Several problems contributed to this situation. First, there was no adequate centralized system for guiding research efforts or helping people find out who else was working on the various aspects of the problem. Therefore, those who wanted to cooperate and work with others often could not find out who was doing related work. Moreover, while there were rewards for those who contributed new ideas, neither the culture nor the company's performance measures supported cooperating with others working on projects. Therefore, people competed rather than cooperated. So, despite its state-of-the-art communications technology, the company failed to efficiently disseminate and grow its knowledge for lack of adequate means of coordination and lack of the culture, performance measurement and reward systems needed to foster knowledge sharing activities.

For knowledge management efforts to bear fruit they must contain large doses of attention to organization culture, performance measurement and rewards, decision-making processes, human resource policies, and communication styles. All of these areas impact on people's willingness to share knowledge and their tendency to hoard it.

Keys to Fostering Knowledge Sharing

Developing a knowledge—Sharing culture. Several steps can facilitate the development of a knowledge-sharing culture. Knowledge-sharing efforts such as mentoring, responding to questions by others, and making contributions to databases and discussion groups, need to be measured and rewarded. The stories leaders tell, the directives they give and the examples they set by their own behavior also have a powerful impact on the organization's culture. Similarly, hiring criteria, training programs and promotion criteria have an impact on the culture of the organization. With a multipronged, focused approach companies can make knowledge sharing the cultural norm.

Willingness to seek information from others, and to use information developed elsewhere, are also crucial aspects of a knowledge-sharing culture. Awards recognizing the use of ideas gathered from elsewhere in the firm, or from outside of the firm, can encourage knowledge seeking. Recruitment and selection should favor people who are open to learning and trying new things. Strong firm identification will help to decrease the perceived distance between people in different parts of the firm, and make it easier for people to accept each other's ideas. Identification with the firm as a whole, rather than only with one's subunit, is fostered by having the experience of working in different parts of the firm, by attending conferences which bring people together from across the firm, and by the attitudes passed down from above. Finally, the culture must be tolerant of mistakes. If not, people will prefer to continue established ways of doing things and not risk experimenting with new ideas.

Procedural justice. Another factor encouraging knowledge sharing is procedural justice in decision-making. Research has shown that when managers feel strategic decision-making processes are fair they tend to voluntarily cooperate. When they feel that processes are not fair they tend to hoard ideas and drag their feet. Procedural justice has three aspects: engagement, explanation and clarity. Engagement means that people are asked for their input into decisions affecting them. Explanation means that all who are affected and involved understand why the final decision was made. Clarity of expectations means that before, during and after decision-making, managers understand what is expected of them and what the rules of the game are. When these three aspects of procedural justice are fulfilled, firm employees are most likely to both share their ideas and to carry out decisions which are made.

Similarly, procedural justice in doing performance evaluations and distributing benefits leads to organizational citizenship behavior. Organizational citizenship behavior includes conscientiousness in carrying out job responsibilities and initiative, and such extra role behaviors as helping peers with their work, and communicating useful information to people in other departments. Thus, an investment in strengthening procedural justice within a firm will pay off in increased communication and cooperation. This in turn will increase the spread of knowledge.

Dealing with defensive mechanisms. The degree of open communication necessary for good knowledge transfer frequently does not occur in organizations. To avoid embarrassment, threat, or the need to change, people in organizations engage in a variety of defensive mechanisms. Common defensive mechanisms include avoiding the discussion of important issues, giving ambiguous messages, and distorting information. In particular, people avoid controversy by covering up or bypassing organizational issues. People not only avoid discussing painful issues, they avoid looking at them by engaging in defensive reasoning such as accepting premises with questionable validity, accepting inferences that do not follow from premises, and accepting untested conclusions. Finally, even when painful issues are brought up, people tend to push them out of their awareness as soon as possible, and therefore, fail to act on them.

Effective knowledge management includes dealing with the defensive mechanisms that impede communication. Potentially helpful ways to deal with these defensive mechanisms are for actors to intensively examine their assumptions, and to engage in group deliberation and decision-making. Perhaps most important, members of organizations need to be aware that they and others have a tendency to avoid discussing uncomfortable subjects, and that this avoidance is likely to be very costly to the organization. Developing a culture which values openness, tolerates failures, encourages questioning of the way things are conducted and permits workers to challenge their superiors is also very important. Coaching/training of managers in open communication and having facilitators/consultants attend meetings can be helpful. GE's "Work Out" sessions, in which managers and workers come together with the explicit purpose of questioning the way things are conducted and acting on the new ideas, present not only an excellent example of a culture of openness and action, but show a way to foster such a culture.

Defensive mechanisms can cripple the ability of people to look at problems, discuss them, and act on them. Regardless of how many interdisciplinary teams and discussion groups an organization has, if the culture tolerates defensive mechanisms and fails to support both honest sharing of information and taking action on good ideas, knowledge sharing and knowledge implementation will be crippled.

Processes and structures fostering knowledge sharing. A firm's decision-making processes and organizational structure, as well as its culture, are important in facilitating

knowledge transmission. R&D on a given issue, but not necessarily all R&D within a company, should be centralized in one place. Moreover, executive management needs to ensure that R&D centers keep in close touch with each other and do not duplicate each other's efforts. Such coordination of efforts often fails to occur. For example, the leading manufacturer in an industry was spending more on R&D than its main competitor, but was falling behind in terms of unit cost and quality. It assumed its competitor was selling products below cost to build market share. In fact, the leader had many locations for research, with frequent duplication of research and waste of resources, while the competitor had centralized research.

Centralizing R&D for issues in designated places does not mean centralizing all R&D in the same place. Different R&D centers should focus on different issues. Ideally, a firm can build a differentiated and integrated network in which research is not duplicated and people know where to look and whom to contact for product innovation. It is best to locate research centers in lead markets (those with the most demanding customers) to facilitate an understanding of market needs. In addition, it is very helpful to locate research centers for an issue near universities that have first-rate departments in the field in question. This permits university-business cooperation in research, speeding innovation and making it easier to recruit the top graduate students with interest in the field in question.

Organizational structures that foster knowledge sharing are often complicated; nevertheless, the benefits they bring are crucial. Simple designs such as functional and divisional organization structures have limits on their ability to share knowledge. Functional organizations are good at sharing expertise within a discipline and allowing people to specialize and therefore stay at the top of their field. But they are typically poor at sharing knowledge across functional lines. Companies organized around divisions/products can share information across functional lines and speed the development of new products, but they are relatively weak at supporting special expertise in functional areas. The matrix organization is a more complex structure designed to get around this dilemma. Matrix organizations, however, tend to slow decision- making and increase conflict. Many companies have found matrices to be more trouble than they are worth. Asea Brown Bovery (ABB) has been able to make their matrix work. ABB keeps conflict under control by allocating greater power to one of the lines of authority, and by leadership intensively working to build a culture supporting collaboration and opposed to political infighting. Another organization design supporting both cross-disciplinary knowledge sharing and intradisciplinary knowledge growth and specialization is to have a product-oriented organization with centers of excellence, which maintain technological expertise.

Various firms have designed innovative processes and structures to foster leveraging of knowledge. For example, people from different geographic regions can be brought together to constitute "best practices teams" in which they share the best ideas held in the company. There can be designated centers of excellence which foster the growth and sharing of special expertise. People can also be encouraged, and provided the resources, to visit other facilities and to share best practices. ABB has biyearly meetings in which functional experts from different operational units meet to share learning and to solve problems. Also at ABB, top executives of the numerous operating units sit on the boards of each other's companies, thereby facilitating the transfer of ideas between the various operating companies. Moreover, the best managers are moved around, thereby spreading their knowledge and ways of doing business. For another example, at the Swedish firm L.M. Erickson international coordination is effected by having senior corporate managers sit on the boards of national subsidiaries. Erickson then uses national subsidiary board meetings as real forums for decision-making, rather than merely pro forma meetings to meet national legal re-

quirements. Finally, at Matsushita, to bridge R&D and production barriers, engineers generally spend several years in central R&D doing pure research, then spend several years in applied research in a production division along with their product, and then move into operations functions along with their product. Moreover, the heads of production teams work with R&D on the product, bridging barriers between R&D and production. There are numerous organizational mechanisms one can establish to link people and business units whose work impacts one another. Exactly which one a company selects is not crucial, as long as some effective linking mechanisms exist.

In addition to firm culture and structure, personal networks are crucial in forging connections between people. Personal networks facilitate information transfer, foster knowledge sharing, and support the development of new ideas. To build networks, companies must have mechanisms to bring people into contact. Cross-office transfers of large numbers of managers and engineers give them the opportunity to learn new practices and to carry the ideas on to their next assignment, or back home. For example, Erickson sends teams of 50 to 100 engineers for a year or two to work on a project. The flow of engineers goes both ways between headquarters and subsidiaries. Similarly, Philips frequently transfers personnel from one subsidiary to another, thereby providing them with experience in many countries during their career. In addition to transfers, training weeks (or months), knowledge fairs, seminars, task forces, and councils all provide opportunities for people in different subsidiaries to meet, exchange ideas, become acquainted and later be able to work together and share ideas while at a distance. The personal networks which these activities support are crucial to fostering knowledge sharing.

Rewarding the use of knowledge. A final factor crucial to the success of knowledge management efforts is motivating people to make use of knowledge that is available. All of the mechanisms noted above will fail to yield benefit unless a company's culture is action-oriented, and its measurement and reward systems strongly recognize and promote the actual implementation of new knowledge and best practices.

Inertia is a powerful force. It is generally easier for people to do things as they always have, rather than to implement new ways of doing things. Without strong motivation for implementing the best available knowledge, many managers will gather the best knowledge and talk about it, but fail to take the steps necessary to implement it. Managers need to be judged on their implementation of the best ideas, not simply for having them.

SUMMARY AND IMPLICATIONS FOR ORGANIZATION DESIGN

Many have argued that we are in a knowledge economy in which intellectual capital is more important than land, labor and capital. Patents and many types of expertise will not, however, bring sustained competitive advantage. Much of our knowledge is only the basis for a transient competitive advantage as our competitors reverse engineer our products, copy our best practices and develop parallel (or superior) technologies. In contrast, tacit knowledge and superb knowledge management capabilities can form the basis of a relatively inimitable competitive advantage. Tacit knowledge can be spread within a firm but will be very difficult for other firms to copy. Superior knowledge-management capabilities are the basis for the rapid acquisition and spread of new knowledge and, therefore, foster continual innovation and continuous improvement.

For tacit knowledge to become a core competence for a company, and not simply the expertise of a small group of experts, companies must make efforts to spread the knowledge. Managers need to be taught how to coach those they supervise, and must be motivated to do so by the firm's culture, measurement and reward system, and the statements and role modeling of senior management. Organizations can further foster

the transfer of tacit knowledge by allocating resources to develop learning histories. Work-group design also affects knowledge transfer. Working in teams, which have ready access to subject matter experts, can be very helpful to transferring both explicit and tacit knowledge.

The knowledge management efforts of most companies have limited efficacy. All too often establishing electronic means of knowledge transfer and storage is the beginning and end of a company's knowledge management effort. As a result, those who go beyond the basic steps and develop the culture and organizational capabilities needed for outstanding knowledge management will have a sustainable competitive advantage.

To foster knowledge acquisition and transfer one needs to develop a knowledge sharing culture. The culture must value knowledge developed elsewhere, and be actively outward looking. Knowledge hoarding and the "not-invented-here syndrome" must be soundly rejected. The organization needs to be open to challenging its own beliefs and reexamining ideas. In particular, routines need to be periodically reexamined. Spending time and effort adding to knowledge databases and teaching others need to be valued and supported. Top leadership must work to develop this culture through their statements about what is important to the company's future, by the myths and stories they propagate, by both recognizing and rewarding those who exemplify the desired culture, and by allocating their time in such a way that they demonstrate their commitment to these goals. Organizational commitment to employees and organizational justice in decision-making are also very important in creating the desired culture of information and idea sharing. Similarly, training in open communication helps to avoid the defensive routines that often plague communication.

Human resource policies need to bring people together so that they can build informal networks. Having career paths that move people between functions and business units helps people to gather broad perspectives and see best practices. Multiple transfers, along with opportunities for knowledge fairs, conferences and the time to continue to foster one's informal network, although expensive, are crucial in fostering knowledge transfer. The organization needs to support best practices teams or centers of excellence and encourage people to visit other sites.

Having a sophisticated knowledge-management department is crucial. New technologies present considerable opportunities, but they can also create information overload. Having efficient ways to find experts and obtain useful knowledge are crucial to effective knowledge management. Specially trained knowledge managers, in collaboration with experts in a given field, are needed to help record, catalogue and index knowledge in data banks in a way which makes it readily accessible to those who can benefit from it. Knowledge librarians can help people find information they need which is stored in databases or held by people elsewhere in the firm. The creation of a knowledge map or "electronic knowledge yellow pages" can facilitate attempts to find experts on subjects of interest. It is not enough to encourage people to record knowledge and to seek recorded knowledge. One must also catalogue knowledge in ways that make it possible for those who seek information to be able to find the information stored in databases, and also to identify the experts that have the information, ideas and expertise they seek.

Finally, the implementation of new knowledge and best practices must be measured and rewarded, supported by the culture and recognized by promotion decisions. Without attention to the implementation of knowledge, people are likely to learn information, but then fail to change their behavior in beneficial ways.

The development of a culture, organization design and human resource policies fostering the sharing and use of knowledge is a complex endeavor. The rewards in terms of building an enduring competitive advantage, however, are also formidable.

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