Knowledge Management in the Software and Services Group

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This paper introduces a practical case of knowledge management in the Software and Services Group of Fujitsu, focusing on real-time management. Systems engineers (SEs) in the organization can perform their work with the most relevant, up-to-the-minute knowledge whenever it is needed and wherever they are. This paper also discusses the organizational issues and the knowledge structure for successful knowledge management.

1. Introduction

The term "knowledge management (KM)" is rapidly coming into common use, and more and more seminars are being held that have "KM" in their titles. Many companies are now considering implementing KM in order to cope with the changes of the 21st century. In this paper, we will explain the meaning of KM through practical examples in the Software and Services Group of Fujitsu.

It is well known in the KM field that there are two types of knowledge: tacit knowledge and explicit knowledge. These concepts were introduced by Ikujiro Nonaka, Ph.D., the Xerox Distinguished Professor of Knowledge at the University of California, Berkeley and Dean of the Advanced Institute for Science and Technology in Japan.[1] Tacit knowledge is knowledge that is difficult to articulate by using text, charts, or diagrams and is therefore difficult to transfer to others. Explicit knowledge, on the other hand, is knowledge that can be articulated in text, charts, or diagrams. Therefore, people can obtain explicit knowledge easily by reading those documents. Dr. Nonaka also explains that an upward spiral of the total knowledge level can be achieved by

spreading new knowledge throughout a company using four types of knowledge conversion modes: socialization, externalization, combination, and internalization.

We consider KM as knowledge-focused corporate management. The key knowledge for a company depends on the industry in which it does business and its type, scale, and current situation. Therefore, the way to implement KM varies from company to company.

There are three major aspects to consider when we implement KM. The first is to identify the key knowledge for the company and to find out how to establish a process for managing that knowledge. The second aspect relates to the fact that knowledge comes from people's thoughts. Since only people give KM meaning, it is crucial to encourage people to participate in KM activities by, for example, rewarding them fairly based on their contributions. The third aspect has to do with establishing a mechanism to encourage people to create, share, and reuse knowledge.[2,3]

2. KM in the Software and Services Group

In this chapter, we introduce a case of KM for systems engineers (SEs) in the Software and

Services Group of Fujitsu. The role of these engineers is to provide IT services (i.e., systems delivery, systems maintenance, and IT consulting) to customers.

The information technologies are evolving rapidly. Until recently, companies processed their business applications on large mainframe computers through "dumb" terminals. The SEs who deliver systems and provide support to their customers have traditionally obtained their credibility with clients by working closely with them. However, the evolutions in semiconductor and network technologies are dramatically changing the way computers are used. This puts SEs in a very difficult situation because to support their clients they need to learn many things about the new hardware and software products that are continually being released.

To understand the clients' needs and provide expert support in a prompt manner, it is important for SEs not to seek everywhere to gather all information by themselves but to be able to obtain required information from the network and then respond quickly. These days, SEs do not always need to acquire a lot of information, but it has become indispensable to have a mechanism in which anyone can use information when necessary. In the near future, SEs way of work will involve sitting in front of a computer to obtain necessary information from a global information resource via the network and to respond quickly to clients. SEs will speed up their work. **Figure 1** shows the relations with customers through the network where the KM activities are performed based on the concepts of "global view" and "speed-up."

Let us think about the key question of "What is knowledge?" for better IT services.

SEs look for essential information from among a lot of information at a customer-support site or at the site of development. Some SEs can support their clients well. However, others cannot do this because, even if they have the necessary information, they lack practical experience. In this
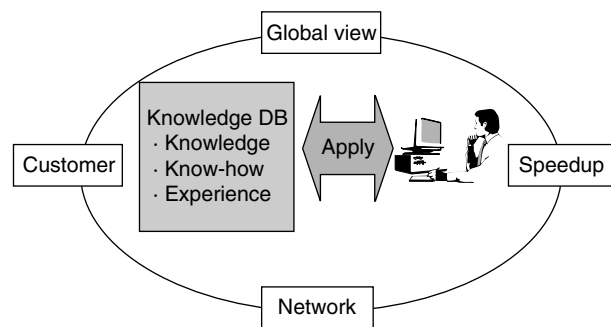

Figure 1
Revolution of SE work-style.

case, the know-how and wisdom by which some SEs can support their client well, are the key knowledge. By compiling and accumulating know-how, wisdom, and other information, SEs in other projects can also access the information and learn how to provide support. This is of great utility. This information, which includes the methods of support by SEs, is collectively called "knowledge." By sharing this knowledge among all SEs in the Fujitsu group, we can provide IT services that are focused on the customers' needs.

3. Changes in knowledge sharing

Since 1978, Fujitsu has been using an information sharing system for SEs called FIND. This system allows SEs to register technical information, product information, and the development status of each project into a centralized system. SEs can search the system for the information they need. FIND has evolved into FIND2/IKB, which currently contains more than 100 000 pieces of registered information.

For FIND to succeed, it is essential to establish a mechanism to encourage people to register the materials produced in each project and to encourage other SEs to reuse them. Therefore, we introduced a management accounting control system which collects a fee for use from departments when they use materials that have been registered by another department. The system then awards the collected fees to the department that registered the materials. Moreover, we have

established an information sharing system, which, for example, sets periodic activity months for promoting material registration.

However, as the quantity of registered information increased, problems such as failures to retrieve accurate information and difficulties determining the quality of information became more common. Also, in the FIND system, SEs had to organize and register the materials created in a project in addition to their field tasks. On one hand, this organization and registration helped the SEs to review and reorganize their projects status; however, because it took time to organize and register the materials, the SEs tended to delay registration when they became too busy with their projects.

In the era of mainframe computers, a lot of the development of mission critical systems was done at the client sites. Development usually took more than two years, which is a long time by today's standards. However, in the cliient sites, since not only the client's IT staff, but also the end-users operate computers these days, faster system development is required.

For SEs' to understand the needs of clients and provide them with prompt support, it becomes essential for SEs to make quick use of knowledge during their day-to-day work. This is the reason for changing from the FIND system, which requires registration by SEs, to a task-oriented system by which SEs naturally store and reuse knowledge during everyday activities.

In this new way of work, SEs use the network for reporting and communicating. If an SE has any questions, he or she can acquire the necessary knowledge by searching the knowledge base. The change in the way of work means a change of mechanism. The old mechanism used to require each SE to be aware of the importance of knowledge sharing and make the effort to register the knowledge. Now, knowledge sharing has been embedded in the mechanism that makes the SEs' daily tasks. Consequently, knowledge sharing occurs without the SEs being conscious of it.

1. SE starts task by using PC to converse over network.
2. SE accumulates raw data from SE's entire activity, converts the data into know-how, and uses it.
3. Anybody can use daily know-how from anywhere in the world.
4. The system runs 24 hours a day, 365 days a year.
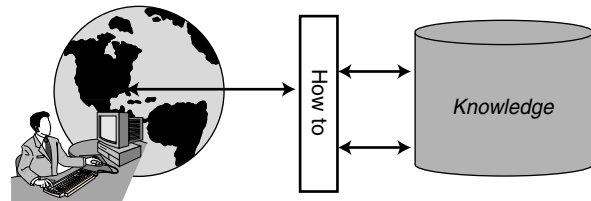5. The latest technologies are used to develop this system.

Figure 2
Objectives of new work-style.

In 1997, we named this change of way of work "SolutionNET." Since then, we have been using and expanding this system.

In the Software and Services Group, it has been acknowledged that the most important information is information about the situation at the client-sites where the SEs perform their tasks. Moreover, it is clear that "knowledge is created and used in the field." We therefore set out to establish a new way of working in which the lessons learned in the field are naturally accumulated and reused through SolutionNET. **Figure 2** shows our objectives.

We tried to train field SEs to habitually ask questions such as "Why does this happen?" and "Why was it a mistake to do this?" in their basic status reports. To the SEs, it may seem troublesome and time consuming to compose a "ToDoList" e-mail message[note 1] indicating the action that was taken. However, it is important that they hold e-mail conversations using the ToDoList e-mail even when they are busy with urgent matters. Making a report on the situation later will require more time because the SEs would have to contemplate the progress and make the report logical. When SEs exchange ToDoLists about a problem and its

note 1) Fujitsu's powerful project-oriented, management software, which has the functions of communication and work promotion (ToDoFunction), teleconferencing, an Internet forum, and a bulletin board system.

solution in real time, later on they may be found to contain contradictions which can serve as useful examples in the future to SEs facing the same situation. Also, an SE can use the logs of the ToDoList e-mails to trace the real-time history of problem.

The new way of work emphasizes real-time knowledge. Moreover, real-time knowledge, with the feeling of being at a live performance, contains processes which tend to be eliminated during the later review and organization process. It is conceivable that tacit knowledge is accumulated and shared naturally.

At this point, the biggest issue concerns middle managers. During project operation, reporting and communication are performed through a network. However, a middle manager may feel unsatisfied on this compared to conventional meetings in which people talk face to face. It is important to make accurate decisions promptly while using a network, since you can acquire information in real time. At the same time, these conversations on networks are open to all project members. If a middle manager persists in requiring the conventional approach to a job, the new way of work will not succeed.

Changing the way of work involves changing the corporate culture. Generally, younger personnel who have recently joined an organization easily become familiar with a new culture and do not resist change. However, middle managers who are accustomed to and familiar with the existing culture may feel uncomfortable with the new way of work. This situation makes changes difficult because it is the middle managers who must implement them. In the new way of work, information must be sent over the network without being constrained by time or distance and middle managers must make timely decisions. A middle manager cannot make excuses such as "I don't have that information." or "There isn't enough information to make a decision." Because middle managers are always able to overview the entire project through a network, their ability to

make decisions is always being tested. Middle managers are therefore required to address issues more quickly and attentively than ever, and to do this they need to use knowledge voluntarily and aggressively.

The change in middle managers' mind-sets and behavior will lead to changes in corporate culture. The members of a project accumulate new experiences by using both methods of work; that is, by communicating with others face to face and through a network. These new experiences are accumulated in the network as knowledge. Thus, the members of other projects can access the same knowledge so they can provide better quality services. An important feature of KM by SolutionNET is that it enables real-time management, which allows personnel to make decisions faster using the knowledge sharing that occurs naturally through the network.

As shown in **Figure 3**, an organization's structure is usually a pyramid. Most project information exists in the field, and as project information goes to the upper levels of this pyramid, the time spent on an issue and the amount of information about the issue become smaller. (In Figure 3, this can be understood by observing that the project information pyramid is wide at the bottom and narrow at the top.) Meanwhile, management information mostly stays on the upper level, since it is usually handled by the top managers of the organization and its quality is
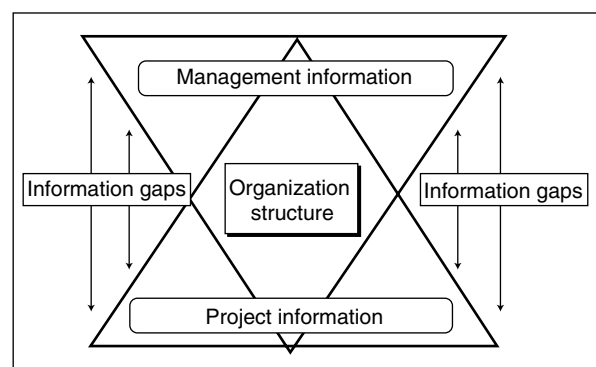

Figure 3
Organization structure and information gaps.

decreased when it comes down to the lower level.

Real-time management fills the information gap between the upper and lower levels in an organization. It also helps the organization to become flat when everyone in the organization starts using released knowledge. When an organization is flat and practices knowledge sharing, it is likely that all of its members will be in the same position and therefore the individual competency gap will be filled in. However, the experience established by SEs with OJT and acquired technologies will become more important than ever. When a company practices knowledge sharing and real-time management instead of having a pyramid structure, the structure becomes a circle with each member standing on the same line and the core members being those who have the most expert knowledge. It will therefore become necessary to change the personnel evaluation method from the conventional seniority system to a method commensurate with the personnels' roles in the circle.

Fujitsu has introduced a new evaluation system which is consistent with task results. The roles of middle managers are to pass information about the management policy for all of Fujitsu to project members and to properly assess the expertise of project members for smooth project operations. Because of their role as a hub for KM, their responsibilities have become clearer and more important than ever.

4. Knowledge structure in SolutionNET

SolutionNET is the collective name for KM in the Software and Services Group of Fujitsu. It enables SEs to share knowledge and do their work anytime, anywhere. To help SEs follow the new way of work, SolutionNET's knowledge structure has three main parts from the user's point of view (**Figure 4**).

4.1 Field knowledge

This is the most important part. Field knowledge is captured, accumulated, and reused by SEs

in their daily activities in the field.

SEs use the networks at their project sites to create the materials, report, and communicate about their daily activities. Conventionally, materials were prepared using a word processor or personal computer and then output to paper or floppy disk. Now, these materials are stored into a server on the network. Therefore, materials, reports, notifications, consultations, and instructions produced from daily tasks, which are usually organized according to its industry or area, become field knowledge, just as they are.

Knowledge is accumulated and reused through conversations about the various problems and solutions that arise during a project and by reporting the work status through a common Web site. Moreover, SEs can perform their tasks even at remote sites by using mobile computers, so it becomes possible to address matters more thoroughly.

The important point here is not to try to standardize the formats and approaches for the tasks of each project. There are thousands of projects going on at the same time in Fujitsu, ranging from large to small. Because the work methods for each project varies with the culture and industry of the client, standardized formats may reduce their work performance. Considering the diversity of projects and their independence, the Software and
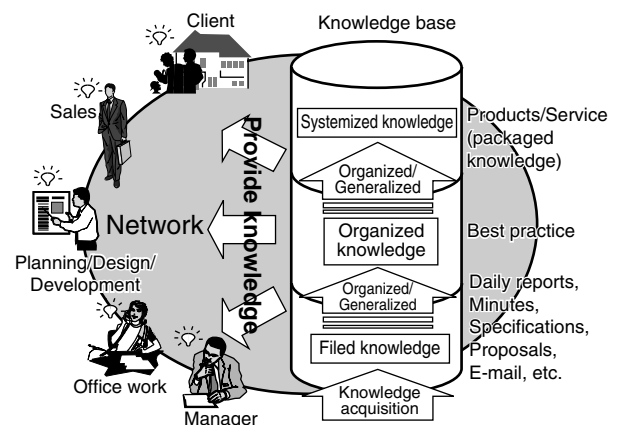

Figure 4
Knowledge structure of Solution NET.

Services Group standardized neither the KM software tools to be used nor their level of usage. After considering the features of the client's industry, each SE selects the KM software tools to be used for the project and finds the best way to use the Web technology with their chosen software. However, basically, all projects in fact do have a common platform because they conform to SDEM21, which is Fujitsu's software development standard, and/or the ISO9001 standard.

4.2 Organized knowledge

Organized knowledge is field knowledge that is organized for reuse as know-how by the entire Fujitsu group.

The conventional FIND dealt with this type of knowledge. Instead of asking SEs to register tasks, we have made it possible for them to search for the field knowledge of any other project by using tools. At the company-wide level, an enormous amount of knowledge has been accumulated, and for accurate searching of knowledge to meet the needs, an ultra high-speed full-text search engine is in use. Moreover, because a variety of software tools are running on 400 to 500 servers in the Software and Services Group of Fujitsu, we adopt new technologies such as software agents for seamless interfacing between the software tools and for retrieving knowledge from each server. Thus, we are trying to enhance the system performance.

4.3 Systemized knowledge

Systemized knowledge consists of 1) systematically organized and summarized know-how which comes from field knowledge and organized knowledge and 2) tools that can be used very effectively for system integration. Systemized knowledge is given to system integrators as an efficiency improvement tool.

SolutionNET has enhanced the collaboration with overseas sites through the Internet, and we promote the accumulation of global explicit knowledge for international use as well.

5. μ (mjú:) Management service

The KM we have been creating in SolutionNET is also the KM which our customers need.

The need for customers to quickly respond to market changes, secure business opportunities, and share expert know-how to improve other employees' skills is becoming increasingly important. Many companies are now trying to enhance their competitive power by focusing on the key knowledge and know-how needed for their survival in today's competitive markets. To manage and reuse this knowledge and know-how, they are considering introducing KM to their company.

When we attend a seminar on so called "KM," they suggest creating a huge database to manage knowledge and introduce tools for retrieving knowledge from the database. We feel like they are saying that KM consists only of database development and the use of search tools.

However, Fujitsu considers KM to be a revolution in corporate management that is focused on knowledge. Therefore, Fujitsu wants its SEs to perform prompt problem solving by using the network and is trying to change its personnels' mind sets, change their way of work, reform the system, and reorganize the infrastructure. Through our experience, we have learned that the key to success in KM is to be aware of the essential point that "people take the leading part."

IT technology is a tool for supporting people's thoughts and activities, but it is not the leading part. The Fujitsu Group has gathered know-how and technologies obtained through in-house KM practices with a view to helping its customers smoothly and quickly implement KM. This service is called "μ Management."

As shown in **Figure 5**, there are four types of KM implementations in μ Management.
1) Communication type
2) Retrieval type
3) Mining type
4) Task support type

We recommend that KM should start from a small scale and progress to a large scale. By

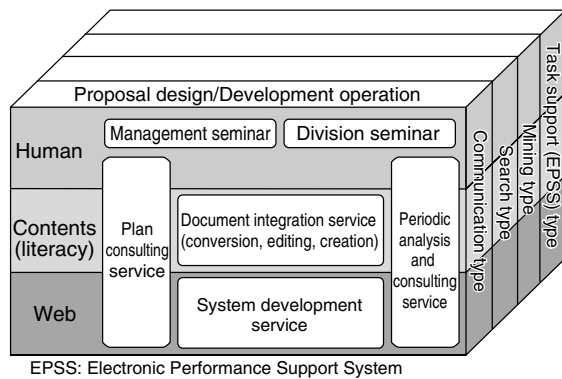EPSS: Electronic Performance Support System

Figure 5
Creating new values μ Management.
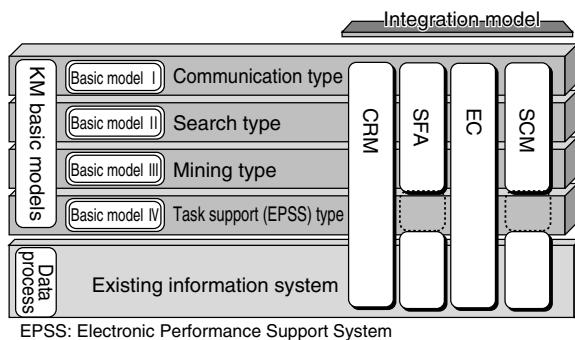

EPSS: Electronic Performance Support System

Figure 6
Integration of KM basic models.

clarifying our customer-oriented policy, we think that KM can be seen as a basic common platform and Customer Relationship Management (CRM) solutions can be realized as shown in **Figure 6**.

μ Management is a set of services which incorporate the know-how of Fujitsu's SEs. Consequently, our SEs can help customers plan KM at their sites by identifying key knowledge and suggesting how it can be used effectively.

6. Conclusion

We will continue to practice KM at Fujitsu. We will also leverage our experience in KM to expand our KM service business. In the 21st century, investing in intangible assets will become a significant part of corporate management. Since human resources are the most valuable of a company's intellectual intangible assets, knowledge management, which focuses on people, will become more and more important.

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