Social organization of access to knowledge and boundary objects : the case of repair technicians of copy machine

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Abstract

In this paper, I describe how access to knowledge is socio-technologically organized based on the ethnographic research of repair technicians of copier. In doing so, it is illustrated that artifacts that have some specific characteristics such as figures, drawings and lists do not necessarily become a boundary objects. Rather, artifacts become boundary objects when they are embedded in a broker's activities of making linkage among sites. Further, a hierarchical linkage among sites sometimes prevents technicians from accessing knowledge and skills because distribution of knowledge and skills produced in various fields is controlled and interrupted by gatekeepers in the middle of hierarchical organization. Informal network among technicians mediated by a mobile phone supports their mutual access to knowledge and skills although a span of this network is pretty confined. Thus, I propose how new linkage among technicians in various fields can be socio-technologically organized.

Keywords

Boundary objects, broker, access to knowledge, informal network, linkage

1. Introduction

Multiple communities or sites are involved in techno-scientific practices, even though each practice itself appears to be small-scale. How are these multiple communities or sites linked in practices? Star (1989) pointed out that boundary objects such as figures, drawings and lists, sit in the middle of multiple sites, linking multiple communities that are involved in a specific scientific project.

However, specific types of artifacts such as figures, drawings and lists do not necessarily become a boundary objects as they are. Whether an artifact become a boundary object or not is dependent on organizing members' way of access to knowledge produced in multiple communities.

Here, I will describe how repair technicians use or ignore documents and knowledge management system concerning technical information of repair and maintenance of copiers. By doing so, I attempt to describe how some artifacts become boundary objects based on ethnographic research on repair technicians of copiers and to reformulate the concept of "boundary object."

2. Knowledge and Skills as a social system

A copy machine can be regarded as a social system rather than merely mechanical system. TV commercial of copier in 1970's represents that this products is a social system perfectly. The TV commercial is saying that "We do not lend only machine. Our products are whole things including seven samurais such as service engineer, telephone service officer, delivery controller, sales representative and others." Actually, as Kawatoko (2004) also described, a copier itself is relatively unstable machine and it becomes stable only with service engineers and other stuffs. Historically, in development of a copier, high performance of machine such as copy speed, quality of copying and function such as down sizing has been preceded rather than stable performance of machine partially because of competition with rival corporations and partially because of rental system supported by service technicians and other stuffs. Borrowing the terminology of actor network theory (Callon, 1986, Callon & Law, 1997: Latour, 1987, 1988) a copier is not a machine but a network including a social organization of maintenance of machine and customers, competitors and the others.

Repairing knowledge and skill of copier can be regarded as part of copier as a social system as well. It is also possible to say that repairing knowledge and skill itself is a social system. How the knowledge and skill as a social system is organized? The previous research shows that technicians share knowledge for repairing as community memory (Orr, 1996. fieldwork was conducted in 1980s) For example, ways of repairing for difficult cases would be kept and distributed as a form of war stories in communities of repair technicians.

Around 2000, various resources for repairing knowledge and skills are juxtaposed as shown in Fig.1. For example, in the department of repair technicians, various kind of technical information are available in intra-net in the corporation. However, it is impossible for each technician to access to all

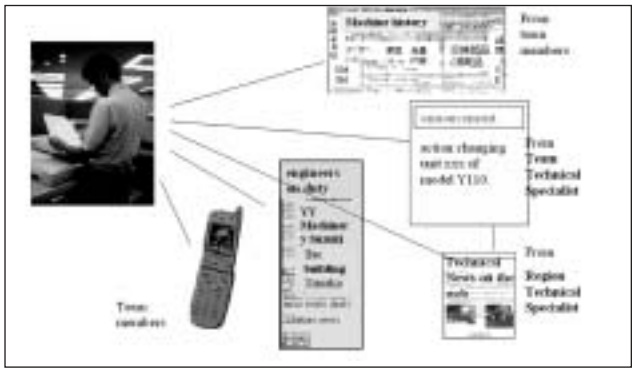

Fig.1. Socio-technological organization of repairing skills: juxtaposition of various resources

necessary technical information of various models since technical information available in intra-net is too huge and it is frequently revised. How do repair technicians access to necessary technical knowledge? As described in Fig.2, actually, some specific persons such as Team (or Branch) Technical Specialists constantly access to some documents and knowledge management system and they mediate between team members and technical information available in intra-net. A Team Technical Specialist is also a field technician who specializes in a specific model. He works as a technician in an area and, at the same time, monitors all the machines of a specific model in his district.

In the following section, I will show how technical specialists in team organize member's access to knowledge and other resources for repairing by following Ueno & Kawatoko (2003).

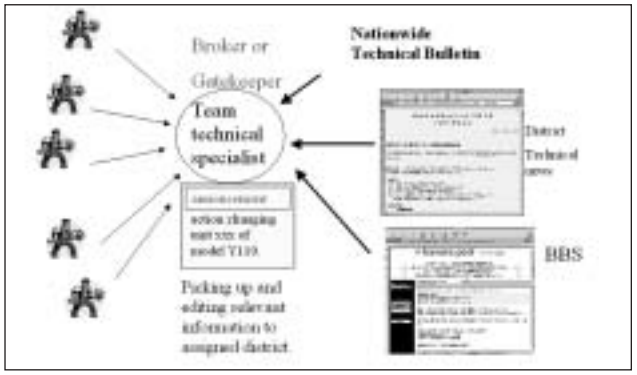

Fig.2. Network organized by Team Technical Specialist

3. Technical specialist in a Team

Technicians analyzing an area

A record of machine histories is an important resource for technicians in diagnosing machines. A record of machine histories is a kind of medical record for a copy machine. Technicians record diagnoses, repairs, and maintenance work, and other information such as copy volume, each time they visit a customer. They make a photocopy of this record and bring it back to a Team Technical Specialist or a Branch Technical Specialist. The original is left inside the machine for a technician who will repair the same machine in near future.

A Team Technical Specialist reads through records of machine histories approximately twice a week, and analyzes the state of the specific model in the area. The result of those analyses is relayed to team members either in a team meeting, or in a monthly team report.

Let us take a look at an example of how a Team Technical Specialist analyzes records of machine histories. A Team Technical Specialist, Yoshida, covers a color copier, the XC2000. Based on his own field experiences and the records of machine histories, he regards the main problems with the XC2000 as copy quality problems such as unevenness of color. He makes a graph that classifies the cause of copy quality problems. In general, there are several types of copy quality problems. In the case of the XC2000, most of the problems of copy quality come from dust on a fuser unit.

Yoshida analyzes the problem as follows: A fuser is a unit that fixes ink to the surface of paper with heat. In a fuser unit, there are seven rollers. Copy quality problems come from dust on one roller. However, dust on one roller is related to dust on an oil tube. Dust on an oil tube is what makes one roller dusty, causing a copy quality problem such as unevenness of color. Even if a technician replaces one dusty roller of a fuser unit, the same problem will occur again. A technician has to exchange not only dusty rollers but also an oil tube.

By analyzing the same or similar troubles based on records of machine histories gathered from team members, he identified the pattern of trouble as described above. At the same time, technical information such as the News from a region technical specialist of Tokyo is useful for him in analyzing records of machine histories. Region technical specialists are also specialists for a specific model and they cover a whole region such as Tokyo. Technical News from region technical specialists are occasionally issued and uploaded on the web.

The News from a region technical specialist was useful for him in planning systematic actions to the problem of oil tube dust. Usually, it takes at least two hours to exchange rollers and an oil tube separately. It is difficult to spend so much time repairing in a customer's office. It is easy to exchange a whole fuser part all at once, and it does not take much time, although a whole fuse part is very expensive. Under these circumstances, Yoshida found a more systematic method for repairing the XC2000. First, a technician temporarily exchanges a whole fuser unit of a machine at a customer's site, and brings the old fuser unit to the district office. Then he exchanges rollers and an oil tube in the district office. After exchanging the rollers and oil tube of the old fuser, he visits the customer again and exchanges the new fuser unit for the repaired old fuser unit. He devised this plan upon reading Technical News from a region technical specialist.

Global descriptions in the field

The analysis and description of a specific model of machines

in an area conducted by Team Technical Specialists (or Branch Technical Specialists) are important resources for technicians in diagnosing machines. The analysis and description based on records of machine histories are deskwork rather than work in the field, in which Team Technical Specialists draw statistical graphs and tables in order to describe the global status of an area. This work of Team Technical Specialists is, in some sense, similar to that of sociologists who attempt to describe society globally from a panoptic point of view. However, global analysis and descriptions of an area by Team Technical Specialists are utilized as resources for field technicians' everyday diagnosis and repairing machines.

The analysis and description of specific model of machines are based not only on records of machine histories but on Team Technical Specialist's everyday experience and Technical News issued by a region technical specialist of the Tokyo region. In short, analysis and description of an area are hybrids of different descriptions produced in different sites.

The analysis and description of a specific model of machines in an area is not accomplished by a single resource but by mutual referencing of multiple resources from different sites. This hybrid is produced by Team Technical Specialists (or Branch Technical Specialists). Thus, one of the critical jobs of Team Technical Specialists (Branch Technical Specialists) is to integrate Technical News from region technical specialists and a Nationwide Technical Support Center with the situation of an area and activities of team members. In this sense, a Technical Specialists in a team is a key person for making a linkage among various sites.

In short, a Team Technical Specialist reads through records of machine histories, and analyzes the state of the specific model in the area. He also monitors Technical News issued by a region technical specialist such as Tokyo region and the other technical information available in intra-net. A Team Technical Specialist picks up relevant information and edits them for team members. In this way, Team Technical Specialists organize team members' access to some documents and technical information available in intra-net. Team Technical Specialists are able to contact Region technical specialists who are specialize in a specific model in a large region such as Tokyo. Further, some of them regularly attend district meetings of Branch Technical Specialists. In this way, Team Technical Specialists can be regarded as a kind of gatekeeper who controls team members' access to technical knowledge. Otherwise, they are knowledge brokers who carry knowledge produced in different sites to their own team.

Documents such as records of machine history and region technical specialist News can be regarded as boundary objects. However, some specific documents themselves do not become boundary objects. Rather, they become boundary objects through activities for making a linkage among sites by technical specialists as a broker. At the same time, technical specialists do not become a broker without using and integrating documents produced in various sites.

4. Work of technical specialists and Complains in fields

In this section, let us take a look at work of region technical specialists. As described previously, region technical specialists are also specialists for a specific model and they cover whole districts such as Tokyo. Technical News from region technical specialists are occasionally issued and uploaded on the web based on information from fields and from Technical News issued by Technical Support Center that covers machine problems in a Nationwide. Region Technical Specialists is in the middle of Technical Support Center and field technicians as shown Fig.3. Technical Specialist can be regarded as a broker or a gatekeeper who links or disconnects between different sites in hierarchical organization.

In the process of fieldwork, we would sometimes heard complains from repair technicians and some chiefs in district branch offices. For example, they pointed out in the followings.

"Feedback from Technical Support Center and from department of machine design is slow and delayed."

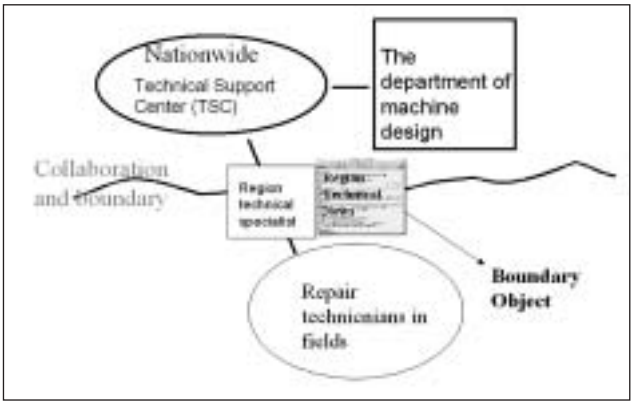

Fig.3. Region Technical Specialists as gatekeepers or brokers.

"We always send various information of machine problems and ways of reparing. However, frequently, there is no answer from Technical Support Center and from department of machine design."

They also pointed out that the perspective of field and Center is different from that of technicians. In field, repair technicians often have difficulties to identify a problem region of machine. On the other hand, region technical specialists and Technical Support Center mainly focus on already specified machine problems based on the perspective of quality control. Repair technicians who always treat machines have know how to specify a problem region of machine and ways of repairing. This knowledge is mainly distributed only within a district or

within a team.

In short, region technical specialists vertically make a linkage between sites, not horizontally. Thus, Technical News issued by region technical specialist can be regarded as a boundary object that vertically links sites in hierarchical organization.

5. Informal Network of repair technicians

Horizontal network among field technicians compensates a lack of information and knowledge from region technical specialists and Technical Support Center. Knowledge of machine problems and ways of repairing are quickly distributed among repair technicians in a team and in a district, or, sometimes beyond it. They know what is relevant information for themselves each other. This is because they share the same perspective and problems for repairing.

Stucky (2003) described knowledge ecology of paper handlers who are engineers of printers and copiers in the followings.

"There was a sizable paper-handling ecology that was made up of various communities of technical expertise, linked by various people who knew someone who could answer the question, who knew the assistant's telephone number who knew that Frank always returned those calls in a timely fashion and made sure Frank knew Joe had called."

Horizontal network of repair technicians of copier can be regarded as a kind of knowledge ecology as Stucky described. Actually, they often referred to colleague repair technicians who are good at specific models in the same district and in other districts. Further, they often call chiefs who are in a branch office in order to ask searching out knowledge management system and the other information in web if they cannot specify a machine problem. A noticeable thing is this knowledge ecology is organized and linked by technologies such as a mobile phone. For example, they cannot contact each other scattered in fields without a mobile phone. Further, a Team Technical Specialist or a Branch Technical Specialist is sometimes critical part of knowledge ecology of repair technicians. As described previously, one of Team Technical Specialists would regularly survey and analyze problems in the district. He would also pick up and edit relevant information to the district from various resources such as Nationwide Technical Bulletin, Region Technical Specialist News and others. In addition, he would monthly distribute local technical news for team members.

6. Conclusion

The case of repair technicians illustrates repair technicians' access to technical knowledge is socially organized by a kind of brokers who mediates team members and technical knowledge produced in other sites. Documents concerning technical information and knowledge management system are accessible for repair technicians as long as these artifacts are appropriately embedded in technicians' social network. In this case, some of artifacts can be regarded as boundary objects. This is not due to characteristics of artifacts themselves but due to social organization of access to knowledge and to everyday activities of brokers who attempt to embed knowledge produced in other sites in their own practice.

However, the above point is mainly concerning linkage and social organization of access among sites in hierarchical organization. Institutionally, there was no formal artifact and social system for developing horizontal linkage among districts although repair technicians pointed out a network among technicians in various districts must be very useful and convenient. An informal network among technicians partially compensates a deficit of vertical organization. However, an informal network is not always expanded beyond a team or a district. Thus, recently, one of region technical specialist organized a regular meeting and mailing list of exchange information and knowledge of machine problems and ways of repairing for branch technical specialists from various districts. We attempt to start a project for designing a web page for a mobile phone in which information and knowledge such as exchanged in the meeting for branch technical specialists are available by using a method of participatory design. We hope such artifact will be a boundary object for making a horizontal linkage beyond a team or a district.

References

Callon, M. 1986 Some Elements of Sociology of Translation: Documentation of the Scallops and the Fishermen if Saint Brieuc Bay. In Law, J. (Ed.) *Power, Action and Belief: A New Socilogy of Knowldge?* Sociological Monograph. Routledge and kagan Paul: London.

Callon, M. & Law, J. 1997 After the Individual in the Society: Lessons on collectivity from science, technology and society. *Canadian Journal of Sociology*, Vol. 22, No.2. 165-182.

Kawatoko, Y. 2004 Machines as a Social System. This issue.

Laour, B. 1987 *Science in action: How to follow scientists and engineers through society.* Boston: Harvard University Press.

Latour, B. 1988 *Pasteurization of France.* Harvard University Press: Cambridge, MA, and London, England.

Star, S. L. 1989 The structure of Ill-structured solutions: boundary objects and heterogeneouse dostributed problem solving. In Gasser, L. & Huhns, M. N. (Eds.), *Distributed artificail intelligence.* Vol. II. 37-54. London: Pitman.

Stucky, S. 2003 (in preparation) *What is Wild Knowledge?*

Orr, J. 1996 *Talking about Machines: An ethnography of a modern job.* Ithaca, NY: ILR/Cornell University Press.

Ueno, N. & Kawatoko, Y. 2003 Technologies making space visible. *Environment and Planning A,* Vol. 35, No. 9.1529-1545.