Cellular Phone as a Collaboration Tool that Empowers and Changes the Way of Mobile Work: Focus on Three Fields of Work

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Abstract. The development and spread of cellular phones have been remarkable in recent years, and these phones are becoming an integral part of the social infrastructure. Owing to mobile technology, especially cellular phone technology, the way of working that entails being unconstrained by time and space has flourished. Over a period of five years, we have investigated various fields of work that involve mobile workers such as sales representatives and repair technicians. Cellular phones were observed to have had a significant influence on task organization and the structure of communication in these fields of work. This paper describes how mobile workers have incorporated this new technology into their work creatively and constructively. Furthermore, it describes how cellular phones have changed the relationship between and enhanced the communication network among coworkers and customers. As a result, we demonstrate how cellular phones are evolving into a type of collaborative tool that supports collaborative work between mobile workers, instead of a communication tool that merely connects two individuals. In other words, based on ethnographical observation, we show that cellular phones are a fundamental element of CSCW technology for mobile workers.

Introduction

The way of working has become increasingly multifaceted in the past few years, enabling workers to choose from a wider range of employment. People can now choose to work in a manner that is unconstrained by time and location and suits

their lifestyle or work style preferences (Froggatt, 2001). In addition to such change, the progress and rapid spread of mobile technology, especially cellular phone technology, is remarkable. In this study, we focus on the mobile work style and the use of cellular phones in the workplace. Further, we investigate the different ways in which cellular phone technology can aid and abet mobile workers.

In former times, people's lifestyles and forms of work changed drastically with the proliferation of the telephone (Fischer, 1992). In the same manner, the cellular phone has also affected the work style and social communication network among people. Cellular phones were initially introduced as a commodity for business people, but it rapidly spread among the youth in many countries (Rheingold, 2002). Various investigations have reported that the communication pattern of the youth and the manner in which they structure their time are changing with the use of cellular phone technology (Ling and Yttri, 2002; Weilenmann, 2003).

Most studies on cellular phones focus on their social, recreational, and familial use. On the other hand, very few studies focus on the use of cellular phones in the workplace. Currently, in the world of business, the number of people whose nature of work involves being mobile is fast increasing. From the viewpoint that it is more efficient to work at a more productive location rather than a fixed office, a person's workplace shifted to the location that would result in higher productivity. Cellular phone technology is one of the most powerful technologies that support such mobile workers.

For the past five years, we have investigated many workers in several workplaces. In most studies on workplaces, researchers have focussed on the interaction between the work and the technology employed (Engestrom and Middleton, 1998; Heath and Luff, 2000; Luff, et al., 2000; Goodwin and Ueno, 2000). In this paper, we focus on mobile technology, with particular emphasis on cellular phone technology. Cellular phones have undergone remarkable changes in these five years, and they have greatly influenced the working styles of mobile workers. People have grown accustomed to cellular phones and are now able to organize their work more efficiently. In this paper, we report on how the cellular phone has changed the working style and communication pattern of mobile workers over the past five years, citing examples from case studies on their ethnography.

Evolution of Cellular Phone Technology in Japan

This section outlines the trends and areas of changes of mobile media, focusing on cellular phones in Japan (Okada and Matsuda, 2000; Ito, et al., 2005).

Introduction Period

In Japan, the full-fledged cellular-phone service business began in 1987. Initially, however, a cellular phone terminal could only be rented and communication charges were high, thereby placing this technology beyond the reach of the common people and limiting its scope to business purposes. Early cellular phone usage was very different from the current trend of individual usage. For example, one cellular phone was shared among team members, and if a member were required to work outside office premises, s/he would be given the phone. Alternatively, at a construction site, only the site representative carried a cellular phone and made or received calls on behalf of the entire team. Thus, since a cellular phone was expensive, it was used more on an organizational level rather than an individual one. Current cellular phone usage has changed drastically from when it was an exclusive product. The fact that it was expensive lent a special significance to its usage. Business people mainly desired cellular phones because, rather than their functions, 'owning a cellular phone' became a status symbol, representing an 'up-and-coming business person'. Therefore, they sometimes deliberately flaunted their phones by using them in public spaces (e.g. carrying on loud conversations on their phones while commuting in trains). Plant (Plant, 2000) described such usage as 'The Flashy Peacock: proud and extroverted, using mobile primarily for show'.

Spread of Cellular Phones to Common Users

In the mid-1990s, cellular phone technology progressed rapidly, resulting in intense competition among carriers in the growing market. By this time, cellular phones had also gradually spread to common users because of the following reasons: reduction in size and weight of a mobile terminal, shift from rental to compulsory purchase of a terminal, reduction in communication charges, etc. Moreover, a simple and cheap cellular phone called PHS (personal handy-phone system) also accelerated the spread of cellular phones among the youth. During this time, the mail function was also introduced, and the cellular phone began to exhibit signs of shifting from a telephone to a colourful communication medium.

Development of Information Terminals for Cellular Phones

The evolution from a telephone to an information terminal began with the release of NTT DoCoMo's 'i-mode'® in 1999. Many PHS users shifted to a different cellular phone. This initiated the rapid spread of cellular phones. Currently, in addition to being an information terminal with mail and Internet functionalities, the cellular phone has been developed to serve as a multimedia terminal, providing photographs, music, games, etc. According to statistics provided by the Ministry of Public Management, as of 2004 (white paper, 2004), the number of

cellular phones had exceeded 80 million, and no less than 89.5% of these phones had an Internet terminal. Thus, it can be considered that many people use cellular phones for their mail and Internet functionalities. Following this trend, cellular phone usage has changed greatly from the notion of 'The Flashy Peacock' in the 1980s.

We will now demonstrate the practical application of a cellular phone in business, including the changes that have taken place in the past five years.

Ethnography of a Mobile Worker: Three Fields of Mobile Work

In the past five years, we have investigated various workplaces. In this paper, we focus on mobile workers and cite examples from the following three case studies on their ethnography. The outline of the three fields of work and the investigation methods are described below.

Mobile Sales

In 1999, we investigated the sales operation section in a certain office equipment manufacturing company. The sales representatives of this section mainly sell office equipment such as copiers and printers. In order to enhance the abilities of the sales representatives, the work style was strategically reformed—they were provided with mobile technology in the form of notebook PCs, cellular phones and secure ID cards. These mobile tools enabled them to work at anytime and from anywhere (Figure 1). The number of visiting customers was therefore expected to increase significantly. The concerned section was located in central Tokyo, and their sales territory extended from the central area to the suburbs. Most sales representatives commuted either by train, on foot, or by motorbike, but those responsible for the suburbs mainly commuted by car. Although sales representatives are essentially mobile workers, they visited their office and met their colleagues in person in the morning, visited customers in the day and returned to the office in the evening. However, with the introduction of mobile technology, they were able to connect to an intra-network from any customer site or distributed office. The purpose of mobile work was to reduce various lead times and improve sales efficiency.
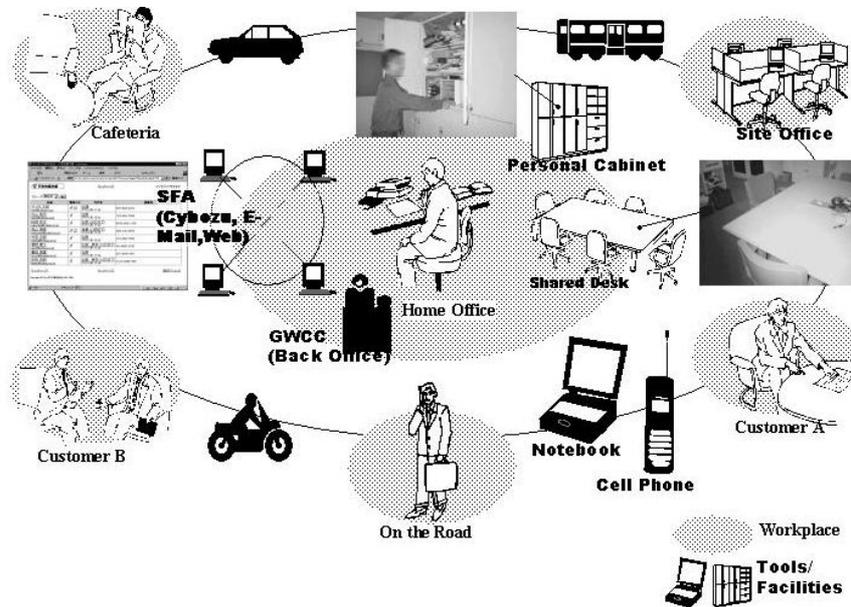
Figure 1. Mobile work environment of the target sales section

This investigation was conducted for about two weeks in 1999 by using the 'self-photo study' technique (Tamaru, et al., 2002; Hasuike, et al., 2003). In this study, each sales representative was provided with a disposable camera and was requested to photograph their workspace, tools, documents and coworkers during a typical work day (Figure 2). Interviews were conducted at a later date on the basis of the photographs, where the workers were questioned about the nature of their work, the use and applicability of the documents and technologies, etc. The subjects comprised three sales teams and nine sales representatives.
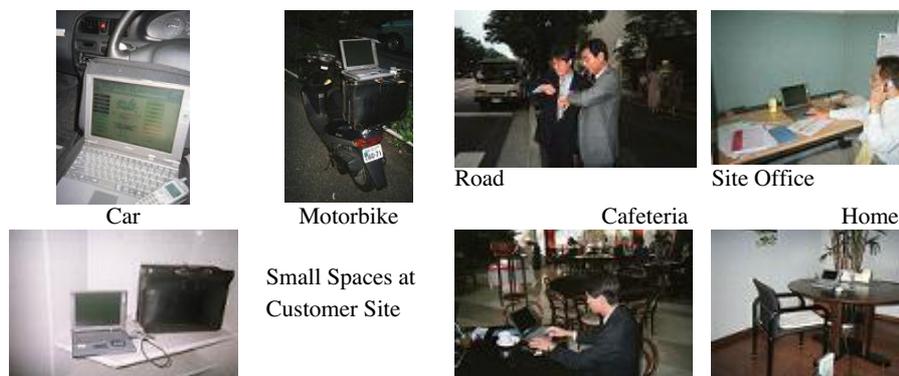

Figure 2. Various workplaces for mobile sales (photographs taken by sales representatives)

Service Technicians

For the second field of work, we investigated the repair and maintenance section of a certain office equipment manufacturing company. The investigation was conducted over five years from 1999 to 2004 (Ueno and Kawatoko, 2003). This section is responsible for the maintenance and repair of equipment such as copiers, printers, etc. and the network systems connecting these pieces of equipment. Workers from this field are also essentially mobile workers. When they receive a customer's request for repair, they visit the residence/office of that customer to fix the machine. Although their work mainly entails individual service at the customer site, they are also involved in various other team activities because all team members are responsible for maintaining the area that has a profusion of customers and machines. One team comprises five to ten service technicians.

Figure 3. Self-dispatch system (display example of notebook version)

A unique cellular phone Web application has been introduced for the workers of this section. They carry a cellular phone that serves as a Web terminal in order to use a mobile application called 'self-dispatch system' (Tamaru and Ueno, 2005). They voluntarily coordinate their schedule for visiting customers using this mobile application. The self-dispatch system visualizes the calling lists (which indicate the status of the repair jobs) and the technicians' visiting lists (which indicate the statuses of the team members) (Figure 3). Using this system, team members can infer the location and status of their colleagues.

The primary mode of transport in central Tokyo is a motorbike. Service technicians carry small replacement parts, manuals and a notebook PC on their motorbikes. In the suburbs, they commute by car.

We conducted a shadowing investigation to understand the activities at the client site. This investigation was carried out for one month each in 1999, 2002 and 2004, and in each of those years, we observed several service technicians. In addition to shadowing, we conducted interviews in order to gain a greater

understanding of their activities. We interviewed several tens of people over the five years, such as service technicians, a technical specialist, the developer of the self-dispatch system, etc.

Office Design Company Sales

The sales section of an office design and furniture supplier company was investigated in 2004. The section under consideration mainly deals with office design rather than furniture supply. The sales representatives handle a wide range of activities—office layout design, construction and relocation.

The role of the sales representatives is to investigate the needs and problems of a customer, provide consulting services, propose new ways of working and recommend designs for advanced workplaces that tackle all the problems faced by a customer (Duffy and Powell, 1997; Zelinsky, 1998). These representatives deal with several issues, such as working styles, office layouts, document management, information infrastructure, etc. On receiving an order, they coordinate with the members of various workplaces, such as information infrastructure vendors, office furniture companies, designers, office equipment companies, construction contractors and building management companies. Sales representatives serve as project managers who facilitate the smooth completion of a project.

The team size of the concerned section is quite small, including only three sales representatives. Their service territories mainly lie within Tokyo and they commute primarily by train or on foot. Similar to the mobile sales investigation, we conducted a self-photo study in this investigation. In this case, we requested the representatives to photograph their work activities for one week—not only mobile work but also activities conducted in the office (Figure 4). Individual interviews were held subsequently. We then conducted a meeting with the sales representatives to discuss the data recorded by each member. During this meeting, the team members realized the differences between their own roles and those of their colleagues and further discussed these differences.

Meeting at a home office

Connect with a customer via mobile mail while commuting in a train

Meeting at a construction site

Telephone at a representative's desk

Figure 4. Work activities of the office design company's sales representatives (photographs taken by sales representatives)

Three Points of Interest

Since the time of the investigation and the fields of work of the above-mentioned case studies are different, we cannot draw a simple comparison among them. However, we proceed by discussing the relationship between mobile work, mobile technology and mobile workers. Furthermore, we discuss how these relationships have changed in these five years by citing characteristic examples from the three case studies. We now describe the viewpoints emerging from the above discussions.

(1) How people changed the way they organized work by cellular phones or how people accepted cellular phone technology and successfully applied it to their work

The introduction of cellular phones has evidently exerted a great influence on the way of working. However, working styles have not necessarily changed with the emergence of cutting-edge technology. People are constantly seeking creative ways of selecting the appropriate technology and applying that technology to their work activities. In this paper, we have focused on the creative ways in which mobile workers have suitably applied cellular phone technology to their work.

(2) How people reorganize the relationships with their coworkers using cellular phones

A mobile worker does not usually function only at an individual level. As a member of an organization, s/he has to maintain relations with colleagues; however, the strength of these relations may vary. In this paper, we discuss how mobile workers connect with their colleagues in a distributed work environment and how they reorganize their communication patterns using cellular phones.

(3) How workers connect with their customers using cellular phones and how this has effected a change in customer relations

Mobile technology has significantly influenced not only relations with colleagues but also customer relations. The relationship between a worker and a customer is essentially the same as that between the organizations to which they belong. We discuss the influence of mobile technology on the relationship between a worker and a customer and how their organizational relationship has changed with the introduction of cellular phones as a personal communication tool.

Reorganizing the Way of Working by Means of Mobile Technology

In this section, we discuss the manner in which mobile workers reorganized their working styles using cellular phones by citing examples of mobile sales representatives and service technicians.

Task Delegation by Sales Representatives

By changing to a mobile work style, sales representatives were able to work from anywhere outside their home offices. They could work not only from fixed workplaces such as at a site office or a car but also temporary workplaces such as the road and in small spaces at a customer site. However, it is difficult to accomplish a time-consuming task from a temporary workplace. When sales representatives work outside their home offices, the back office plays an important role in coordinating their actions. Sales representatives are accustomed to organizing their tasks by means of task delegation utilizing back office functions and mobile tools (Figure 5).
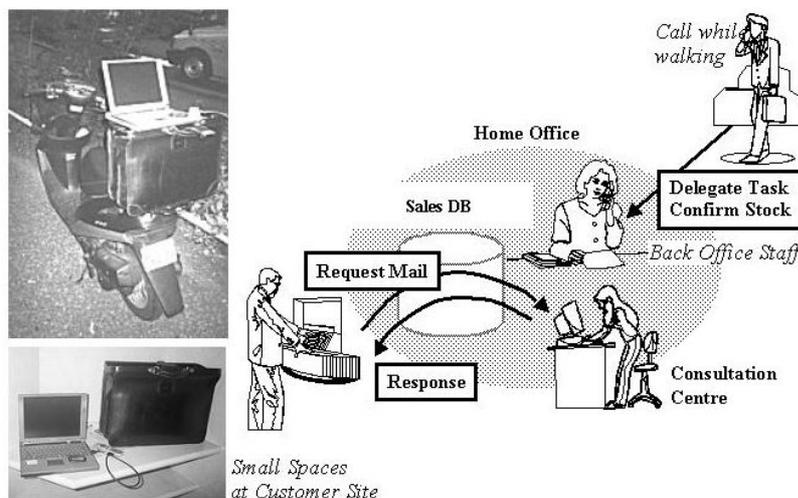

Figure 5. Work organization by task delegation

Delegation to office staff by means of a cellular phone

Upon receiving an order from a customer, a sales representative creates a shipping order after returning to her/his home office. If the stock is verified before returning, s/he can complete the shipping order smoothly. When requesting for an order outside the home office, s/he delegates a check task to a back office staff member via cellular phone. By doing this, s/he can work efficiently from the

home office. Of course, at present, it is possible to check the stock via current cellular phone technology; however, the sales department did not employ such technology in 1999. Although restricted by technology, sales representatives developed creative methods for checking stock. By means of cellular phones and appropriate task allocation between the back office staff and themselves, they could carry out a pseudo inventory check anytime and from anywhere. This approach equalled the current technology of carrying out an inventory check using only a cellular phone.

Delegation to a consultation centre via electronic mail

When calling on customers, sales representatives are often asked various questions. However, certain questions cannot be answered immediately. After the visit, the sales representatives forward the questions to a consultation centre (which provides the necessary information to the sales representatives) via electronic mail by setting up their notebook PC in a small space at the customer site. In most cases, the centre replies to the sales representatives by the time they reach their home offices, and the sales representatives can then immediately forward the required information to the customer by e-mail. If the sales representatives were required to search for this information by themselves, the information would reach the customer on the following day at the earliest. In the case described above, the turnaround time is reduced by 'delegation'. Through the combination of back office assistance and mobile tools, sales representatives can dedicate themselves to more pressing tasks. Here, a cellular phone functions as a data communication terminal to access to the intranet.

In these two cases, sales representatives organized their tasks using not only mobile technology but also other resources, such as human resources. This is a key factor in successfully applying the new technology to their work (Brown and Duguid, 2000).

Parts Supply by Service Technicians

The method of supplying replacement parts has changed due to the occasional application of cellular phone technology. Here, we describe how service technicians reorganized their work entailing parts supply by using cellular phone technology.

Bottom-up approach among team members

As stated by J. Orr (1992; 1996), service technicians usually troubleshoot according to the problem at hand rather than completely relying on a manual. They structure an effective repair method depending on the status of the territory they cover and the status of the problem. However, procuring replacement parts often hinders the efficient execution of the repair method. If unable to obtain replacement parts when visiting a customer, they only perform emergency

measures and revisit the customer upon obtaining the necessary part to carry on complete repairs.

Since numerous models and types of machines exist, it is difficult to carry along all types of replacement parts. Service technicians attempt to guess which parts will be required before the visit by evaluating the self-dispatch system or directly contacting the customer to enquire about the status of the problem. However, their ability to make an accurate guess is limited due to inadequate information. Therefore, efficient supply of parts to the client site is essential.

A basic method of ensuring parts supply is to contact a parts warehouse. They supply the required parts via a motorcycle delivery service. However, service technicians work at distributed sites. Thus, when the client site is at a distance from the parts warehouse, the supply may get delayed. This entire process is sometimes time-consuming. To avoid a delay in service, the technicians utilize the self-dispatch system that allows them to track the statuses of their team members to determine who is nearest to them at that time. They then call the nearest colleague to enquire whether s/he has the required parts. If available, they coordinate the method of transferring the parts. Apart from the parts supply system established by an organization, service technicians have created their own new method of parts supply.

Since team members can track each other's statuses on the self-dispatch system, it is important that a technician strategically follow her/his coworker's network without making reckless calls depending on only her/his personal network. In addition, the essential function of cellular phones, which is to connect individuals, promotes the coordination by effectively linking distributed colleagues. These two points support the organization of the bottom-up collaborative approach for parts supply.

Centre Approach for parts supply

Recently, a new cellular phone application for parts supply was introduced. The parts management system is centralized and uses a parts database. With this system, a service technician calls the central warehouse, which searches the database and locates the nearest warehouse that has the required parts. The parts are then delivered to the client site. By utilizing the GPS function of a cellular phone, this new application maps the parts delivery process with respect to the service technicians on a particular network. Once the parts are dispatched from the warehouse, the service technician receives a mail on her/his cellular phone providing tracking information such as the current location of the required part and the time it will be delivered. Since this new tool enables an accurate prediction of the delivery time, service technicians have developed a sense of security and are now capable of planning their work more efficiently.

It is speculated whether this new method of parts supply is quicker and more efficient than conventional methods. Irrespective, this method has certainly

imparted a sense of security to service technicians. The ability to predict the delivery time of the parts has significantly facilitated the ease in planning work. In the former bottom-up approach, since it was difficult for technicians to carry many parts with them, their colleagues, too, did not usually have the parts they required. They would therefore frequent warehouses of nearby back offices to obtain the required parts. The probability that a technician can acquire replacement parts from her/his colleagues is, in fact, rather low. However, such methods were only resorted to because of the anxious feeling of 'procuring the parts as soon as possible', even if it would be faster to directly return to the back office in a calm and rational fashion. On the other hand, the purpose of the new tool is to not only reduce the waiting time for parts but also facilitate efficient time management at the client site. The use of GPS enabled an accurate prediction of the delivery time and thus enabled technicians to devise effective repair plans. Therefore, it can be said that GPS played a large role in organizing the way of working and in reassuring a technician.

Communication with a Colleague

A cellular phone is essentially a communication tool that connects people. Similar to mobile workers, people who work at diverse locations can contact their coworkers via cellular phones at any time. In this section, we describe how the relationship among colleagues and their patterns of communication have changed over the past five years.

Informal Collaboration Work by a Self-Dispatch System

At a basic level, service technicians work as a team. They can constantly track their team members by using a self-dispatch system and are conscious of the existence of their colleagues as they work. On one occasion, a technician (A) consulted the self-dispatch system and called his colleague (B) who was working in a company (C). A had previously visited C and had fixed a machine there. Although he might have resolved the problem, he remained somewhat anxious. However, upon referring to the self-dispatch system on the current occasion, he learnt that the same machine (at C) was giving trouble again and that B was working on it. A became increasingly anxious and telephoned B to enquire whether the same problem was encountered. Thereafter, it was revealed that it was not the same problem.

Thus, service technicians are conducting collaborative work informally using the self-dispatch system on a cellular phone. This mapping of a colleague's location and status facilitates collaborative work. Moreover, the communication function of a cellular phone aids technicians in establishing a direct link to their colleagues.

Communication by Mobile Mail

Initially, mobile mail was not adopted in the workplace, but this has changed over time. Although mobile mail was available since 1999, it was seldom used in business. As the use of mobile mail gradually increased among common users, many service technicians began using this function for personal purposes. Moreover, their organizations recommended the use of mobile mail as it proved cost effective. In such a scenario, some technicians began using the mail function for various purposes, e.g. connecting with a colleague, posing a question, connecting from a back office, etc. The exchange of mail messages had explicit purposes such as arranging for certain parts to be collected or even organizing lunch meetings. In this manner, service technicians who are familiar with mobile mail and use it in their personal life pioneered the use of this function in their team communication.

Collaboration using the 'multiple addressing mail' function

In 2004, the use of mobile mail became widespread and the number of people fully acquainted with the use of a cellular phone increased. In such a situation, its practical functions transcended individual use and permeated the realm of business. The 'multiple addressing mail' function can be cited as an example. Similar to mailing lists on the Internet, this function enables a mail to be transmitted simultaneously to all registered members. Upon discovering its convenience in personal use, the head of a certain team was keen on using this function in his work. He therefore introduced it to his team members and promoted its use.

At the time of observation, the team had been using this function for two months. However, it was obvious that this function had transformed the conventional communication pattern (individual network) among team members. While the tool remained unchanged, it could now link all team members. Earlier, questions could only be exchanged between two individuals; however, the multiple addressing mail function enables all team members to share messages and learn about problems simultaneously. When one technician is unable to resolve a confounding issue, another who has a solution can transmit it to the colleague. This also allows other technicians to learn about the types of problems encountered in their field and thus increase their knowledge. In this manner, an individual query is shared among all team members via the multiple addressing mail function.

Furthermore, they occasionally send messages like 'Today, I (A) will spend all day with a specialist (B) at the client office (C) because of a severe problem. I'm sorry for the inconvenience.' Until now, such information was only available to them indirectly via the self-dispatch system; however, by sending such messages, they receive this information directly. Such information increases awareness of team members, and it is interpreted as 'We should support A because he is unable

to visit other customers.' This usage of mobile mail clearly differs from the conventional method. A similar situation was observed in the usage of the self-dispatch system. However, it should be noted that the multiple addressing message function is not a specialized tool like the self-dispatch system but a basic function of mobile mail.

The salient features of the multiple addressing mail function are as follows:

- Transmitting messages to all members enables the sharing of problems, statuses of team members and, of course, troubleshooting information. The conventional mobile mail is shared only by people who exchange messages. Note that these two functions have different capabilities.
- Team members began to exchange messages that do not require individual replies, such as context and awareness information.

As mentioned above, mobile mail, which was initially only a communication tool linking people (colleagues), has now become a collaboration tool realizing a shared context within a team and enabling informal collaboration work among service technicians.

Chat Meeting by Mobile Mail

The next example of communication among colleagues involves three project members managing the construction of a new office. The three members usually planned to meet in the morning. On one occasion, one of the members sent a message by mobile mail saying, 'I will be late for the appointment.' However, the other two members had already reached the office. The delayed member was expected to reach the office an hour later by train. As soon as they received notification of the delay, the three members began exchanging mails such as 'How did yesterday's proposal go?' and 'Please reply with the details at the earliest.' This form of communication was similar to a chat but via mobile mail. By chatting via mobile mail, the members had covered all the points on the agenda for the meeting that morning.

Two of the three members of the concerned project were mobile workers working in different time zones. Thus, coordinating a meeting was difficult. Usually, two of the members arrived at office early while the third was delayed. Since the member who usually arrived late commuted by train for an hour in the morning, s/he effectively utilized this time by communicating with the other two members via mobile mail. This frequent exchange of mails could be considered as a chat meeting. In this case, an advanced function such as multiple addressing mail was not used, but the ordinary mobile mail function was used for chatting in a short span of time. Thus, mobile mail facilitated a pseudo-remote meeting. Hence, this form of communication, which was conventionally used to connect individuals, has again been demonstrated as a collaboration tool used to efficiently conduct a remote meeting.

Worker–Customer Relations

In the preceding section, we described how mobile technology effected a change in the communication network among colleagues. In this section, we describe how mobile technology has affected the relationship between a mobile worker and a customer. When sales representatives are scheduled to visit a customer, they first call the customer to enquire whether it is suitable for them to visit the customer's office. In this regard, the cellular phone was a very effective tool in maintaining customer relations. However, the relationship between a sales representative and a customer is essentially the same as that between the organizations to which they belong. Therefore, as noted above, when a customer requires certain services, s/he calls the office of a sales representative and not the sales representative directly. In a similar manner, a sales representative does not divulge her/his personal cellular phone number to the customer. The customer's query is received via the back office. However, with the complete proliferation of mobile technology, a new trend is emerging with regard to worker–customer relations, as demonstrated by the following example.

Customer Directly Contacts the Sales Representative

A sales representative of the office design company checks her mobile mail while commuting to work by train. In this case, she has just taken charge of a new project of relocating a certain office. She is very busy and is continuously travelling from one location to another. For this reason, her customers and colleagues complain that she is often inaccessible. She has therefore provided the project members with not only her cellular phone number but also her cellular phone mail address. They can now be assured of contacting her via mobile mail, even when she is visiting other customers or commuting. The client of the new project had several concerns and frequently communicated with the sales representative via mobile mail. On one occasion, her phone signalled the arrival of a new mail after midnight; however, since it was very late, she did not check it at that instant. When checking her mail on the train the next morning, she noticed that the mail she received the night before was from her client and promptly replied. Such an occurrence is fairly common. Occasionally, the exchange of mails would lead to a chat meeting, similar to the above-described communication with a colleague.

'I am worried about the security of our entrance. Is there any solution?'

'Did you manage yesterday's problem? Please reply as soon as possible.'

'I received the solution from the building maintenance company a little while back. I will send the formal report by FAX.'

Such exchanges of messages were frequent. Exchanging messages for a short span of time is similar to conducting a meeting. Thus, since mobile workers are constantly on the move, e.g. at customer sites, it is difficult to contact them.

Therefore, many people find it easier to contact mobile sales representatives via mobile mail rather than phone calls. This led to sales representatives gradually providing customers with their cellular phone mail address.

Thus, the relationship between a customer and a sales representative was transformed into that between two individuals rather than two organizations. In this manner, mobile technology has shifted the relationship between a sales representative and a customer from an organizational level to an individual one. As mentioned above, mobile technology has especially effected changes in the style of communication—'from a communication tool for individuals to a collaboration tool for a team', 'from an organizational relationship to an individual one'.

Implications

Effective Utilization of Existing Social Infrastructure

From the viewpoint of adapting to the new tool, the process of introducing cellular phone application tools that use the GPS function is of great interest. The number of advanced trials carried out for physical distribution systems, which are used to track and map the current status and location of replacement parts, has been increasing over the past few years. For example, some systems use the IC tag technology for tracing. However, such systems require newly built infrastructure, which requires immense investment. However, systems using GPS have the following characteristics.

(1) Cellular phones have already spread in the market and many of them are GPS enabled.

(2) This system does not directly trace replacement parts. Instead, it tracks people carrying a GPS-enabled cellular phone. It is based on the idea that 'the replacement parts are carried by people'.

On the basis of these two characteristics, it is important to introduce such systems without changing the infrastructure. Cellular phones are already becoming the basic infrastructure of the social communication network system. Therefore, by effectively utilizing the existing infrastructure of mobile networks and terminals, the swift construction of a cost-effective system became possible.

With regard to task delegation of mobile sales representatives and the bottom-up approach for parts supply by service technicians, each worker effectively applied cellular phone technology to her/his work environment. The example depicting the use of cellular phone by a central warehouse for supplying replacement parts demonstrates how an organization can effectively structure a new task by successfully integrating existing organizational work and social

infrastructure. It is thus important for individuals as well as organizations to adapt to cellular phone in order to structure their work effectively.

Lightweight Collaboration Tool

Earlier, the cellular phone was used as a communication tool connecting individuals with individuals. However, the latest trend is that cellular phones play the role of a 'collaboration tool' and not a 'communication tool' (Churchill and Wakeford, 2002). As demonstrated by the example of service technicians, cellular phones are used to share a gamut of information and contexts required for teamwork, which is very different from a tool that links only individuals. Cellular phones support communication, information sharing and context sharing among team members. This is in complete agreement with the aim of CSCW technology.

This also applies to the use of cellular phones for chat meetings. Cellular phones need not offer a remote meeting function for this type of usage. Large-scale CSCW technology that connects remote locations through multimedia applications via broadband is not suitable for mobile workers. Rather, a cellular phone that simply connects an individual with an individual and transforms itself into an ad-hoc remote conference system is preferred. A mobile worker can use this lightweight meeting system anytime and from anywhere, which is more convenient than a complete remote conference system.

Thus, by the creative usage of a worker, a cellular phone now plays the role of a collaboration tool rather than a communication tool.

Importance of Long-term Interaction between Cellular Phone Technology and Usage

As observed in the case of parts supply, the new technology has changed a service technician's way of work. This technology has gradually permeated the entire working world and led to the creation of a new way of work. As mentioned above, service technicians can identify the location of a certain part using a self-dispatch system. This gives rise to the need for a system that visualizes the current location of a part. The new GPS parts system satisfies this need. In addition, this system is advantageous in terms of the ease in planning work and provides a sense of security. This system and the way of work have evolved mutually.

Such interaction is also visible in communication among service technicians. Although initially hesitant towards the use of mobile mail, service technicians soon recognized the potential of this feature. Its advantages became apparent with the introduction of new functions such as multiple addressing mail. Thereafter, mobile mail was accepted by service technicians. Thus, it is important to examine the manner in which technology and its usage mutually influence each other and evolve by adaptation.

Summary and Conclusion

Sales representatives and repair technicians are essentially mobile workers. They constantly visit customers and work at customer sites. Their workplace is not a fixed office; rather, they work at various locations such as customer sites, coffee shops, trains or cars. However, they never work in isolation but as part of a team, always maintaining contact with coworkers, superiors, project members and customers.

Technological support is an essential component for the mobile worker whose nature of work entails being on the move. Although CSCW technology had evolved to support people working in different workplaces, conventional full-featured CSCW technology that integrated broadband networks and multimedia technology did not necessarily suit a mobile worker's working style. Instead, recently developed cellular phone technology enables mobile workers to organize their work more efficiently. By effectively utilizing human resources, including coworkers and support staff, mobile workers have successfully adapted cellular phone technology to their work.

Furthermore, although cellular phones do not directly support remote meetings, mobile workers often conduct these meetings using mobile mail as a chatting tool. Such usage was promoted by the mobile mail characteristics of 'being contactable at any place and being lightweight'. These features enabled mobile workers to restructure their work efficiently. This suggests that the conventional full-fledged CSCW technology would not be able to sustain a mobile worker's working style. A cellular phone is a simple communication tool; it can thus promote the reorganization of work by effectively utilizing social and human resources.

Moreover, the proliferation of cellular phones has effected a change in not only the working style and communication pattern but also the relationship between mobile workers and customers. Essentially, the relationship between a customer and a sales representative is inter-organizational. However, sales representatives contact customers directly using a cellular phone, which is a tool to connect individuals. This has led to communication using mobile mail. This concept of 'calling sales representatives directly' is very different from 'calling sales representatives via a company'. A cellular phone is owned by an individual. Thus, customers and sales representatives can connect with each other anytime and from anywhere. Although mobile workers have now established certain boundaries between their work and private lives, such changes will affect the relationship between a company and a worker.

In this paper, we describe the manner in which cellular phones can be used in the workplace based on ethnographic data from three fields of work and discuss how cellular phones have affected the communication pattern and working style of mobile workers. In future, we will discuss the design of cellular phones for

business use and will also consider the interaction between technology evolution and the changes necessary for long-term usage.

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