

Talking about new technologies: when new technologies are introduced into the workplace

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Introduction

Japanese electronics industries as in personal computers, mobile phones and digital cameras had experienced technological innovations in the late 20th century, with the introduction of IC-logic as its beginning, followed by computerization and digitization of machinery in 80s and networking in 90s. The advent of small-sized, multi-functional, and mobile electronic media has degenerated our time and space, and forced us to reorganize the relationships both with other people and things & matters. In the storm of those technological innovations, how have technicians near production fields experienced 'new technologies' and talked about the issues?

Carolyn Marvin (1988) exposes through people's discourses in the late nineteenth century how the invent of electric media had given impact to the communities. Marvin describes how "patterns anchored in older media that have provided the stable currency of social exchange are reexamined, challenged, and defended (p.4)." Then she points that the introduction process of new media into the society is " a series of arenas for negotiating issues crucial to the conduct of social life; among them, who is inside and outside, who may speak, who may not, and who has authority and may be believed (p.4)." She irradiates socio-technical reconfiguration of the world, the human relationships, and the regular pattern of people's lives around new electric media those days: the telephone, phonograph, electric light, wireless, and cinema.

The similar kind of phenomena as Marvin showed in the introduction of 'new media' has happened in the case of 'new technologies'. The introduction of new technologies is considered as new practices in which social boundaries in older technologies that have provided the stable currency of social exchange are reorganized, and in the reorganization processes the struggle and conflicts of groups are most easily observed.

In the early 80's, Japanese metal parts manufacturing factories brought in CNC lathe machine into their work places one at a time. Those days Japanese economy reached the peak. Mass production of metal parts was sweeping across manufacturing factories. Not a few factories cleaned out their cam-lathes or ordinary lathes to change over to CNC lathes. Some discourses about 'deskilling' were diffused around the scene of Japanese manufacturing such as; "With the advent of CNC lathe, no more expertise are needed." or "Just anyone who can make computer programming will be able to process precision metal parts."

However, not every factory changed all machine from traditional lathes to CNC lathes. Naturally there were a few factories using both traditional lathes and CNC ones. Especially the factories being ordered high precision parts by customers, or the factories being intent on giving young technicians a good training showed a strong tendency to use both types of lathes side by side. SB-factory (Kawatoko, 2000) produced high precision metal parts, using CNC lathes, cam lathes, and old lathes jointly. In this factory, whenever they disassembled or repaired cam lathes, they had young CNC lathe men join the work. They explained how it came about as follows: it is essential to understanding the workings of a machine including a CNC lathe for lathe men to learn the mechanism of a cam lathe on which the relationship between the movement of cutting tools and the cutting is directly seen. At this occasion,

young lathe men had another opportunity to compare old technologies with new ones, being exposed to the stories of old technicians who were well versed in old machinery. In this way, SB-factory used the knowledge and technology of an old cam lathe to learn skills of a new CNC lathe. Against the prevailing discourse as "Just anyone who can make computer programming will be able to process precision metal parts", the factory manager mentioned as follows; "You cannot write an efficient program, unless you have an operating skill and knowledge about a cam lathe. Even if someone without the skill and knowledge of a cam lathe writes a program, the program will be too long or too complicated to be of use."

When the new technology, automatic lathes by computer programming, had come on metal parts manufacturing, two types of factories appeared on the field. The one is a factory that the new technology has broken up a traditional pattern of socio-technical relationship in the way of the new technology being superior to the old technology. The other is a factory that the new technology has done much for reorganizing a new socio-technical relationship in the way of the new technology dragging the old one in. What is the difference between the two factories, that is, the two manufacturing communities? In the case of SB-factory, the relationship among human and non-human factors such as the relations between old technicians and new ones, knowledge and technology around old and new machines, customers' requests for high precision, and the policy of managers were different from those in other factories. Callon, M. (2004) would say that the difference between the two factories resides in the ways of socio-technical configuration of hybrid collectives constituted of human and non-human actors.

The introduction of CNC lathes into manufacturing industries illustrates two things. First, new technologies are

given new social meanings from the ways of socio-technical configurations in each community, simultaneously while the new technologies reorganize socio-technical arrangements of the community. Second, both various discourses concerning the introduction of new technologies and the ways of talking about it have something to do with the ways of configurations of human and non-human factors in each community of practice where new technologies are introduced.

This study takes up how copier's repair technicians talk about the technological innovations in copiers initiated in 1970s and the consequent changes of their repair techniques. By doing so, I try to figure out the following things; Under what kind of socio-technical arrangements have the new technologies such as IC-logic, computerization, digitization, and networking been given new social meanings? ; What kind of social meanings have been give to the new technologies? ; And how have the new technologies worked on reorganizing social relationships between human and non-human factors in the community concerned?

Technician's talks are part of their practice in which they protect or reorganize their social boundary concerning technologies. In the succeeding chapter, old and new repair technicians talk about old and new machines, and the changes of their repair techniques with fellow technicians and interviewers. Their talks make their social and physical distance from new machines and technologies visible, simultaneously while the social distance and boundary among technicians are gradually made visible and organized. In the storm of technological innovations in Japanese electronic industries, how have field-technicians formulated "new technologies" in relation to their own works? I examine this question from the point of view that technicians' ways of formulation are mutually constructed with the ways of

socio-technical configurations of their communities, in which the technicians themselves are part of them.

Technicians' talks as the practice of protecting or reorganizing social boundary concerning technologies

1. Technological innovations concerning copiers and the consequent changes of repair works

KJ Co. entered upon a new phase of the digitization of machinery and the unit construction system in early 1990s. The function of digitization has been extended to the whole driving systems in every model of a copier. This has become possible for a repair technician to monitor the behavior of main parts of the systems on the screen. The unit construction system has been installed not only in mechanical parts but also in electric systems in the form of a circuit board. Nowadays if there is a problem with the functioning of main parts, an electronic board and all is entirely replaced without specifying which part is wrong.

The digitization of machinery and the unit construction system have brought two epochs in the operation of a machine by a repair technician. A technician had used to check trouble points of both main parts and electric circuits all by his hands with a 'tester'. There used to be a lot of technicians who listened to the sound of paper-feed and the rhythm of a machine, judged what was wrong in the machine, and checked it with a tester. Today there is no need for a technician to check and specify machine problems relying on his "intuition and knack". The trouble of a machine is diagnosed automatically with IC (Integrated electronic Circuit), and diagnostic contents are displayed on a monitor. Besides, a repair technician is provided with a manual to read a monitor screen.

Moreover, such occasions that a technician directly touches on the interior of a machine have extremely decreased. Those machines installed new technologies are all "black boxes" that can't be taken apart and just have to be replaced when they break down. It looks as it had become unnecessary for a technician not only to touch on the interior of a machine but also to understand the mechanism of it. These days when repair technicians talk about the change of their repair works, they often bring up the subject that they have no longer handled a tester on their service fields.

2. "Technicians no longer put a tester into a tool bag!"

In the following discourse, an interviewer (YK) asks both the repair technicians on active service (Saka, Oota) and the former repair technicians in the post of manager (Tana, Hase, Kaki) about the use of a tester past and present.

<Transcript 1: the use of a tester past and present>

1. YK: About when was it that you used a tester to repair machines?
2. Tana: Well, they still use it...
3. Saka: (looking to Tana) *We no longer use it!
4. YK: *Do you still use a tester?
5. Saka: We seldom use it now.
6. YK: Around which model did you leave off using a tester?
7. Saka: Um, I'm not sure, but at the model 500, we still used it...
8. YK: Ok, you still used it at that time...
Then, you've stopped using it, since machines were digitized?
9. Oota: In fact, it is since the 'diagnostic' function was loaded on a machine. With this function, if you feed

some number into a machine, you can operate each part of it separately. As loaded such kind of function on a machine, the use of a tester has rapidly decreased.

10.YK: With this diagnostic function, you can locate the spot of trouble, can't you?

11.Oota: Yes, in most cases.

12.Hase: But, we were using a tester even after the load of diagnostic function, weren't we?

13.Kaki: Oh, yes, yes, yes! We used a tester! Struggling to fit it this way and that way, perfectly! (going through the finger motions)

14.Tana: By the way, Saka says, "Technicians no longer put a tester in their tool bags." I wonder since when?

15.Saka: It might be around 2000, or so, I think.

16.Saka: Whenever we exchanged parts, we had to adjust the next part to the targeted part. For that, we had mainly used a tester. Sometimes we had also used it to test if the power was on or off. But, nowadays, there's no need to do such things. So, I haven't put a tester in my tool bag since a couple of years ago.

17.Oota: No, we still need a tester once in a while. But actually, it's extremely rare. So, everyone tends to say that he no longer carries it.

18.Hase: They now use it only for measuring a voltage of the power, don't they?

19.YK: The change of the design could have an effect on the tendency to quit themselves using a tester?

20.Tana: Yes, I think so.

Inherent skills to the hard(mechanism) used to be required before. However, since the electronic board replaced electric parts, the individual difference in skills in handling a tester would have been revealed.

21.YK: I see.

22.Tana: Now, there are either technicians who can follow the signal with a tester, or technicians who use a tester only for measuring a voltage.

23.YK: Technicians have only to replace boards and all?

24.Tana: Yes. They just exchange boards and all.

To be fixed or not is simply wisdom after the event.

One of the senior technicians uses gestures of handling a tester as he talks about it, showing nostalgic feelings for his skill. The repair technicians on active service, Saka and Oota, talk about a 'tester' in their respective ways. Saka speaks how a tester has become unnecessary for field technicians, by repeating, "we no longer use it". As oppose to Saka, Oota claims that a tester is still necessary once in a while, even though he admits that the frequency in the use of a tester has drastically decreased. In the early part of the transcript, Oota talks about the use of a tester in the context of following up on the cause of a trouble and giving a diagnosis of a machine. Saka looks back on the past to say that he used a tester mainly for measuring a voltage of the power. Saka does not put a tester under the context of the identification and diagnosis of a machine trouble. Those differences in how they position a tester in the socio-technical arrangements of their repair work become visible in their different ways of talking about the use of a tester.

Tana, a senior technician in the post of manager, suggests that there is a distinct difference in skills of the use of a tester among active repair technicians. And he refers the appearance of electronic boards to making those individual differences visible. The electronic board is the core of a copier. Following up signals of a board means by controlling the mechanism of a machine. Here, Tana talks about the individual differences in the distance between a technician and

the core of a machine, namely, how deeply a technician can enter into a machine and touch the mechanism of it.

3. "The sphere we could take a hand in a machine was getting less and less....."

In the following discourse, two senior technicians, Tana and Kawa, talk about that the digitization has completely changed the way of the adjustment of a machine. Through their discourses, the change of the distance between a technician and a machine is also referred.

<Transcript 2. The change of the distance between a repair technician and a machine>

25.YK: Is it 1995 to 96 that you've begun to exchange an electronic board and all?

26.Tana: Yah... What shall I say...In the period of transition from the analog to the digital, I am afraid that the sphere we could take a hand in a machine was getting less and less.....When would it be, that transition period?

27.Kawa: When I was in charge of model 8000, I had to make fine adjustment to a machine with a tester, every time I exchanged the board.

28.YK: I see. You mean that just doing exchange had not been enough at all, don't you?

29.Kawa: That's right! For example, as the voltage of A,B,C was different each other, I always made adjustment and setting with a tester, while dropping the valtage with a mini-driver. Now, we can adjust the voltage all on the monitor screen. In this sense, technological evolusion proceeds amazingly!

30.YK: Yes, it is! you can operate everything on the screen,

can't you?

31.Tana: Yes, indeed! In a digital machine, everything is displayed on the monitor. As there were no displays in the past, we had adjusted everything with a tester, either an electrical belt of charge that draws toner of the dram, or an electrical current. Now, a technician controls everything, connecting a PC and feeding numbers into it. Lots of things are changing, aren't they?

Giving an instance on the adjustment of electrical parts, senior technician, Tana says that the past technicians had controlled a machine by touching on it with a tester. Another senior, Kawa compares past with present in the ways of fixing machines, citing the examples of both exchanging an electronic board and all, and monitoring diagnostic codes to feed numbers on a PC. Their talks mean that there is no need to do the old ways of operation, now, in which a technician used to open the interior of a machine for figuring out the point of a trouble and touch on it directly to make sure what was wrong. The distance between a technician and a machine has actually become far.

Tana also claims that with a diagnostic function being installed in a machine, there has been little room for a technician to control even a small risk of a machine by himself. In response to the interviewer's simple question of the era in the beginning of this transcript, Tana regretfully says, "The sphere technicians can take a hand in a machine has been getting less and less". What Tana regrets is clear from his subsequent talks. He regrets that nowadays the room for a repair technician to control a machine has been decreasing. In other words, he regrets that the distance between a technician and a machine has been getting far and far.

4. "If only follow a manual, everyone can fix a machine!"

The senior repair technicians who have appeared on the previous transcripts were on duty from 1970s to 1990s, and now they are in the post of managing all the repair services. Nogu, from a repair technician like Tana and Kawa, who is now a technical specialist and participates in the design and development of new machines, talks about the present situation of the repair work as follows:

<Transcript 3. Just follow a YES-NO chart, and then 80 to 90 percents of troubles will be fixed! >

33.YK: The basic things technicians have to understand are the same as before, aren't they?

34.Nogu: Um, as the chart of YES or NO is completed now, technicians easily get to the point of trouble without making a mistake. Of course that is the case, unless they will take YES for NO...

35.YK: I see, it seems like a flow-chart... In the past, did technicians judge the trouble themselves?

36.Nogu: Yes, they made it. They had to judge everything by their own experience. By now, as long as they run after the manual, they will be able to repair a trouble, as for a common trouble.

37.YK: Isn't it difficult for a technician to figure out where to look on the manual?

38.Nogu: As they look into a trouble-shooting on a manual, they will see the lines of error codes written fully. So, all they have to do is check on the relevant code.

39.YK: If so, can a technician somehow fix machines without even understanding mechanical reasons?

40.Nogu: Yes. If a technician follows the manual correctly, he could make it. It's 80 to 90 percents, for sure.

41.YK: Oh, really? In the past, technicians couldn't check on a point of trouble, unless they understood mechanical reasons, right?

42.Nogu: That's right! In the first place, they couldn't track a trouble without understanding mechanical reasons. As machines were all analog in the past besides no color, white and black, that was easy to handle. But the mechanism of the present machinery has become complicated, involving network, digital, and full color. So, it is difficult for a repair technician to cover all the things, and to grasp what causes the trouble by himself.

43. YK: Hum..

44.Nogu: A repair technician has to take care of various models, so that it almost impossible for him to understand every mechanism on every model.

45.YK: I see.

What you're saying is that it is not necessary for a repair technician to understand the mechanism of each machine, so long as he can take care of various machines. So, your policy is to encourage the standardization of manual operations, isn't it?

46.Nogu: Exactly!

Nogu says that it is unnecessary for present technicians to understand the mechanism of machinery, and all they have to do is check on the relevant code in order to follow the YES-No chart that leads them to a point of trouble. Regarding the interviewer's question such as "If so, can a technician somehow repair a machine without even understanding mechanical reasons? ", Nogu responds that even if a technician does not

understand the mechanism of a machine, he can fix most of troubles following a manual. What Nogu is saying means that present technicians, unlike old technicians, are kept their distance from the core of a machine. In this sense, what Nogu talked about the situation of the present technicians is quite similar to that of Tana, a senior technician, in the previous transcript.

However, Nogu shows a remarkable contrast with Tana in the way of talking. Tana regretfully talks about the situation that it has increasingly become difficult for repair technicians to access to the core of a machine. As for Nogu, he regards it as quite natural. Rather, Nogu talks about it as the fruit of technological innovation. He takes it for granted that present technicians who have to look after various types of machines have only a superficial knowledge of machinery. That is exactly why technicians are given an excellent manual, and to follow the YES-NO chart on the manual makes them fix most of machines. Nogu as a technical specialist is on the side of providing the YES-NO chart besides being in the position closer to the design & development section in the company. When Nogu says that all technicians have to do is check on the relevant code, he implies that present technicians do not need to understand the mechanism of machinery.

Two different discourses such as "Just follow a YES-NO chart, and then 80 to 90 percents of troubles will be fixed!" and "Whether you use a tester or diagnostic system, you'll have to understand mechanical reasons of a machine." are produced as part of repair technicians' practice, in which they protect or reorganize their old and new socio-technical arrangements in their community of practice. The difference in two discourses results from different forms of 'repair technician agency'. The word, 'agency' denotes the capacity of any being to act, think and experience emotions (Callon, M. 2004, p.7).

Agencies are not only diverse and multiple, but they are subjected to reconfiguration, depending on their environments. The agency of any human being depends on the socio-technical arrangements in which she or he is situated (Callon, M. 2004).

The model or form of a 'repair technician agency' that Nogu as a closer person to the design & development section imagines is a technician who is capable of fixing one multi-functional machine after another according to the manuals; he learns how to use monitoring functions developed by digitization; he selects relevant error codes without delay to fix up a machine, feeding numbers into a monitor according to the manual; otherwise he fixes up a machine exchanging a unit or board and all. This form of a repair technician agency is surrounded by different types of copiers, perfect manuals, exchange units, electronic boards, PCs, team members and self-dispatch systems (Kawatoko, Y. 2004). The form of a 'repair technician agency' that Nogu imagines is configured to the socio-technical arrangement of the above-mentioned human and non-human actors. On the other hand, Tana plans another form of a 'repair technician agency'; he has still access to the mechanism of a machine and tries to control it by himself, under the circumstances of the introduction of digitization of machinery and unit construction systems into the repair work; he is self-mastering. Those different forms of repair technician agencies are made visible in the senior repair technicians' discourses.

5. Talking about IT makes one's conflict visible

Technicians' talks about repair technologies make remarkable contrast to each other. Repair technicians discuss past and present in contrast as follows; the contrast of past work with present one and the contrast of past technology with

present one. Repair technicians reorganize both the present by talking about the past, and the past by talking about the present. As already seen in the discourses regarding the use of a tester, it is Saka and Oota who made the strong contrast with each other in the ways of talking about both the present and the past. Both of them are the repair technicians on active service who cover midtown commercial and office areas, although they belong to the different service centers. What does the difference in their ways of talking about the 'present' make visible? Here I take up repair technicians' discourses on IT (Information Technologies), and analyze the implication of the difference between Saka and Oota in their ways of talking.

<Transcript 4. Now, the network age! >

47.YK: Now that the digitization of machinery and the unit construction systems besides a full monitoring system have advanced in your work field, what kind of skills are required for a repair technician?

48.Saka: In the past, all we had to do was take care of a copier itself. But, now, almost all the equipment is linked with a network, and our copier is placed within the network. Suppose a specific file or a homepage happens to disappear, as a customer is operating a scanner or a printer. A repair technician has to tackle this kind of situations now. These days, to be a repair technician is a hard job.

49.Ita: Yah, since digital compound machines have appeared on the market...

50.YK: Ah, it is after digital compound machines, isn't it?

51.Kawa: In the past, you had only to handle a Fax, or a copier, or a printer as a single item. As Saka says, the equipment in the office is now linked with a network, and within the network people print out documents. You

know, there are some cases where a printer does not work with some OS. So, you will have to figure out which is in trouble, a printer or the OS. The ability to solve these problems is required for a repair technician now.

52.Tana: It is Saka who has coped with this circumstance severely and appropriately. (with a smile)

53.Saka: Well, not that much... (giving an affirmative nod)

In response to the story until now that the way of fixing machinery has drastically changed due to the technological innovations as in the digitization of machinery and the unit construction system, the interviewer (YK) inquires what kind of skills repair technicians are asked for. Saka, a repair technician on active service, is the first to answer to the question. He says that as the computer age arrives, it is no such time that all you have to do is take care of a copier as a single item. His remarks have to be taken in the background of widespread 'digital compound machines' on the market. In a digital compound machine, various functions related to reproduction such as a copier, a printer, a scanner, a FAX are integrated into one machine. If you install the compound machine in your computer network, you can use it as a copier, a printer, a scanner, a FAX, operating your own PC. What Saka mentions a "network" refers to this situation.

By adding words that "These days, being a repair technician is a hard job", Saka not only puts the present repair technicians in technically higher position; at the same time he puts their "hard" tasks involving a network in skill of a high order. A senior technician, Kawa follows Saka's opinion, pointing out the necessity of "cut and divide" operation under the circumstance of networking. Saka's boss, Tana praises Saka for his work, saying that Saka takes the lead in coping with

the networking. In this way, senior technicians so far have not raised any objections to Saka's claims that the appearance of "networking" has changed repair technician's work completely. However, Oota who is also a repair technician on active service clearly opposes Saka's words, "Now, the network age!" , in the following discourse.

<Transcript 5. There are still lots of paper-jam trouble! >

54.YK: What percentage of repair service do the network related
one hold in your area?

55.Tana: Is it fifty or so?

56.YK: Fifty! Oh, that much?

57.Saka: From the impression I get when I actually go around,
I'd say it reaches seventy.

58.YK: Oh, really!

59.Saka: Although it may be that my service area, Chiyoda-ward
and the Ootemachi is a place like that.

60.YK: Hum..

61.Saka: There are not many requests for fixing only a copier
these days. There are a few... It might be simply my
area's uniqueness. Of cause, there could be some.

62.YK: Hum..

63.Saka: Well, it may be that I am not in charge of the trade
like KINKOS.

64.Tana: I see. That's what it's all about.

It is because Saka's area has many customers with
financial business.

65.YK: Oh, I see! That's because many financial related offices
are there.

66.Saka: No, that's not necessarily.

Now, not only financiers but almost all the offices
are digitized, or computerized now. That's how things
are.

67.YK: Hum...

68.Oota: It's too much to say that all the trouble is related to the networking.

69.YK: I see, it's not always the case, is it?

70.Oota: Yes. There are still lots of paper-jam trouble. For one thing, popular low-priced paper is easy to be stuffed,...

71.Saka: (looking at a printed matter with an unconcerned air)

72.Oota: Also, there are some cases where people dare to use both sides of a piece of paper, concerning "environment".

73.YK: You still have lots of paper-jam trouble, don't you?

74.Oota: Yes, we do. We still go to the customers to fix paper-jam troubles every day.

Saka says that 70 percent of the requests for repair services are something to do with networking, and gives reasons for "70 percent" this and that. However, Oota raises an objection against Saka's words that "There are not many requests for fixing only a copier these days", giving the example of the "paper-jam" that is a basic and typical trouble in copiers. And by doing so, Oota suggests indirectly that there are not so many network related repair services. The fact that Oota dare to refer a "paper-jam" forms sharp contrast with the "network" mentioned by Saka. A fault of a copier is generally said to "begin with a paper-jam and end with a paper-jam". Whether it is serious or not, every trouble of a copier reveals itself as the symptoms of a paper-jam. In the past a repair technician had been required to have such a high degree of skill that he could locate a problem from a "paper-jam" to fix it. This high degree of skill is nothing to the difficulty of "cut and divide" operation under the circumstance of networking, though the nature of each skill may be different. In the background Oota

refers to a "paper-jam" we can see his self-confidence as a repair technician, in other words, his model for a "copier's repair technician".

<Transcript 6. Even now almost all the offices use a copier as a single item>

72.YK: Two years ago, I had an experience to make a tour of various offices with repair technicians. I remember that almost all the offices used a copier as a single item at that time.

73.Ita: I wonder a phenomenon like segregation of a niche occurs in our field? (with a laugh)

74.Kane: As Oota said, many offices usually use our machine as a simple copier more than as a compound machine, right?

75.Oota: Yes, that's true. They generally use the equipment as a single machine such as a Fax, a copier and a printer. Since the political slogan of the electronic management of documents is pushed ahead, an Internet environment has been gradually set up in private offices. But even at this point, almost all the offices use our machine as a simple copier.

76.YK: Well, the same is true of my university.

Another technician on active service, Oota's utterance that all the trouble is not always related to the networking breaks down the drift of an argument, and changes the direction of their discourses. Till then the senior technicians have not raised any objections to Saka's claims that the appearance of "networking" changed the repair technician's work completely. On the contrary, those seniors even follow and praise Saka. After Oota's claims, senior technicians, Ita and Kane begin to express their approval of Oota's claims on the use of a copier as a single item and the existence of lots of paper-jam troubles.

Oota definitely says that although the networking is generally advanced in offices, almost all the offices use a copier as a single item without installing into their networks. A few minutes after this, Saka's boss, Tana is a long way off the mark to bring up the subject of accounting management. Tana refrains from making any comment in which the difference between present technicians, Saka and Oota becomes clear. It seems that a senior technician, Ita's words that "I wonder a phenomenon like segregation of a niche occurs in our field?" make a compromise between two present technicians' claims, and aim to make the difference between the two invisible.

According to the customer service center in KJ Co., a percentage of the network related repair service is 20 to 30 or so among all the repair services they offer. Nevertheless, why does Saka say that the network age arrives so that being a repair technician is a hard job now? Why do the senior technicians try to go along with Saka's views and to make differences in views on the change of repair technology between Saka and Oota who argues back against Saka invisible?

Here we can see the repair technicians' community facing in the conflict and dilemma over the way of socio-technical arrangements, which has been brought by the technological innovations of copiers. In case of the repair technicians on active service, Saka and Oota, their positioning and dilemma in the changing socio-technical arrangements are expressed, when they talk about the distance between themselves and machines, in other words, where to locate their own leading activities. Saka talks that "we no longer use a tester", and "now the network age!". He may intend to motivate himself to do his job through having his 'repair technician agency' overlapped with the social situation where Information Technologies have been loudly trumpeted. On the other hand, the 'repair technician agency' described by Oota who talks that

"we still need a tester once in a while", and "there are still many paper-jam troubles" sounds a way of 'instinct and a knack' shared by that of senior technicians. But it may not be true. From his talks about repair technologies, his objective should be the repair technician who can access to the core of a machine. Oota takes upon himself to oppose "networking" mentioned by Saka. This is because Oota may not consider the network related repair service as an essential work for the repair technicians to be responsible for.

The senior technicians who manage all the repair services have taken on the responsibility of organizing socio-technical arrangements of the present repair technicians' community of practice. The senior technicians have experienced themselves the socio-technical changes of the whole repair service community, such as the competition with rival companies for developing compound machines, a stream of technological innovations, the relation between the old and new machines and the repair technologies, the change of customers, the policy of the company, education for technicians and so on. The senior technicians could have easily recognized the difference between the two present technicians, Saka and Oota in the way of technical practice and the way of talking it, all the more. But the senior technicians still have to accept different forms of 'repair technician agencies' and make the difference between them invisible. Because the senior technicians have to have the present technicians keep working without losing their motivation to do their work under the circumstances of holding dilemma and impatience in the work of repair services.

Conclusion

Is "deskilling" the final stop on the advances in technology?

Until mid 1990s, copiers' repair technicians had diagnosed a machine, determined the cause of a trouble and fixed it, using a tester on the basis of understanding the mechanism of a machine. Thereafter, as the digitization of the equipment has advanced, and the diagnosis and monitoring functions have been loaded on a machine, most tuning has become feasible by means of numerical operations on a screen without touching the body of a machine. Besides, the fault in each part has possible to restore by exchanging a unit or an electronic board and all. The repair works have changed completely. They are not what they used to be.

The state of things that technicians are removed from the central position in manufacturing process is found not only in a copier's maker but every manufacturing field. This is called 'deskilling' phenomena. The talks about 'deskilling' as in "With the advent of CNC lathes, no more expertise are needed." are profoundly related with the following points of view; 'Deskilling' is to reduce the level of skill required to carry out a job through replacing people's tasks to machinery; If workers are deskilled, they no longer need special skills to do their work, especially because of modern methods of production. 'Deskilling' is often spoken as the fruit result of mechanization and computerization. Those views are derived from the approach that intends to reduce 'deskilling' to a matter of individual skill and knowledge.

It's about time for us to reconsider the issue of 'deskilling', and to overcome the conventional pattern of thought on 'deskilling'. In the previous section we heard a technical specialist saying that "Just follow a YES-NO chart, and then 80 to 90 percents of troubles will be fixed". This remark is one version of the discourses about 'deskilling'. And, the remark that "Now, the network age! ", which one technician, Saka put emphasis on repeatedly, could be regarded as another

version of the discourse about 'deskilling'. Those discourses were spoken under the circumstances where repair technicians were confronted with drastic change of their practice owing to the appearance of new machines carrying new technologies such as the digitization, the unit construction system and the electronic boarding. There were three things occurred; the change of a socio-technical configuration of technicians and instruments; the change of a socio-physical distance between a technician and the core of a machine; the diversification of 'repair technician agencies'. It is clear that the technicians' discourses about 'deskilling' have been exactly spoken as part of their practice in which they protect or reorganize their social boundaries concerning new technologies. This means that 'deskilling' is not the issue of individual skill and knowledge, but the discourse as people's practice in which they reorganize or protect their social boundaries accompanied with the introduction of new technologies. In other words, 'deskilling' can be considered as the people's 'translation' on which they aim to reconstruct a new hybrid network around the introduction of new technologies. In this way, the above-mentioned discourses about 'deskilling', or the translation are done in the way of forming the alliance that excludes old technologies and technicians.

On the other hand, there are some groups who speak different discourses from the 'deskilling' ones, and aim to reconstruct different hybrid networks. As previously seen, there is a factory manager who speaks a discourse such as "you cannot write an efficient program, unless you have an operating skill and knowledge about a cam lathe", against the prevailing discourse as "Just anyone who can make computer programming will be able to process precision metal parts". In his factory, he has every lath man operate both new and old types of lathes. Also as seen in the foregoing chapter, there are some repair technicians who

claim their views that "whether you use a tester or a diagnostic system, you should understand mechanical reasons of a machine", opposing the discourse of "Just follow a YES-NO chart, then 80 to 90 percents of troubles will be fixed". It is clear from their discourses that those people aim to form a different alliance from that of 'deskilling' ones. Again, 'deskilling' is not a matter of individual skill and knowledge. What kind of networks, alliance or exclusion the persons concerned aim to form is called into question.

Will the reorganization of the network that the 'deskilling' discourses intend to achieve actually succeed? In other words, will the 'deskilling' be the final stop on the advances in technology? The answer to these questions has never been given to us so far. But there is an instance giving us a little hint for the answer. It is a story of growth and collapse of a new traffic system, called "Aramis" (Latour, B. 1996). Why did the Aramis project end in failure just before the success? Latour and young researchers try to find out the cause of the failure, but they have never gotten a clear answer. It seems to us, a third party, that the cause of the failure of the Aramis project derives from so called 'technological reductionism'. For instance, in the Aramis project they stick to fully automated operation to the exclusion of human intervention. The failure of the Aramis project teaches us two things as follows; The future of technology is not necessarily fixed the course of 'deskilling'; It contains a possibility that in the process of technological projects' taking concrete shape, various socio-technical factors and their configurations may result in change in the form of 'technological rationality'.

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