Lead Time Reduction and Efficiency Enhancement Show Strong Interference with Customer Constraints in Banking Service Process Design

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Abstract
This paper reports our results of applying engineering process design to the banking service of housing loan credit approval. Process design of manufacturing digitalizes the entire process and stacks independent judgments one by one; and process design for banking service has the same nature. A major difference between the two is that lead time reduction and work efficiency enhancement have strong interference with customer constraints in banking service, and weak in manufacturing. The interference is hard to eliminate because we cannot force the customer to always fill out the application forms in a complete manner.

Keywords:
Scheduling, Service, Bank

1 INTRODUCTION

Service is a process that satisfies the customer expectation. The service provider should clarify what the customer expectation is before starting the process, and at the same time should confirm the customer constraints and then start finding the optimum design solution process for the customer. In real service, however, the process starts before the customer constraints are clarified and towards the end, the service provider adjusts the design solution to offer the best satisfaction to the customer. The solution often turns out to be a compromise between the customer and the service provider. A good example is a housewife shopping for groceries to prepare dinner. In this case, even if she had prepared a list of items to shop for the expected dinner, depending on what a good buy was at the store on that day, she would change the expectation drastically by changing the original constraints of freshness or cost that she had.

In modern manufacturing processes, functional requirements and constraints are set before production starts and remain unchanged until the production at the first run ends. Information technologies these days have tools for process management such as axiomatic design theory [1] and once an order is confirmed, obtaining material to manufacturing processes are determined immediately to the optimum conditions. For example, even with a single part production with injection metal mold [2-3], once the manufacturer has the drawing of the final plastic product the customer wants, he can use 3D CAD to invert the part to determine the mold shape, apply CAM to generate tool paths, and cut the material with NC machining to produce the part as originally designed. In this series of processes, a decision is made based on the ones made up to the point of the proceeding one and is stacked to the set one by one. According to the independence axiom [1], no interference should take place, for example, fitting two parts that are machined separately without any adjustment.

One of the authors Nakao has reduced the lead time of a metal mold [2] by 86% from 352 hours down to 49.8 hours by dividing up the mold production into 583 digitalized and independent sub-processes, and at the same time replaced operator judgments with machine measurements and CAD calculations to limit the number of human judgments. Of the 583 sub-processes only 17% of 77 remained. Allowing judgment by operators should be avoided [3] because they will introduce exceptions. The result is a large number of options to complicate the processes like a coupled design and this will eventually cause a long lead time.

So far, many engineering researchers have reported production scheduling problems. The approach should include social aspects, not only technical aspects [4-6]. Precise simulations of the digitalized scheduling were also introduced [7-8]. This report applies these production scheduling methods to a banking service process to clarify its difference from production processes and discuss how to shorten lead time and enhance work efficiency of the service.

2 BANKING SERVICE PROCESS

2.1 Credit approval process for a housing loan

We need to select the service process for the analysis of this paper. The large number of banking processes can be categorized based on the uncertainty of the aforementioned constraints [9]. For example, the service that expects to “withdraw cash from an ATM” proceeds as designed without the influence of constraints. The customer inputs his personal identification number (PIN), specifies the amount to withdraw and the ATM checks the ATM card and balance after the transaction to complete. On the other hand, the customer expectation for the service to “manage the balance of a trust deposit” is constantly affected by the uncertain economy and politics, and processing it to the original design usually leaves a customer dissatisfied.

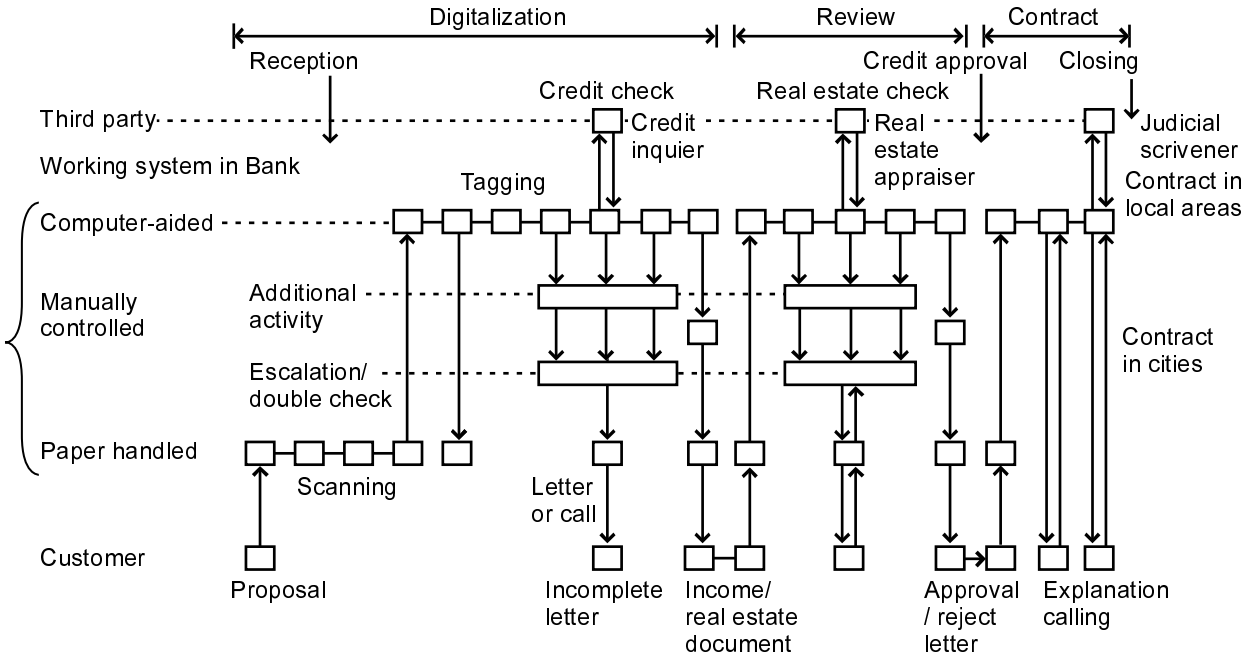

Figure 1: Credit approval processes for housing loan in the bank.

Our study chose the service of credit approval (CA) for a housing loan (HL), one that stands in between the above two services in terms of uncertainty with the constraints. The customer has established the expectation to "borrow money to buy a house," however the constraints of income and housing price fluctuate. Banks nowadays have their own formulae to automatically judge the possibility of the customer making the mortgage payments, however inputs to the formulae like income, other loans, land price, or insurance have to be double checked.

At first, we digitalized the CA process. The method is complicated, but familiar to engineers [7-8]. Figure 1 shows the entire process. The CA process of HL is roughly separated into three process groups.

The first is the digitalization process group that inputs personal information for the application in the computer. Japanese banks have a long history of following instructions by the Ministry of Finance and cannot change the manual process easily. The customer has to fill out the application on paper, not on a network, and confirm the application with a personal seal. The bank we worked with for this research is aiming to digitalize the process by first scanning the application form to input it as digital data, whilst the analog application form is still stored in a big warehouse in the suburbs.

The processes are separated into one for each judgment and the sequence of the approximately 30 sub-processes looks the same as a mold making process [2]. Since the passing criteria are clearly specified, the service operation needs no special skills. Each operator can pick up any lead of the open sub-process of any customer without any interference. Some important sub-processes, however, employ a dual system. Two operators work one sub-process separately, and the computer checks the difference of the result.

The computer requires the form to be completely filled out. For example, if the form is not checked where it says fulltime employment, the system judges that the income is unstable and declines the application. However, some customers simply forget to place the checkmark and the process may require sending a letter urging the customer to reapply for the loan.

The second is the review process where income and land are checked. Other loans and insurance are automatically searched through companies that offer such services. However, reviewing the income requires someone to read the tax return documents and checking the land requires land appraisers to be hired. The matter is simple for salaried people working for large companies. However, self-employed applicants usually have a number of income sources and loans, and purchasing an office house for living would further complicate the process. Reading the pile of documents alone takes hours. When such efforts still do not meet the criteria, the bank would write letters or make phone calls to have further documents attached to the application.

The third group is completing the contract. The bank explains the conditions over the phone and then mails the contract to the customer. The customer signs the contract in front of a bank person or a judicial scrivener. However, some applicants lose interest in making a purchase at the time of signing.

2.2 Process design for digitalization

Just like the metal mold process, the digitalization process is divided up into sufficiently fine digitalized and independent sub-processes. The judgments are not only automatic but the processes themselves are visible.

Figure 2 explains the differences before and after digitalization. At this time, the processes are analyzed by axiomatic design theory [1]. Before digitalization, the process was a coupled design as shown in Figure 2 (a). The person in charge checked his own customer with the help of specialists or supervisors. Their expertise created interference in the process. The file of the document of each customer was a kind of process tag, but the progress on the work was not visible. Some files were stocked in his cabinet, making a long lead time. The design matrix might be not square because the number of customers is generally larger than that of operators.

After digitalization, the process became a decoupled

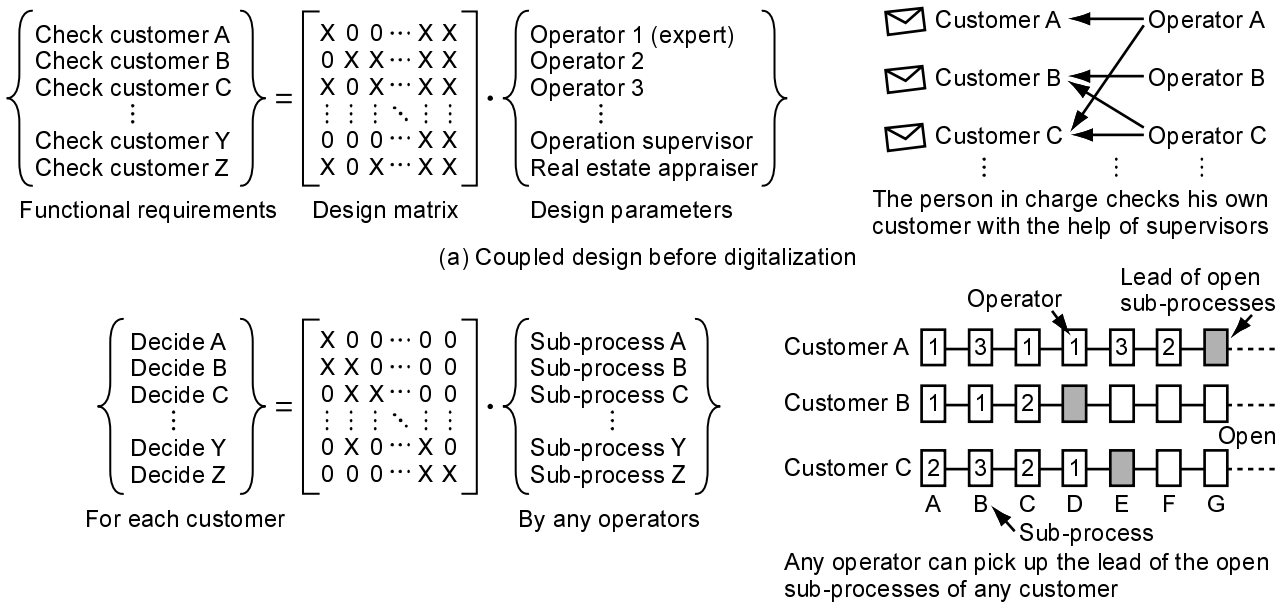

Figure 2: Design equation of credit approval service in the axiomatic design perspective.

design in Figure 2(b). The system controls the lead of the open sub-processes. Any operator can pick up the application of any customer. The judgment of the sub-process is decided using information only in the processing sub-process. The process should not have any feedback loops. The design matrix is a lower triangular, square matrix, so it is a decoupled design. Axiomatic design theory says that the decoupled design of the digitalized process should be more effective for optimizing the job.

This design matrix can be optimized for shortening the lead time using the design structure matrix (DSM) method. DSM is also familiar to production engineers for designing hardware or software products. The tool of DSM, partitioning or clustering, can change into a triangle or quasi-diagonal matrix. In this paper, the change from the set of functional requirements in Figure 2 (a) to that in 2 (b) presented an essential improvement. This charge was induced by axiomatic design for us, but also could be done by the quality function deployment (QFD) method.

The operator has only to process the customer transaction and the system automatically records the process of who worked on which customer request. Even if an operator dozed off in front of the terminal that time is also counted as work hours so the count includes idle time. When a base process time exceeds 15 minutes, the system judges that an unexpected trouble occurred and closes the original base process. At this point the operator has to consult with the supervisor (escalation) or manually move on to the other means (additional activity) to revive the process as shown in Figure 1. Such remark, revise or rescheduling is familiar to production engineers. We could add the rework sub-processes like a manufacturing process.

In the second review process group and the third contract group, the process shifts from computer-based to manually-based with the help from specialists and supervisors. The first shift is to the process of land and building evaluation by an appraiser. The second is the process of closing the contract with a witness from the bank or a paralegal. The third is working with a supervisor to verify matters that are unclear. (The time for this process is counted as work hours in bank).

These processes branched out from the review process and waiting takes place before and after the process steps. The longest waiting time, however, is in delays by the customer not filling out forms to resubmit. Half of the work of about 800 calls par day at call centers is taking inquiries from customers and the other half is reminding customers to resubmit applications. Without these efforts, customers usually do not bother resubmitting the forms again. These play-catch steps between the bank and the customer are unfamiliar to engineers because the week-span delay, not a minute-span one, happens in the scheduling as mentioned in the next section.

3 ANALYSIS RESULTS OF HOUSING LOANS

3.1 Analysis results of lead time

Figure 3 shows the distribution of the lead times of digitalization and review processes combined as well as the lead time for contract for 9,323 cases that closed during a certain time period. The mode of the former is about 650 hours, but with a long tail in the long lead time area. The average was 1,177 hours (49.0 days). The mode of the later is about 450 hours with an average of 804 hours. If we combine the two, the mode is about 1,100 hours (46 days) and the average is as long as 1,981 hours (82.5 days).

Figure 4 splits the processes into some sub-processes and shows their average lead time values. In the former digitalization and review group, 81.5% of the 49.0 days, 40.0 days were spent in waiting for customer reply. If we look at outsourced processes, land appraisal took as long as 5,173 minutes (3.6 days, 7.3% of the entire lead time). Land appraisers receive data in digital form and complete the appraisals before their deadlines. Judging from the fee, the time for appraisal is probably about 1 hour. Waiting time among base processes in the bank was long as well. It was 7,607 minutes (5.3 days, 10.8% of the entire lead time). For example, the processes start every morning after mail delivery and a wave of processes is passed on to the following processes. When an operator cannot complete all of the applications during that day, the remainder will be left on the desk for at least 12 hours to add to the lead time. Lastly, the net process time without the idle time was only 243 minutes (4 hours), i.e., only 0.3% of the entire process time.

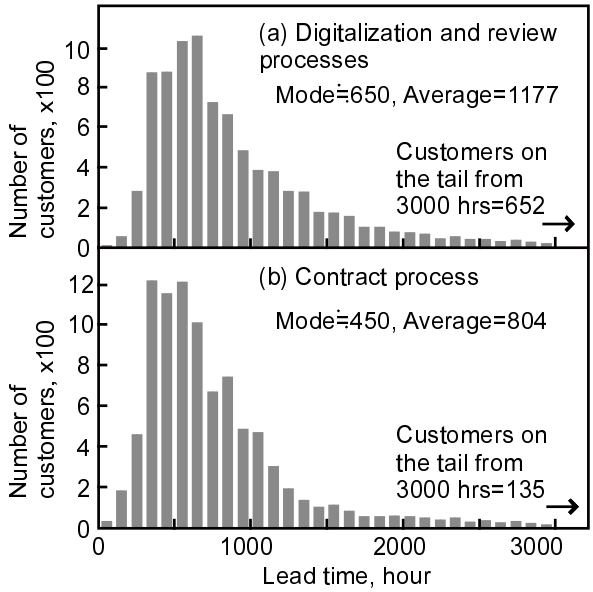

Figure 3: Distribution of lead time from reception to closing (total number of customer is 9232).

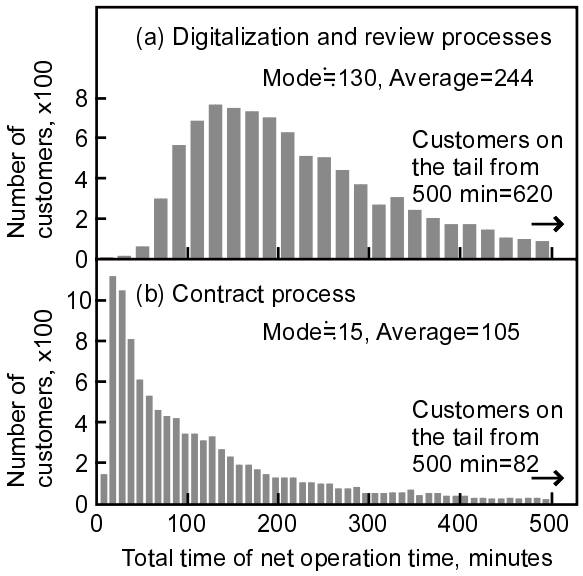

Figure 5: Distribution of total time of net operation time in the bank (total number of customers is 9232).

The later contract process group showed the same trend. Lead time waiting for customer reply was 56.7%, and that inside the bank was 43.1%, and the net process time was

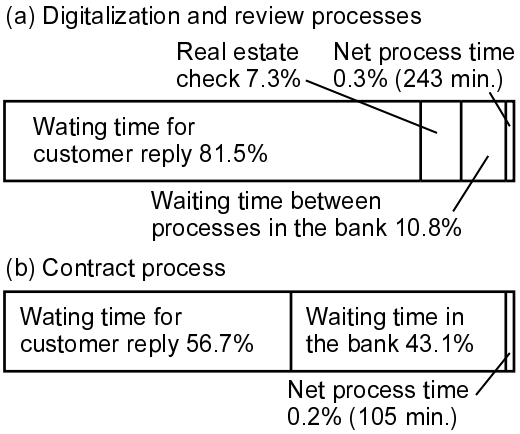

Figure 4: Breakdown of average lead time.

only 0.2% (105 minutes). In other words, most of the lead time was spent in waiting.

Figure 5 shows the distribution of net work time. The aforementioned combined digitalization and review processes have a mode at about 130 minutes, and the later contract at about 15 minutes. Similar to Figure 3, the number of cases tail long in the longer lead time area.

As we discussed above, many customers will be asked about their applications with unclear entries, however, a straightforward application that zips through the system without repeated reviews will go through in about 130 + 15 minutes, i.e., the addition of the two models in Figure 5. In short, the fastest process from start of review to contract closure takes only 145 minutes plus an hour of land appraisal, and an hour of contract sign-off, and finally the total time is about 4.5 hours. Nevertheless, a typical process takes 46 days, i.e., 240 times of the net total time.

3.2 Distribution of work efficiency

The previous section analyzed the lead time from the customer standpoint. This section explains the analysis results from the standpoint of a bank clerk.

The amount of review for an HL varies largely with the economics. During our study, the period from the fall of 2007 to the summer of 2008 enjoyed a good economy and there was plenty of work. The Lehman shock that followed turned the economy down but it has started to slowly come back from the fall of 2009. Employees are hired in response to the amount of work. However, the time delay in hiring and terminations cause busy or relaxed work during such times of big economic change.

The work includes not only closed transactions, but also those that did not close. The rate of closing is also affected by the economy with an average of about 60%. Among the transactions in Figure 5, those with a short lead time consisted about 40%, thus among all of the transactions, 60% x 40% = 24% enjoyed short lead process times to go through the processes. In contrast, among those that did not close, about 50% were immediately turned down and thus, 40% x 50% = 20% rejections did not take long. The remaining half (20%) of those that did not close were, for example, cases where the customer wanted to refinance but lacked a mortgage due to a drop in land price. An accurate estimate for the land price required much information from the customer and the lead time was long. So 60% of the 60% closed and 50% of the 40% that did not close, a total of 56%, were customers that caused long work times for the bank and whether closed or not, the waiting time for the customer reply caused a long lead time.

Figure 6 shows the work by employees in the digitalization and review process group. The net work time captured by the computer was 41%, and that measured manually was 42%. The net time included 16% escalation that involved the supervisor, and 26% additional activity when a process step took 15 minutes or longer. The transactions that had to go through these extended time processes were 61% for escalation and 35% for additional activity. We traced the transactions to find that these customers were in the 56% of troublesome customers that caused long process time to the bank.

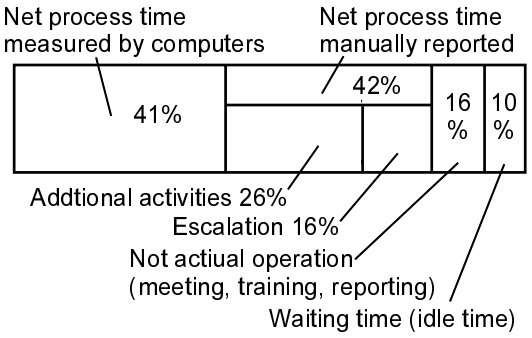

Figure 6: Breakdown of working time in the digitalization and review processes.

Other times totaled 16% including 4% attending seminars and meetings, and 10% waiting in between processes. When we measured the work time of metal mold operators [2-3], the time for attending seminars and meetings, waiting, and bathroom breaks totaled about 20% and thus was not very different from this bank employee time. This scheduling system could optimize the resource issues because a scheduling manager could check whether his people are busy or relaxed immediately and remove his resource from the relaxed process to the busy one.

Figure 7 shows examples of reasons for moving from automatic measurement to manual. All of them could have been avoided if the customer took time in preparing perfect applications. The fact was even a single entry that is unclear caused the operator to ask the supervisor or send additional questions to the customer.

4 DISCUSSION ON THE SERVICE PROCESS

4.1 Differences in processes for service and manufacturing

We found that the digitalization and scheduling method of manufacturing processes could be applied to the bank process effectively. Resource optimization could also be realized like a factory. Sequential sub-processes with independent judgments one by one satisfied the independent axiom of axiomatic design theory [1]. Each operator could individually take the lead of the open sub-processes of any customer without any interference. The design theory also works well in the service process.

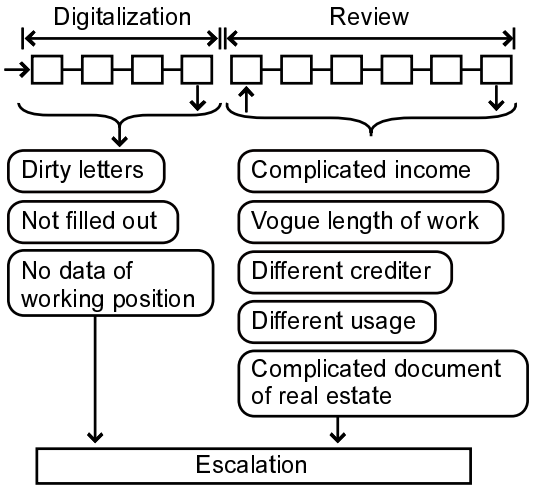

Figure 7: Reasons for escalition process.

The shorting of the lead time, however, needed a totally different method from manufacturing. Figure 8 shows the results of comparing the CA for HL process lead time to those of mold manufacturing. The mold was a single piece production thus the involved work varied with each order and could not be arranged for a synchronized flow production. This caused 55.4% waiting time for CAD/CAM design or cutting tools. On the other hand, HL processes had to wait as long as 71.4% for customer replies. This long waiting time is not due to inefficiency of the workers. Comparing the net work-hours, HL was 0.3%, whereas that of molds was 44.8%. This shows the large influence of customer constraints is on the HL process.

In other words, the lead time consists of 71% waiting time for customer reply, and in terms of work efficiency, 42% occupies additional process time for customers with complex information. As a result, the main reason for poor efficiency is the customers, not the workers. The Japanese customers do not complain thinking that long review processes of 46 days by banks or government are natural. Thus, shortening the lead time would not gain customer satisfaction or excitement, and the service provider loses interest in such efforts. Banks, however, are different from the government and have the business motivation to reach a contract even with incomplete application forms from the customer. This motivation made the 42% net work-time of additional activity for the 56% special complex customers, and solving this part will lead to great improvement in productivity.

Forcing the customer, however, to always provides complete information and to return immediate replies is not easy. This is a large difference between service and manufacturing. Note that even in manufacturing, however, preprocesses of market research, and interaction with the customer including presales, defining the specification or requirements are there, and often, the work proceeds with constraints not fully defined. This situation is similar to the bank service.

4.2 Improving the service process

As we showed in this report of HL process analysis, the shortening of the lead time of this service had a trade-off problem to the customer's satisfaction. Drastic reduction in process lead time and enhancement of work efficiency require more detailed and quantified information about the customer from the beginning, so the computer of the bank can make automatic judgments. Banks have worked hard in improving the application form so it is easier to extract the necessary information from the applicants. When these efforts succeed, escalations and additional activity for special customers will reduce as well as lead time and the amount of process work. We estimate that the improvement of lead time or necessary human resources will be reduced to about 70%. This solution, however, is shifting the work of eliminating vagueness in the information from the bank to the customer.

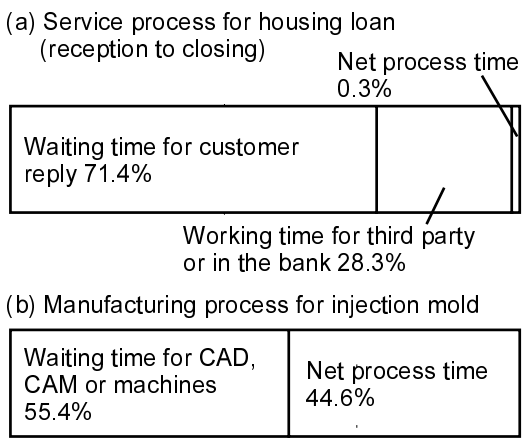

Figure 8: Difference of working between service and manufacturing.

The customer may want to pass the work to a consultant. In Japan, however, it is customary not to provide monetary compensation to consultants whose accomplishments do not have physical form. For example, consulting a customer who wants to build a custom design house would not accept an invoice for consultation, thus the fee is added onto the construction fee. The consultation appears to be a free service. Banks indirectly have been paying for it so far.

Overseas companies are now entering the Japanese market and like the case of life insurance business, Japanese banks will suddenly have to enter the competition of good service to the customer. In order to stay competitive in the race, banks should at least make the preparation of dividing the work, digitalizing, and individualizing them. The bank in this study did so and now they can at least visualize the work processes with the computer.

5 CONCLUSION

We applied the conventional scheduling method of the manufacturing process into the service process. We took the credit approval process of housing loans by a bank, analyzed the service processes, and aimed at shortening the lead time for the customer and enhancing the work efficiency for the bank.

Sequential sub-processes with independent judgment one by one based on axiomatic design theory was effective for optimizing scheduling for each customer or each operator. Each operator could pick up the lead of open sub-processes of any customer. The digitalization, scheduling and optimization method and design theory of the axiomatic design in the manufacturing could work well even in the bank.

But the shorting method of the lead time does not work sufficiently because the cause of the long lead time was related with the customer's constraints. Almost half of customers resubmit the application due to insufficient information in the application, and that caused the longer lead time, and affected the additional work time. Filling out the application forms with complete information, however, may reduce the customer's satisfaction because the customer has to do a troublesome job. Engineers should consider the scheduling of the service in the social aspect.

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