Proceedings of the 1992 Winter Simulation Conference
ed. J. J. Swain, D. Goldsman, R. C. Crain, and J. R. Wilson

CUSTOMER SERVICE EVALUATION IN THE TELEPHONE SERVICE PROVISIONING PROCESS

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ABSTRACT

This paper describes a new method of evaluating "customer service quality" proposed for service provisioning process in the telecommunications field. This method is based on a new concept called measures of customer service quality (MOSQ). Next, "Work Flow Simulator" is introduced to precisely evaluate the work-flow-dependent response time as an example of MOSQ by computer simulation. The telephone service provisioning process is evaluated using this simulator, and the possibility of improving the process is shown.

1. INTRODUCTION

One of the most important services of telephone companies (telcos) is customer service. Customer service involves the interaction between customers and the personnel of telcos, and includes line establishment, line repair, and telephone equipment sales. In the past, telcos have made a lot of effort to improve customer services from the viewpoint of reducing human effort [Appel and Woodruff (1978), Bauer and Krantz (1978), Boggs and Stenard (1978), Fleckenstein (1982), Noe and Pinnes (1985)]. In the highly competitive telecommunications market, however, it is getting more and more vital that telcos should make much more effort to improve their customer service quality than to reduce human effort.

Because customer service quality corresponds to the degree of customer satisfaction, the following characteristics should be considered in the evaluation.

(1) "Customer satisfaction" is subjective. A good service for a customer may not necessarily be a good service for another one. The impression of a service depends on the situation. Hence the impression may change according to the circumstances even for the same customer. Any customer who received excellent service previously would be disappointed to receive anything less. Therefore, it is difficult to quantitatively evaluate customer satisfaction.

(2) Service itself has no physical shape. Moreover, every service has the feature that the provisioning and the setup are made simultaneously. Therefore, it is difficult to examine the quality of a service before it is actually provided. As a result, evaluating customer satisfaction in advance is also difficult.

These restrictions make it difficult to measure the influence on customer satisfaction of "Network Systems" including work flow, operating systems (OpS), and network elements. In the past, the "PDCA (plan, do, check, and action)" procedure was used to improve service quality. A low customer satisfaction rating resulted in some modification of the Network System in the field. Customer satisfaction was then measured again to see whether that modification was successful. If improvement in customer satisfaction was not enough, other changes were implemented. A drawback with this procedure was that no information was obtained prior to the field trial. Furthermore, this method was costly, time-consuming, and sometimes dangerous.

This paper proposes a new customer service evaluation method based on computer simulation, for the telephone service provisioning process as an example of customer service. Section 2 outlines the service provisioning process and defines a new service quality measure, measures of customer service quality (MOSQ), for this process. Section 3 outlines the Work Flow Simulator developed in order to evaluate response time in the telephone service provisioning process. Finally, Section 4 analyzes the simulation results obtained, and shows the possibility of improving the process.

2. TELEPHONE SERVICE PROVISIONING PROCESS

Telephone service provisioning is an operation corresponding to the "Service Order (SO)" process. SOs include initial establishment of lines for customers, assisting movement of customers across the serving areas, changing services (i.e., adding vertical features).

The reasons for the importance of the telephone service provisioning process for a telephone company are;

(1) SO applications (more than 8 million SOs are made every year in Japan) occupy the dominant part of all the service applications.

(2) SO work flows are very complicated because customer orders require processing by many departments. Therefore, customer service might be improved greatly by changing the work flow.

(3) SO-related service representatives and technicians in a telephone company serve customers directly. Therefore, the service provisioning process strongly affects customer satisfaction.

2.1 Organization and Work Flow

Figure 1 illustrates partial structure of a telephone-related organization which processes SOs. It is divided into two groups: branch and telephone equipment division. The branch includes a telephone office which comprises a customer contact section, a service order control section, a frame/switching section, and a billing/cashier section. It also includes a plant engineering department which comprises an office equipment section and an outside plant section. The plant engineering department plans, installs, and maintains facilities such as switching systems and feeder cables shared by many customers. The telephone equipment division includes a telephone equipment bureau which comprises a sales section and an installation/repair personnel section. The installation/repair personnel section performs outside wiring and work at customer premises. Clearly SO work is related to many sections.

Figure 2 outlines the present SO work flow. A customer service representative in the customer contact section receives a customer's order by telephone (phone no. 116) or at a telephone office. Corresponding to the customer's order, he (or she) fills out the reception sheet, assigns a telephone number by referring to the non-use telephone number list, determines the installation day/time, and, if necessary, sells telephone equipment. Then, he (or she) delivers the reception sheet to the service order control section. Personnel in the service order control section assign an appropriate cable pair of the outside plant and/or a line equipment circuit of the switching system if necessary. The SO data on the reception sheet is then entered into an OpS terminal and transmitted to other sections, i.e., frame/switching and installation/repair personnel sections. These sections periodically print out SOs. In the conventional work flow used in many areas, however, SOs are printed out only a few times a day. A lot of SOs are printed simultaneously. In the frame/switching section, a manager assigns technicians to perform inside work: wiring a cable pair to the assigned line equipment circuit with a jumper in the main distributing frame (MDF), and entering the customer's information (e.g., name, address, and assigned telephone number) on a terminal connected to the switching system. In the installation/repair personnel section, a dispatcher dispatches installers to the customer's premises and, if necessary, procures telephone equipment. These installers visit to the customer's premises taking procured equipment, perform outside wiring, and install the equipment at the customer's premises. Finally, the installer contacts the frame/switching section by telephone to perform a line test confirming the connection. The customer's line is then installed.

As can be seen from the above, the SO work flow goes through several sections and is very complicated. There-

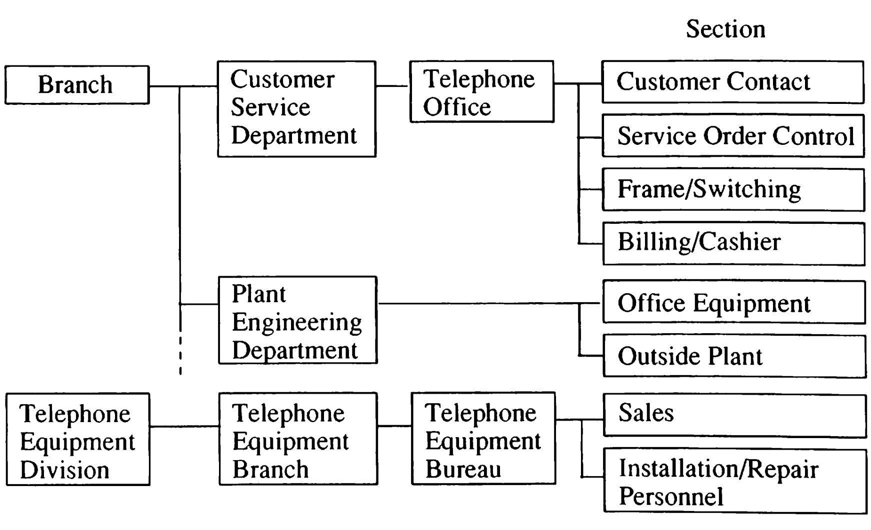

Figure 1: Partial Structure of a Telephone-related Organization

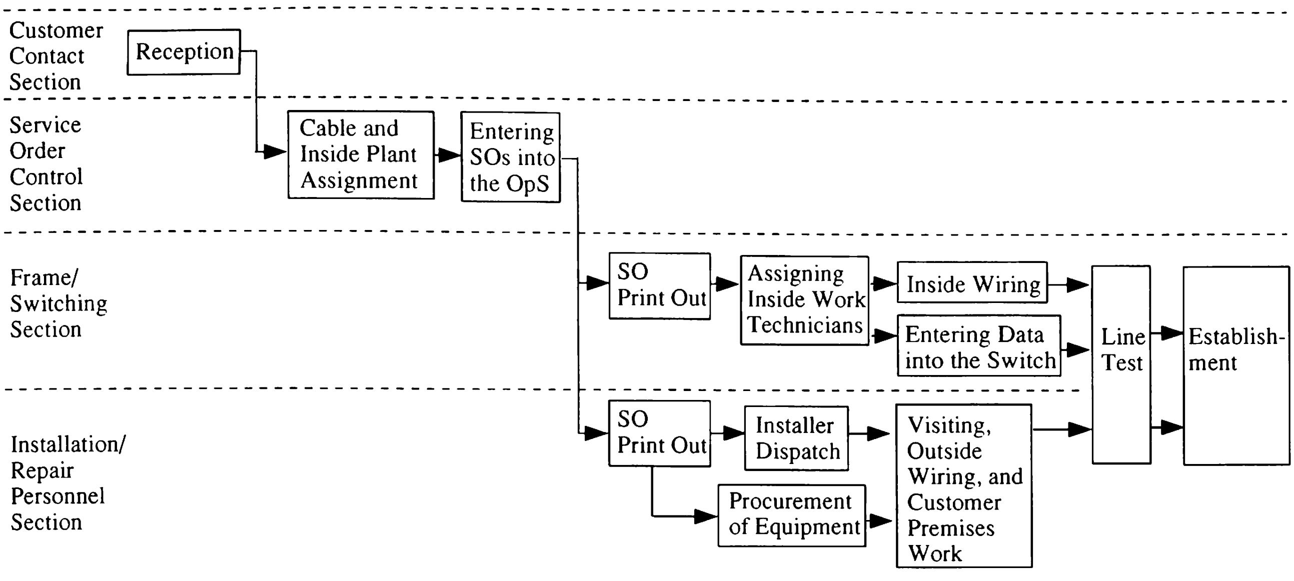

Figure 2: Outline of the Present SO Work Flow

fore, changing the SO work flow has a large influence on the customer service quality.

Telephone companies have made a great effort to improve customer services [Cartwright (1982), Hickin, Ditton, and McIntyre (1984), Dobson (1990), Simpson (1990), Yoshida et al. (1991)]. However, these aimed at automation or modification of an individual work process within the entire process and were carried out independently. A few attempts have been made at changing the total work flow as a whole [Hines and Pinnes (1988), Takahashi, Oyamada, and Aso (1991), Blasko (1992)].

2.2 Customer Service Quality

As mentioned in Section 1, customer satisfaction is subjective, and therefore difficult to study quantitatively. In order to deal with this difficulty, we have defined the new measure, "measures of customer service quality (MOSQ)", between the Network System and the customer satisfaction. Thus the customer service quality evaluation method can be divided into two stages. In the first stage, the impact of improvements in the MOSQ is evaluated under the condition that the work flow procedures, OpSs, and network elements are given. This enables us to evaluate how the introduction of new products or technologies will affect operations prior to actual implementation. The second stage deals with more complicated problems involving psychological aspects of human beings as well as statistical and mathematical theories. This paper deals with the first stage only, thus the issue of evaluating customer service quality is transformed to the issue of evaluating the MOSQ.

Table 1 shows several examples of MOSQs related to the telephone service provisioning process. This study primarily evaluates the MOSQ in terms of time, especially the response time which means the total required time from the customer's request through actual installation.

The reasons for choosing the response time are as follows.

(1) Many customers desire quick telephone service after making a request.

(2) Time is an easier measure to evaluate quantitatively than others.

2.3 MOSQ Evaluation

When evaluating the response time as a MOSQ, Many difficulties arise as described below.

(1) The response time depends not only on how orders are processed in each section but also on how they flow among several sections. Therefore, the total process should be considered.

(2) The response time includes not only processing time but also blank time, i.e., the time during which the service process halts for various reasons. These include the time waiting for workers at each section and the procedural delay before receiving service orders.

(3) The result should be evaluated in the form of a distribution. This means that average values are insufficient because a few poor services could easily damage the credibility of the company.

Computer simulation methods have been used to overcome these difficulties [Chubb et al. (1987)]. Simulation

Table 1: Examples of MOSQs

Item	Objective		Subjective
	Time for Service	Others	
Total Process	· Response Time in the Service Provisioning Process (Total Time from Customer's Request through Installation)	· Grade of Charge	
At Service Counter	· Waiting Time at Reception · Required Time at Reception	· Number of Places to Receive Customer's Order · Number of Items to Declare	· Manner of Representative · Ease of Understanding Explanation
At Customer Premises	· Processing Time at Customer's Premises · Time Difference between Customer's Request for Installation and Actual Installation	· Probability of Meeting Customer's Request for Installation Day/Time	· Adequacy of Construction · Manner of Installer
At Billing	· Waiting Time to Pay · Required Time to Pay	· Number of Places to Pay at	· Manner of Representative · Ease of Understanding the Account

is used in various industries to evaluate customer service quality [Aran and Kang (1986)] and to optimize operations [Millar and Gunn (1990), Basu and Blasko (1991)]. Among various simulation languages, SLAM II (Simulation Language for Alternative Modeling) [Pritsker (1986)] was selected for the following reasons.

(1) A service order can be modeled as an "entity" which flows through the "network model" when process-based simulation languages including SLAM II are used. This type of simulation makes it easy to evaluate the "waiting time" which is one of the factors of blank time.

(2) The SO work flow may vary depending on the situation. For example, when some members of a section are busy, other members of the same section or another

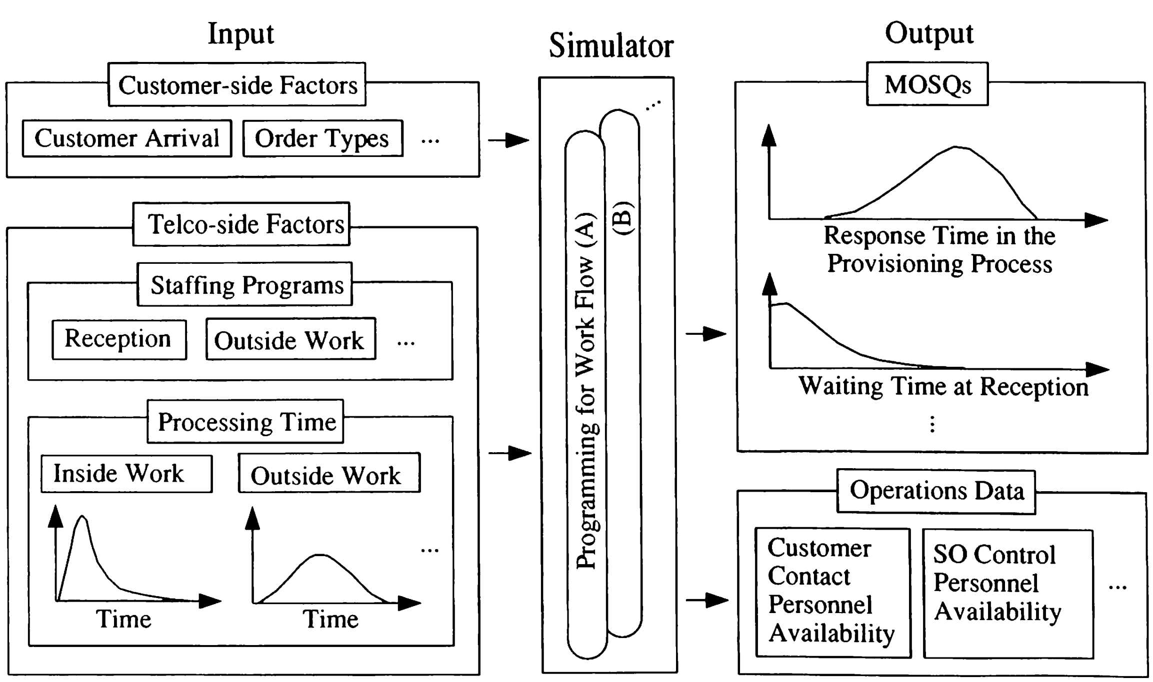

Figure 3: Outline of Work Flow Simulator

section may help them. SLAM II has the ability to define event subroutines with FORTRAN, so any complicated procedure unable to be represented with a network model can be described.
(3) SLAM II supports the graphic interface TESS (The Extended Simulation Support System). With TESS, network models of SLAM II can be made schematically, and simulation results can be analyzed visually by means of graphs or animation.

3. WORK FLOW SIMULATOR

3.1 Outline of Simulator

A "Work Flow Simulator" using SLAM II was developed to evaluate the MOSQs. Figure 3 outlines this simulator.

The input data to the simulator are divided into customer-side and telco-side factors. The customer-side factors depend on the customers themselves such as the distribution of customer's arrival and the probabilities of order types. These factors differ by area (e.g., population of the area) and season (e.g., the end of the fiscal year). The telco-side factors depend on operational policies including staffing programs, processing time, etc. The processing time differs depending on the ability of the personnel and the occasion. The processing time data are entered into the simulator in the form of a distribution to reflect these factors.

Using this simulator, MOSQs such as waiting time at reception and response time in provisioning process can be obtained as distributions. Operational data such as personnel availability in each section can also be obtained. By making simulation programs based on various flows, the differences in MOSQs depending on work flows can be estimated.

3.2 Network Model

Figure 4 shows a simplified SLAM II network model in the proposed Work Flow Simulator. This model is based on the present work flow shown in Figure 2. An entity represents an SO in the flow. Table 2 shows examples of variables in the network model.

Several ideas are applied to describe this model.
(1) An entity flows through different routes according to its SO type and requirements such as the necessity to as-

Table 2: Examples of Variables in the Network Model

Variables	Definition
ACT/ 1	Reception
ACT/ 2	Cable and Inside Plant Assignment
ACT/ 3	Entering SOs into the OpS
ACT/ 4	SO Print Out (Frame/Switching Section)
ACT/ 5	Assigning Inside Work Technicians
ACT/ 6	Inside Wiring
ACT/ 7	Entering Customer's Data into the Switch
ACT/ 8	SO Print Out (Installation/Repair Personnel Section)
ACT/ 9	Installer Dispatch
ACT/10	Schedule Management
ACT/11	Equipment Supply
ACT/12	Visiting, Outside Wiring and Customer Premises Work
ACT/13	Line Test (Inside and Outside Plant)
GAT1	Reception Hours
GAT2	Timing for Periodic SO Print Out at Frame/Switching and Installation/Repair Personnel Section
GAT3	Procuring Equipment
GAT4	Timing for Periodic Order Reception at Installer
WORK	Resources of Outside Work (Installer)
TEST	Resources of Line Test (Frame/Switching Section)

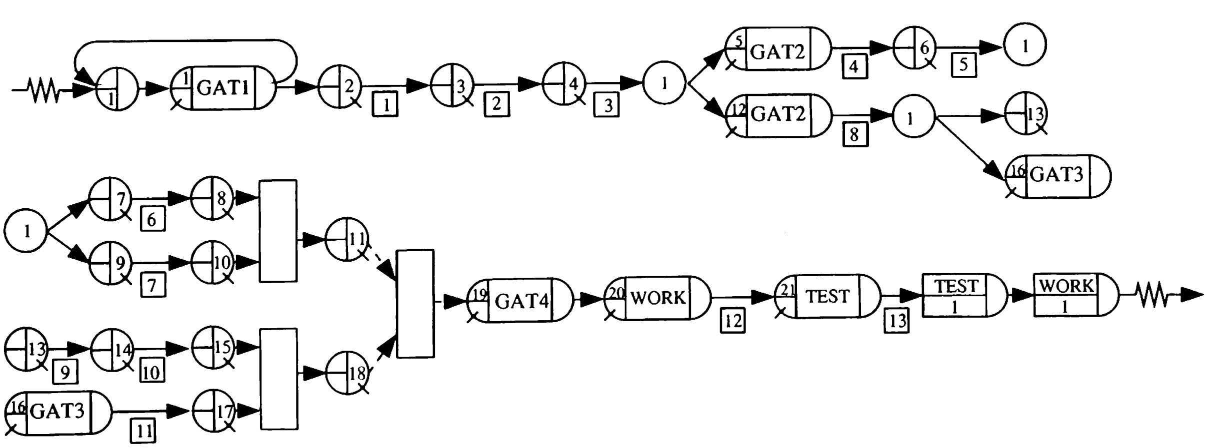

Figure 4: Simplified Network Model in the Work Flow Simulator

sign line equipment and the necessity for installation. This is implemented by making the entity flow through each ACTIVITY toward the ASSIGN node which represents the order type.

(2) The order flow is controlled by several types of GATEs: customer reception hours, order transfer between sections, frequency of receiving orders from OpSs, and working hours. The orders go through AWAIT nodes if the gates are open.

(3) If a worker performs different tasks, the worker is considered to be a RESOURCE. A task can be done only when it can occupy the related RESOURCEs.

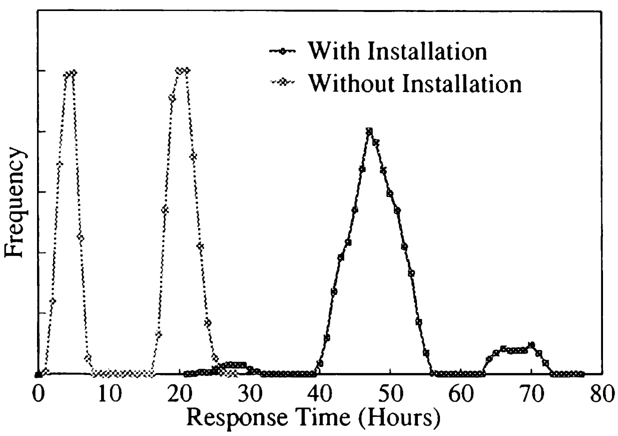

Figure 5: Response Time Distribution

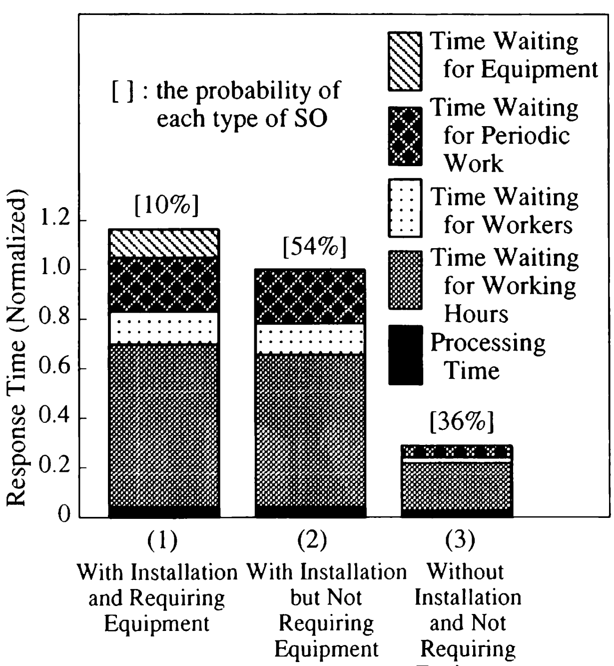

Figure 6: Breakdown of the Response Time

(4) Sometimes an order flows through different sections in parallel then comes together at the next step. In the network model, the same order identified by its serial number comes together at the MATCH node.

4. ANALYSIS OF SIMULATION RESULTS

4.1 Analysis of Present Work Flow

The present work flow is evaluated by the Work Flow Simulator to clarify the MOSQs. The response time corresponding to the required time from the customer's request through the actual installation is evaluated taking a small telephone office in a typical residential area in Tokyo as an example.

Figure 5 shows the response time as a distribution for two categories of SOs: SOs requiring installation and those not requiring it. As described in 2.3, the response time includes the blank time. The response time for SOs with or without installation is about 1 or 2 whole days. It is much longer than the processing time (about 120/80 minutes for SOs with/without installation).

Figure 6 shows the breakdown of the response time. Although the response time depends on the type of SO, this analysis focuses on SOs for customers moving in from other serving areas. These SOs are classified into three groups: (1) with installation and requiring equipment (mainly telephone equipment), (2) with installation but not requiring equipment, and (3) without installation and not requiring equipment. (If equipment is necessary, installation is also necessary.) This indicates that the blank time, such as time waiting for working hours, periodic work, and workers, is dominant and is much longer than the processing time itself. Therefore, decreasing the blank time concerning these factors seems to be more effective for reducing the response time than decreasing the processing time by process automation such as wiring robots in the distributing frame [Yoshida et al. (1991)].

4.2 Proposal for New Policy

The results in 4.1 show that the response time can be greatly reduced by decreasing the time waiting for working hours; e.g., by extending working hours. This policy, however, is not realistic because involves problems of labor management. Next, we examine the second and third dominant factors; i.e., time waiting for periodic work and for workers. The following three work policies (b)~(d) are proposed and compared with the present work policy (a).

(a) present work flow and present staffing program
(b) increasing the number of workers
(c) increasing frequency of periodic work
(d) a combination of (b) and (c)

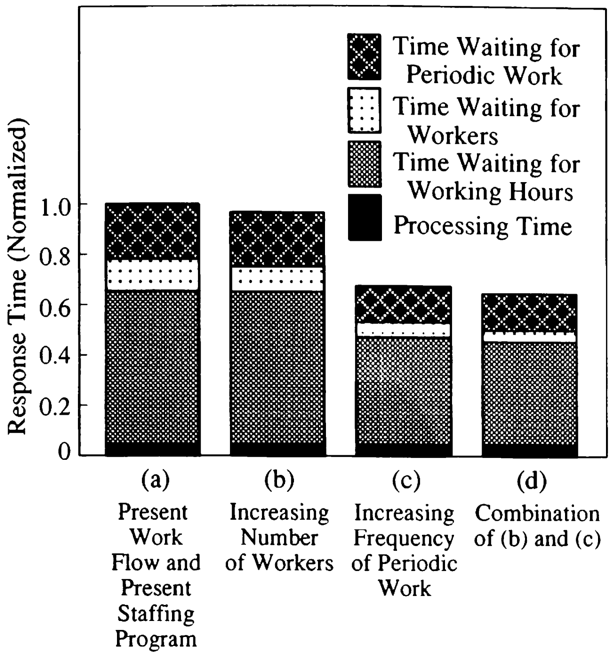

Figure 7: Response Time for Possible New Policies

The results are shown in Figure 7 for the most popular type of SO, "with installation but not requiring equipment". Policy (c) is more effective than policy (b). This is because the time waiting for periodic work is more important in the response time than the time waiting for workers. In addition, increasing the frequency of periodic work averages the work load during working hours, so that reduces the time waiting for workers and working hours. Although policy (c) is a little less effective than the combination policy (d), it seems to be the only realistic policy when the number of workers is limited.

In this way, by running simulation programs based on the proposed work policy, we can estimate the MOSQs specific to the policy. By comparing the results of various policies, we can determine the optimum work policy prior to the actual introduction.

5. FUTURE WORK

The present Work Flow Simulator has the following problems.

(1) Engineers with knowledge of simulation techniques are needed to model the flows, code programs, and analyze the results. Furthermore, the turn-around time to obtain an answer is long.

(2) This simulator only deals with the telephone service provisioning process. To evaluate another process, it is necessary to make another simulator, although similar techniques might be applied.

(3) Only objective factors such as the response time and the probability of meeting a customer's request for installation day/time can be evaluated quantitatively. This simulator cannot evaluate customer satisfaction itself.

Future works will be focused on two areas to solve the above problems.

(1) Developing a user-friendly simulation system based on the following three key technologies.

a) The CASE (Computer Aided Software Engineering) tool which enables automatic modeling and coding.

b) Extension of the HMI (Human Machine Interface), which allows schematic input [Johnson et al. (1982)], graphic output, and animation.

c) An object-oriented simulation language [Belanger (1990)] to give high software reusability.

With the simulation system using the above technologies, managers at branches or in telephone equipment divisions who are not experts in simulation languages can make timely decisions for whole service provisioning process [Rogers and Flanagan (1991)].

(2) Determining the relationship between MOSQ and CS/CE (customer satisfaction/customer expectation). This may require psychological theories, ergonomics, fuzzy logic, or automaton modeling. These methods will show how to improve customer satisfaction.

6. CONCLUSION

We have proposed a new method of evaluating customer service quality prior to the actual implementation by defining a new measure, MOSQ, which is a measure of customer service quality. A Work Flow Simulator was developed to evaluate the MOSQ for the telephone service provisioning process. This simulator can evaluate the response time in the telephone service provisioning process as an example of the MOSQ, and can show what improvements would be made to the present work flow.

ACKNOWLEDGMENTS

We would like to thank Mr. Chihaya Tanaka and Mr. Hisao Uose of NTT Telecommunication Networks Labs., Dr. Sadahiko Kano of NTT Network Engineering Headquarters, and Dr. Yoshikazu Yamamoto of NTT Telecommunication Field Systems R & D Center for their valuable discussions and technical advice. We are also most grateful to Mr. Minoru Takahashi of NTT Shinjuku Branch for his helpful comments on SO work flow.

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