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A SIMULATION SYSTEM FOR EVALUATING CUSTOMER SERVICE OPERATIONS IN TELEPHONE COMPANIES

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ABSTRACT

A simulation system has been developed for evaluating the customer service operations of telephone companies. The operation flow to be simulated is described by manipulating icons and links on the display. The operation flow is then simulated and quantitatively evaluated in detail.

1. INTRODUCTION

One of the most important services provided by telephone companies is customer service, which involves interactions between customers and telephone company personnel. The degree of customer satisfaction corresponds to customer service quality. To improve customer service quality and to make service operations more efficient, the operation flows in each telephone office must be re-engineered. Since quality is evaluated by customers when a service is provided, it is difficult to determine the quality of a service before it is actually provided. To evaluate customer service quality, such quality measures as service response time and waiting time at reception have been defined and evaluation methods based on computer simulation have been proposed [Ozeki et al. (1992)].

When evaluating and re-engineering customer service operations, simulation models should be constructed to match office conditions because operation flows are quite different among branch offices. We can simulate the customer service operation re-engineering process as shown in Figure 1. The process consists of five steps:

Step 1- investigate data needed to make simulation model,
Step 2- model and make simulation program,
Step 3- simulate operation flow based on the model,
Step 4- analyze results, and
Step 5- make improvement plans.

The optimum operation flow is determined by repeating from Step 2 to Step 5. Since simulation programs must be created, it takes a while to complete the process.

To shorten the evaluation time, we have developed a simulation system for evaluating customer service operations that allows users who are not experts in simulation languages and/or techniques to develop new procedures

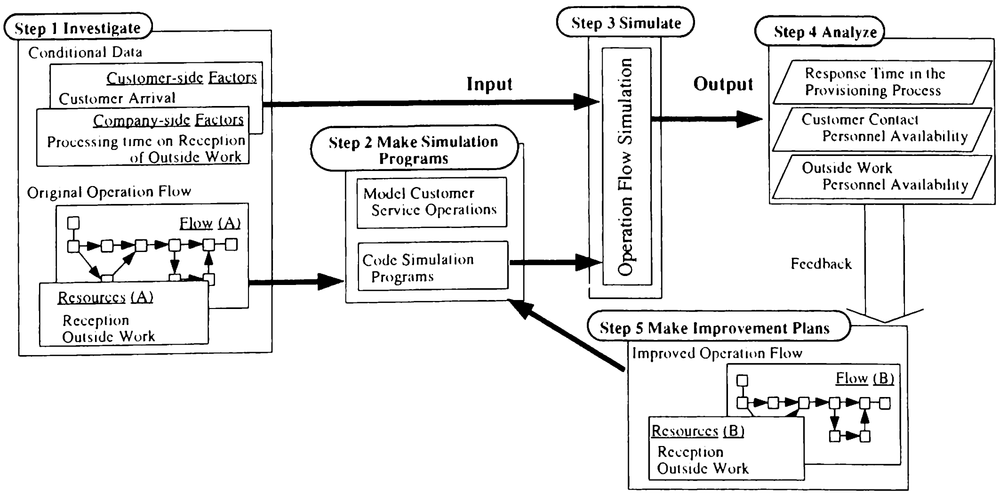


Figure 1: Customer Service Operation Re-engineering Process using Simulation.

over the entire range of customer services.

2. REQUIREMENTS AND IMPLEMENTATION OF SIMULATION SYSTEM

Systematization of Step 5 in Figure 1 is very difficult because it requires knowledge of and experience in customer service operations. The simulation system proposed here thus supports Steps 2 to 4. The requirements for the system are as follows:
(1) easy input of operation flows,
(2) automatic generation of simulation models,
(3) execution of simulation models, and
(4) visual illustration of the simulation results.

To satisfy these requirements, our system consists of three software modules: pre-processor, simulator, and post-processor. Figure 2 shows the configuration of the system and the data flows between these modules.

The simulation system was developed in the C language and runs on a SUN SPARC workstation in an OPENWINDOWS environment.

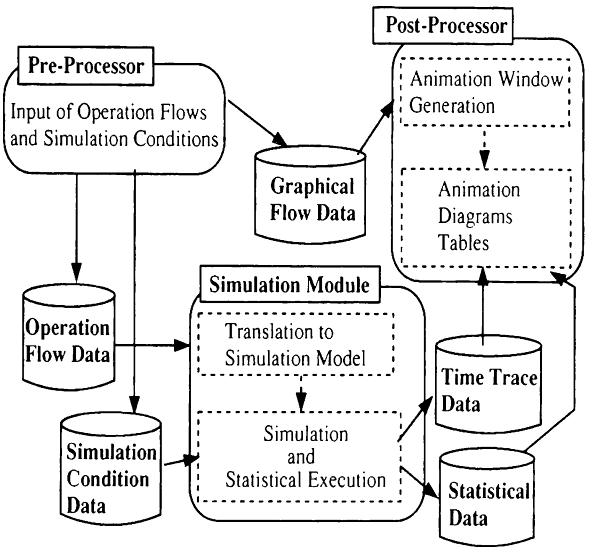


Figure 2: System Configuration and Data Flows

2.1 Pre-Processor

The pre-processor supports the input of operation flows, divides the input data into graphical flow data and operation flow data, and stores the data.

The operation flows are easily described by placing and connecting icons in a graphical window with a mouse. A node icon can be placed anywhere in the window by moving the mouse cursor and selecting the node type on the menu, which is in a dialog box (a pop-up window). The user can then create corresponding operation flows by connecting the nodes. More detailed operation

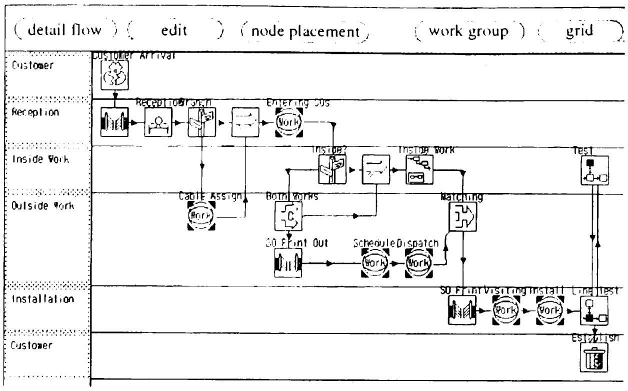


Figure 3: Input Window for Operation Flow in Pre-Processor.

flows can be described in another window that corresponds to lower hierarchical operation flows. These detailed flows play the same role as programming subroutines. Users can easily build even complex operation flows because the detailed flows are reusable. Node attributes are entered with the pop-up window. They include the node name, processing time distribution, and resources. Figure 3 shows an example of an input window for an operation flow. It is based on the telephone service provisioning operation.

Inputting simulation conditions, such as the period and iteration number, is also supported by the pre-processor. The data are stored as simulation condition data.

2.2 Simulation Module

The simulation module automatically translates the operation flow data into a simulation model and then simulates the operation flow by using the simulation condition data. After the simulation, the time trace data for animation display and the statistical data, such as the average and standard deviation of response times, are stored.

The simulation program is made by combining executable programs corresponding to the input data. These executable programs, which are compiled and linked with library files, were previously stored. They are written as discrete-state event scheduling simulations [Balci (1988)].

2.3 Post-processor

2.3.1 Animation

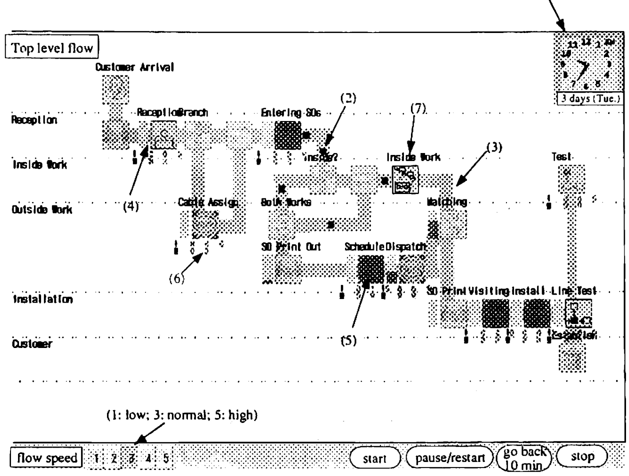
The post-processor automatically generates an animation window based on the graphical flow data and displays the time trace data by post-processing animation [Henriksen (1992)]. The post-processor can display animated results independently of the simulation module only if time trace data exists.

Figure 4 shows an example of an animation window. The squares on the paths represent entities, and the movement of the squares along the paths represents streams of entities. The level meter shows the queue state. If many entities are queued up, the meter turns red. The color of each server node changes according to the state of the resources being used; red means the node is working, gray means the node is free. In this way, the animation function helps in the analysis of the state of the working server nodes and queuing entities.

2.3.2 Diagrams and Tables

The post-processor provides diagrams and tables for easy analysis of the simulation results. The simulation results stored in the statistical data can be manipulated with spreadsheet software, such as Lotus 1-2-3.

Figure 5 shows example statistical data representations. Figure 5(a) shows the calculated response time as a distribution for telephone service installation. Figure 5(b) shows a breakdown of the average response time. Figure 5(c) shows the percentage of personnel utilization for each section.



(1) clock representing simulation time and date
(2) entity
(3) path along which the entities flow
(4) level meter shows queuing level of entities
(5) server node representing work condition: red is work, gray is rest
(6) number of resources (workers and machines) used by the server
(7) detailed flow node; this node has a more detailed flow in a lower layer

Figure 4: Example of an Animation Window.

3. EXAMPLE OF RE-ENGINEERING TELEPHONE SERVICE OPERATIONS

In this section, we discuss an example of re-engineering telephone service operations based on the results shown in Figure 5.

3.1 Analysis of Simulation Results

The simulation results indicate the following:

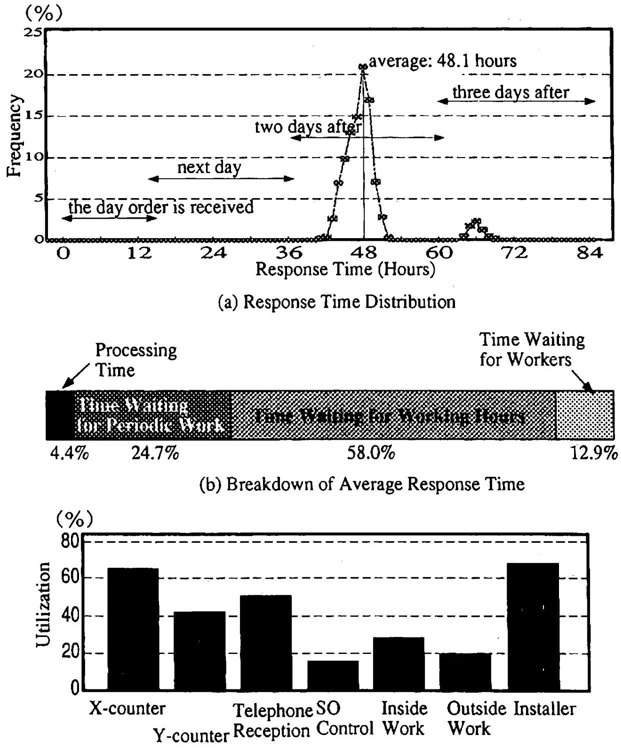
(1) While most orders are completed within two days, some takes as long as three days.

(2) The majority of time is non-productive time, such as time waiting for working hours, waiting for periodic work (such as printing service order sheets and bringing them to other sections), and waiting for workers. This time is much longer than the actual processing time. Reducing this non-productive time is more effective in reducing total response time than reducing the processing time by process automation.

(3) The biggest part of non-productive time is the time waiting for working hours. This can be reduced by increasing working time.

(4) Rearranging periodic work schedules or adopting flexible work styles can also reduce response time.

(5) The percentages of personnel utilization for each section are unbalanced across the different work categories. Assigning workers to more than one section would improve overall personnel utilization.



(a) Response Time Distribution

(b) Breakdown of Average Response Time

(c) Percentage of Personnel Utilization

Figure 5: Example of Statistical Data Representation.

3.2 Preparing Re-engineering Plans

To reduce the response time for installing telephone service, we prepared a re-engineering plan corresponding to the above analysis. While increasing working hours is most effective, it is not realistic because it would involve problems with labor management. We therefore focused on the second biggest part of non-productive time: the time waiting for periodic work.

One way to decrease the time waiting for periodic work is to increase frequency of printing order sheets. Figure 6 compares the expected results with the present process. Figure 6(a) shows that most orders would be completed within one day following the proposed re-engineering plan. The average response time, Figure 6(b), would be shortened to about one third that presently achieved. This is because increasing the periodic work would reduce not only the time waiting for periodic work, but also that for working hours.

4. CONCLUSION

To evaluate customer service operations, especially in telephone companies, a new simulation system has been proposed and constructed. It simulates operation flow characteristics and displays statistical simulation results, such as response time. It allows even users who are not familiar with simulation techniques to accurately analyze operation flows and to develop optimum re-engineering plans for individual telephone office. The proposed simulation system can also be used for other customer services.

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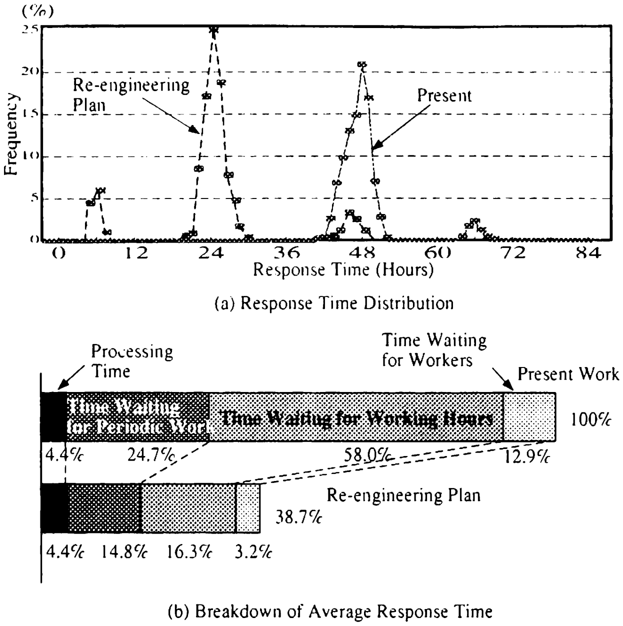

Figure 6: Effect of Re-engineering.

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