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USING A MANUFACTURING BASED SIMULATION PACKAGE TO MODEL A CUSTOMER SERVICE CENTER

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ABSTRACT

A model of a customer service center using a manufacturing based interactive simulation language is described. The current customer service center operating conditions were modelled so that "what if?" scenarios could be analyzed. The objective was to identify the conditions necessary to optimize the level of service to the customer based on the department's goal of answering 95 percent of the calls within the first three rings. Animation shows call and personnel flow within the system.

The model is data driven and the inputs are obtained from the telephone system. The user interacts with the model and data bases to test the effects of manpower and telephone system changes. The model records information on the performance of the individuals, bottlenecks, and staffing requirements based on the frequency of incoming calls.

This paper will describe the approach of data gathering, creating the model, simulating "what if?" scenarios, and reaching conclusions based on the results.

1. INTRODUCTION

During the first half of 1989 Square D Company's customer service centers were consolidated from seven regional locations to one central facility in Florence, Kentucky. This is where the Central Distribution Center for Square D's Distribution Services division is located. The driving force behind the centralization is to better respond to customer needs. The major benefits identified through consolidation are greater control of service levels, formalized training and career planning, and decreased cycle time for order entry (reduced from 3.5 days to same day processing). The consolidation also improves cost effectiveness through economies of scale; facility overhead has been dramatically diminished with a manpower reduction from 130 to 75 employees.

The Customer Service Center is divided into four groups each having a different operational responsibility. Orders are received by mail, facsimile, and telephone calls direct to the Customer Service Representatives (CSRs). Once the order is received, another group enters the orders into the mainframe computer. Any order which is rejected by the system is rectified by the Order Editing group. Once the order is processed by the warehouse, claims and credits are handled by the Claims Central group. The simulation project focuses on the CSRs and their interaction with the customers through the telephone system.

The Customer Service Center uses a dedicated phone network. The incoming calls are placed in queue and are automatically assigned to the first available CSR. The phone system has the capability to generate reports based on individual and group statistics. The various information tracked includes percent of calls answered within three rings, the call arrival rate by hour, telephone staffing by hour, call duration, post processing time, and individual performance levels.

2. GOALS AND OBJECTIVES

During the centralization process, goals were established in order to ensure competitiveness within the industry. The primary goal is to answer 95 percent of the incoming calls within the first three rings. This was derived, in part, by analyzing competitive information and assessing the customer call abandonment rates. After setting the goal, the next step was to determine the staffing requirements and systems changes necessary to meet the goal. Estimates were made based on staffing in the regional centers. At this point, the Operation Support staff was called in to help determine the optimal performance levels, manpower requirements, scheduling, and processing protocol. It was decided that a simulation model would provide the tool necessary to achieve these means.

The objective of the simulation model is to determine the "optimal" configuration to achieve the 95 percent call answer rate in a cost effective manner. The focus is on staffing levels, but system variables such as abandon rate and processing time are being tracked as well.

3. INFORMATION STAGE

Under today's operating conditions, the customer service center operates in the following manner:

Calls enter the phone system and are assigned to a CSR based on availability. If all CSRs are busy processing calls, after the third ring, the call is placed into a secondary queue. A percentage of these calls will abandon the system if the wait time is excessive. When a CSR becomes available, the phone system will assign calls on a first-in first-out basis. Once a CSR receives a call, time is spent performing any combination of the following functions:

- Taking an order
- Stock availability checks
- Customer/plant inquiries
- Post-call processing (follow up activities)
- Complaints and compliments
- Outgoing calls for additional information

When a call is completed, the CSR becomes available for the next call unless post processing work is being conducted. The CSC' hours of operation are from 8:00 a.m. to 8:00 p.m.. The individual CSR work and break schedules are staggered to meet the coverage demands.

The efficiency of the Customer Service Center is measured by a processing formula called "Busy Time". Busy Time represents the time on the phone plus the time conducting post call processing. Results collected by this formula are accumulated into a frequency distribution. The distribution is used as an input to the model and can be modified to identify the effects of changing elements of the processing formula.

4. MODELING METHODOLOGY

WITNESS simulation software is being used for the modelling due in part to its user friendly, interactive, menu driven approach. Its animation helps to visualize the simulation results. Even though this is a manufacturing based package, its application to the service sector proves to be very accommodating. People and work stations are modelled as machines, breaks are treated as downtime, calls are represented by parts, and buffers are used to replicate the holding queues.

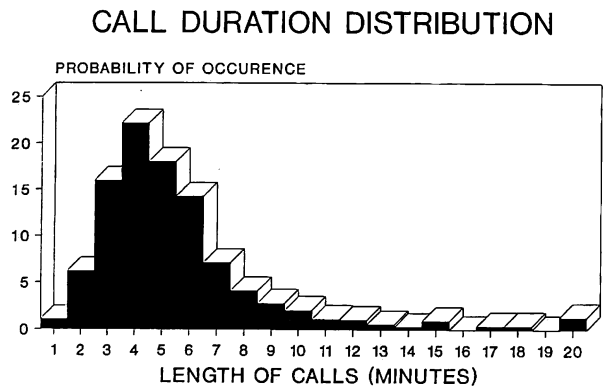
5. MODEL DESCRIPTION

A basic model (named BASE) represents the current processing conditions of the CSRs. By creating real-time conditions, the output is used as benchmark values against which the "what-if" scenarios can be compared. Reports generated by the telephone system provide much of the raw data used to drive the BASE model.

A variable "PERCENT" calculates the percent of phone calls answered within a set time interval in relation to the total number of calls coming into the system. The resulting percentage is compared against the 95 percent goal established by the group to test (1) accuracy of the model and (2) feasibility of a change in the system. Pseudo-random number generators intrinsic in the software aid in attaining higher confidence levels in the results.

Another variable being tracked is the number of calls abandoned. This is the number of calls that exit the hold queues during the simulation run due to excessive wait time. "Excessive" is defined by a variable which can be altered as required.

Each CSR is modeled with an independent machine and a corresponding break machine. Phone calls enter the system according to a predetermined demand rate. The call duration distribution is based on length of the call plus post-call processing time which involves writing orders, making calls out, and other miscellaneous duties.



6. EXPERIMENTS

A total of six "what-if" scenarios are presented after validation of the BASE model. Three involve changes in staffing and scheduling, and three involve changes to the phone system. The staffing changes are summarized by observing the hourly manpower requirements based on a specified demand. The manpower levels are derived from historical data collected on the phone system. Arrival rate of phone calls is broken down hourly to accurately reflect the demand. The phone call processing rate is partially determined by individual CSR productivity.

One of the system changes looks at increasing the CSR response time from three rings to five. The other two scenarios test changes to the processing times of the CSRs. Each of the results are analyzed through the PERCENT variable and by tracking the number of calls abandoned. A summary of the scenarios and results are listed below:

6.1 Experiment No. 1

ADD ONE CSR TO COVER TIMES 8 AM - 5 PM, WITH LUNCH 2-3.

One CSR is added to the BASE model to handle the phones during the given times and simulated over several trials. The result is a 91.20 percent average calls answered within the specified response time and 236 calls being taken outside the three ring constraint. A total of 130 calls were abandoned during this time period.

6.2 Experiment No. 2

REDUCE OUTGOING CALLS BY 20 PERCENT AND INCREASE CALL TIME BY 1.5 MIN.

The processing formula is revised by increasing average post call processing time by 90 seconds and decreasing the number of outgoing calls by 20 percent. The change results in a revised call duration distribution. The result is 96.72 percent of calls answered within three rings with 119 of 2,300 calls being answered outside of the constraint and 56 abandoned calls. The length of call distribution shows an increase in the number of calls around 4-5 minutes in duration. If more information is available to the individual CSRs, they will save the time of making outgoing calls to another source for the additional information. A decrease in outgoing calls will free up phone lines and result in more open channels for incoming calls.

6.3 Experiment No. 3

ADD 1.5 PEOPLE TO COVER:
(A) 10:30 am-7:00 pm, WITH LUNCH 3:30-4
(B) 3:00 pm -7:00 pm, WITH NO LUNCH

One and a half schedules are added per the above times and simulated over several trials. The result is 92.04 percent of the incoming calls answered within three rings with 227 calls taken outside of the constraint and 115 abandoned calls. Similar results are found when the 3-7 person was moved to 8 am-12 noon. This experiment is performed to test the effect of a temporary (part-time) employee.

6.4 Experiment No. 4

WHAT ARE THE HOURLY MANPOWER REQUIREMENTS TO HANDLE 95 PERCENT OF CALLS WITHIN THREE RINGS FOR 2,300 CALLS PER DAY, GIVEN TRANSFERS TO OTHER CSRs = 5 PERCENT, VACATIONS = 2,992 HRS PER YEAR, HOLIDAYS = 54 DAYS PER YEAR, ABSENCES = 2 PERCENT, MEETINGS = 4 HRS PER MONTH PER PERSON.

This experiment looks at the overall staffing requirements for the Customer Service Representatives. This is a macro approach instead of looking at individual hours where demand is high. To simulate this, the base model is modified to look at manpower needed based purely on phone demands. An additional screen was set up with CSR machines to test optimal number of people required for each hour of operation. Transfers are treated as additional phone calls for simplicity. Vacations, holidays, absences, and meetings are treated as time out of the system and amounted to two people out per day. The results are as follows:

Time of Day	CSRs Required for 95% Answer Rate (Average Calls per Hour)			
	(13)	(12)	(11)	(10)
8-9	8.7	9.5	10.3	11.4
9-10	16.5	17.9	19.5	21.5
10-11	18.6	20.2	22.0	24.2
11-12	20.0	21.6	23.6	25.9
12-1	15.8	17.3	18.7	20.6
1-2	16.4	17.8	19.4	21.3
2-3	19.6	21.2	23.1	25.4
3-4	20.0	21.7	23.7	26.4
4-5	19.6	21.3	23.2	25.5
5-6	9.5	10.3	11.2	12.3
6-7	4.1	4.5	4.9	5.4
7-8	1.8	1.9	2.1	2.3

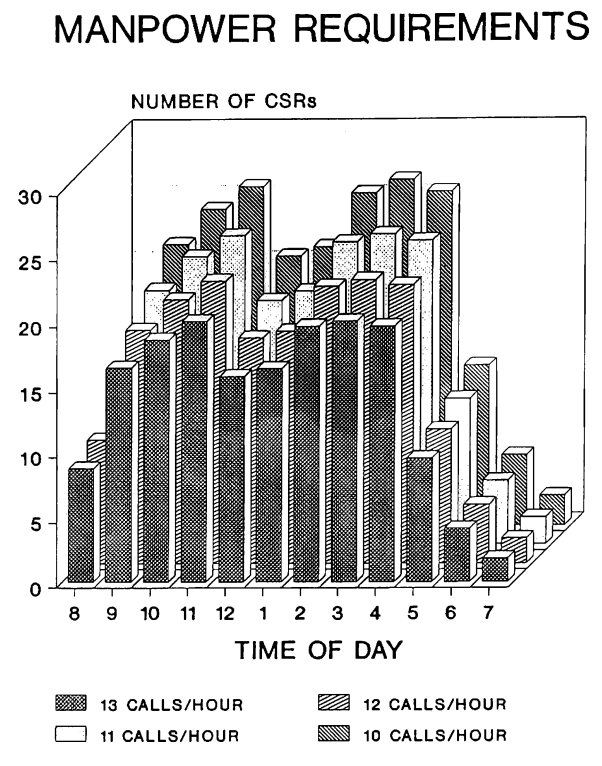


Figure 1. Manpower Requirements Based on Individual Productivity

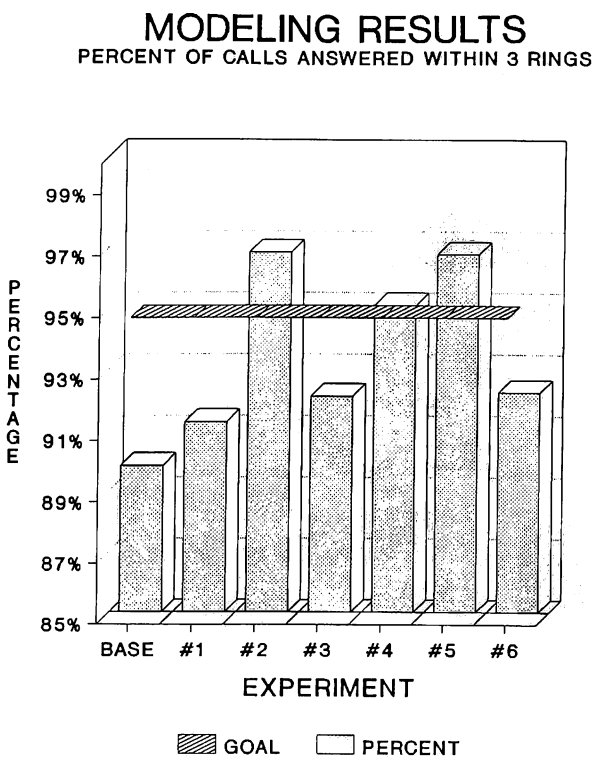


Figure 2. Modeling Results Comparisons

6.5 Experiment No. 5

REDUCE POST CALL PROCESSING TIME TO AN AVERAGE OF 32 SECONDS PER CALL

The post call processing value in the "Busy Time" formula is kept at a constant 32 seconds and the Busy Time distribution is once again recalculated. As a result, the percent of calls answered within three rings becomes 96.66 percent over several trials with 126 calls taken outside of the constraints and 87 abandoned calls.

6.6 Experiment No. 6

WHAT ARE THE EFFECTS ON THE 95 PERCENT GOAL IF THE RESPONSE TIME WAS CHANGED TO FIVE RINGS

The variable for number of rings before the call is transferred to a secondary queue is increased to five rings instead of three. The resulting percent of calls answered becomes 92.18 percent with 188 calls answered after five rings, as opposed to the BASE 89.78 percent. This experiment does nothing to affect the operation of the system, it, in effect, changes the goal.

7. RESULTS

The BASE model percent of calls answered within three rings averages 89.78 percent over ten simulation runs using different random number streams. Since the results fall below the 95 percent goal, manpower is added to the model to increase the service level. It is found that an additional two to four CSRs are needed to maintain a 95 percent service level based only on staffing changes.

Modelling the systems changes shows a higher potential than staffing changes alone. Changing the response time from three to five rings results in a PERCENT value of 92.18 percent. However, this only serves to loosen the constraints and results in a minimal service improvement.

Another change involves reducing a portion of the post call processing time. This results in a change in the distribution for call length, and the results show after several simulation runs a 96.66 percent rate of calls answered within three rings.

The final systems change involves reducing the number of outgoing calls by 20 percent and increasing the CSR talk time by 1.5 minutes. This scenario tests the hypothesis of providing more information on hand to the CSRs as opposed to having them call out for the information. This change results in an average answer rate of 96.72 percent over several runs.

8. RECOMMENDATIONS

The results of the "what-if" scenarios were examined and compared to the 95 percent call answer rate in order to improve response time. Upon review, the recommendations may be classified into two groups–staffing changes and systems changes. Both are described below.

8.1 Staffing Changes:

Using the BASE model's results of 89 percent and staffing of 27 CSRs as a benchmark, further modelling shows that a total of 29 people are required to staff the phones over the course of the day. The number of CSRs required is based on an average of 2,300 calls into the system per day at given demand rates which vary by hour. It should be noted, though, that the staffing number precludes time away from the system for such things as meetings and vacations which currently amounts to approximately two people "out" per day. Therefore, a total of 31 CSRs are required to meet the 95 percent answer rate goal.

8.2 Systems Changes:

Three of the "what-if" scenarios involve testing changes to the system in the way a call is processed. Two of these changes yield the best results. Both involve changing the processing formula which results in an increase in the number of calls at the three to five minute range in the call duration distribution. Therefore, it is recommended that procedural changes be made to make more of the calls average around four minutes. One of the ways this can be accomplished is by reducing outgoing calls, perhaps by providing more information on-hand.

The results given show that overall, changes to the system will present the greatest increases in percentage of calls answered within the constraints mainly by reducing phone processing time. An additional benefit is the increased availability of incoming phone lines.

9. FUTURE USES

Modifications to the model are being planned to identify the benefits of creating cross functional service teams. Each team would provide service to a specific group of distributors and customers. The teams would have responsibility of the CSR function as well as order entry, order editing, and claims and credits. This would allow a better working relationship with the distributors and customers and would allow a better response to their needs.

For the model to be more effective, the customer service center personnel will be trained in changing the inputs to the model so that experiments can be performed to test the effect on the system as special conditions arise. This will give the teams some ownership in the model and provide them a resource to test ideas before implementation.

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