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SIMULATION: A KEY TO CALL CENTER MANAGEMENT

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ABSTRACT

In the rapidly growing information and communications era, call centers are becoming an integral part for a majority of corporations. Consequently, it calls for practicing scientific decision-making methodologies and tools for strategic management. With a significant amount of investment in call center setup, resources, and business impact at stake, managing call centers is a complex issue.

The case discussed in this paper uses real-time discrete event simulation to model a typical call center environment. The main objectives behind modeling were to identify and optimize the total number of online resources and estimate off-the-phone work, while staying within constraints of queuing time and resource utilization to meet the highest level of customer satisfaction. Simulation provides a structured approach to do dynamic modeling of real life environments, understand behavior, analyze, and improve performance of both existing and future systems.

1 INTRODUCTION

Call centers are becoming an integral part for most type of businesses, ranging from communications, software hardware technical support to banking. In the current age and time, call center managers face tremendous amount of challenge than ever before. Modern communication devices provide great flexibility, but at the same time complicate the planning and analysis by making it possible to link centers, prioritize calls, provide agents with different skill sets and create customized routing algorithms. The industry is growing rapidly, creating opportunities for simulation modelers to solve its complex operational issues. Some of the most common issues that call center managers are facing on a day to day basis are:

- What should be my staffing level, how will it impact my financial budget?
- How can I handle variation in my forecasted volumes?
- How to keep up Service Levels and maintain Average Speed of Answer (ASA)?
- Should I staff more people or extend working hours, which scenario would be more beneficial?
- If I install a new communication gadget, how will it impact my ASA and staff utilization?
- If I decide to invest in reengineering, which process areas should I concentrate on?

Managers in the past have relied on back of envelope calculations or spreadsheet models to solve some of their issues. Unfortunately these techniques cannot take into account the complex dynamics and variation inherent to a real life system such as a call center. The case discussed in this paper illustrates how simulation can help managers make sound business decisions.

2 SIMULATION MODELING

Simulation is one of the methodologies that can effectively and accurately model a call center environment and study its performance to solve majority of issues. The simulation case study summarized in this paper illustrates one of the many ways how the technology can enhance call center management. The step by step simulation methodology used for this simulation case study is described by Pegden et al. (1995). The information published in the simulation case study is for presentation purposes only.

2.1 Problem Definition

The primary objective behind the simulation case study was to identify the total number of online resources. Specifically, the challenge was to build a model that could predict the appropriate level of Customer Service Agents (CSA) available to pickup the phone and help customers. There should be just enough number of CSAs to stay within the targeted Average Speed of Answer (ASA) range, hence optimization of resources under constraints is required. The simulation model was built using BPSimulator™, by Systems Modeling, Sewickley, PA, a simulation software that has the ability to project both queue times and resource utilization at varying levels of available resources. Thus, the model can help forecast what the optimum staffing level would be at specific times during the day and/or week.

2.2 Formulation

It is highly recommended to investigate and study the existing system if it exists or study other systems that have close behavioral resemblance. The simulation model should always be designed to focus on achieving primary objectives and not to imitate the real life system precisely. As soon as the flow of the entities, and functional relationships of activities within the system is understood a graphical logic diagram should be generated. The logical diagram helps communicate and better understand the processes involved. The schematic flow chart (Figure 1) shown below demonstrates call center operations at a very high level.

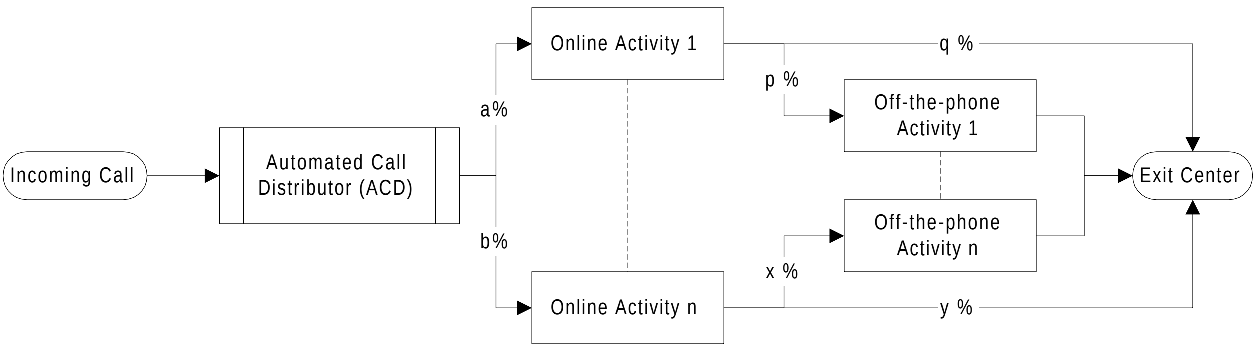

Figure 1: Schematic Flow Chart of Call Center Operations

Incoming calls enter the system based on a particular calling pattern, and are distributed by an Automated Call Distributor (ACD). ACD is an intelligent machine that can be programmed to handle various algorithms to distribute calls. The call is distributed based on the type of service activity to be performed by the CSAs. For each service activity, the work is either completed online and the call exits the system or it requires additional off-the-phone work before exiting the system. The split in the model between online and off-the-phone work is essential to provide accurate queue time (ASA) information.

In order to build a model that would provide the type of information requested, it was necessary to collect data related to volume of work coming into the center, the nature of work, and how much work is being performed online with the customer versus off-the-phone work. Because the model is attempting to establish online resources needed at various times, it was also necessary to collect data related to incoming call pattern.

After analyzing the incoming call pattern the interarrival rate distribution is determined. A typical incoming call pattern is illustrated in Figure 2. The challenge is that incoming call patterns have unique characteristics such as within a day, it has multiple intermediate peaks and valleys even though it follows a typical bell pattern. A downwardly reducing trend for number of calls from Monday through Friday was also noticed. The obvious reason being that people call mostly during the middle of the day and beginning of the week.

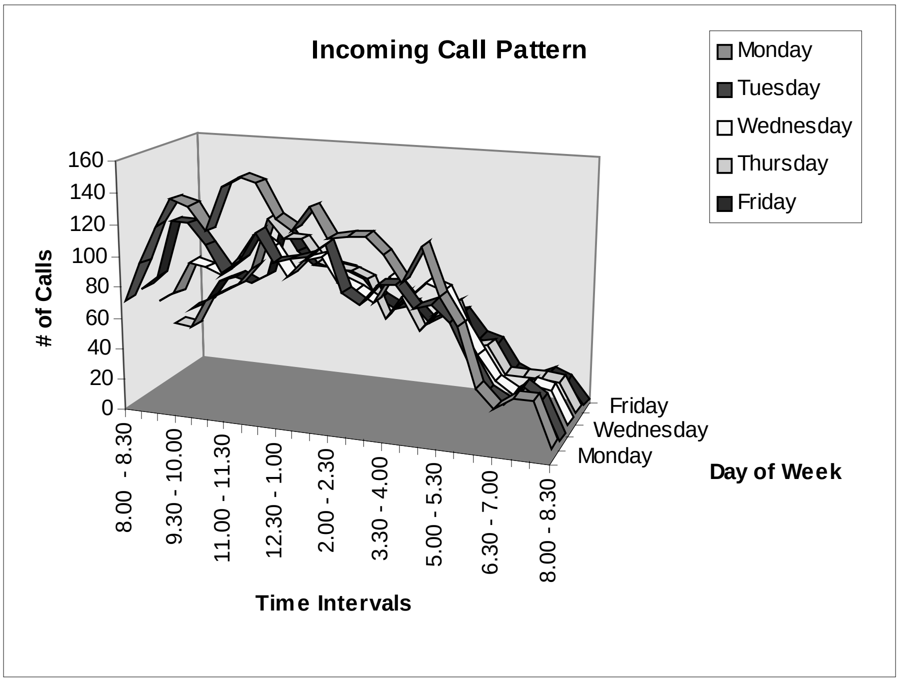

Figure 2: A Typical Incoming Call Pattern

2.3 Model Inputs

The main inputs into the simulation model are listed below and more detailed explanation of each follows:

- Interarrival rate
- Service activity mix
- Process times
- Number of resources
- Off-the-phone work frequency factor

2.3.1 Interarrival Rate

The interarrival rate represents the average time between each entity entering the system which in this case is an inbound call. Since the purpose of this model is to examine the impact of varying call volumes on resource requirements, it also will need to have multiple interarrival rates to capture trends within the calling pattern. The most prominently adopted methodology for calculating the interarrival rate is:

Interarrival Rate = (Total Time)/(Total number of calls processed within that time)

This means that on an average, an inbound call is received into the center every *x* time units that a CSA will need to answer. This factor is input into the model as "EXPO(*x*)," which means that entity interarrival time will be created based on an exponential distribution with a mean of *x*. In other words on an average, an entity will arrive every *x* time units, but there is some variability.

2.3.2 Service Activity Mix

The service activity mix determines what type of work will have to be performed as a result of the incoming call. The mix can be typically calculated using historical data of tracked work transactions. The main transactions performed at the case study center were: Billing Inquiries, Sales Requests, Service Request, Support Requests, Other Requests, and Referrals. Based on historical data, the percentage mix is calculated and used to distribute the entities within the system.

2.3.3 Process Times

Each activity has a unique process time in the model. Time and motion study is an acceptable methodology to calculate the process times. A less expensive methodology is to interview Customer Service Agents and Subject Matter Experts, ask for their estimates of time it takes to perform the particular activity. It is recommended to take minimum, maximum and most likely values of the time estimates because it can be translated into a triangular distribution. The modeler can use the inherent advantages of triangular distribution since we are approximating process times.

2.3.4 Number of Resources

As mentioned previously, the number of online resources is the desired output of the study. It is determined by experimentation, based on optimizing the queue time (ASA) and resource utilization. For online resources, the queue time must be as close as possible to the target ASA for the time period without exceeding and resource utilization should be around 90%. Since our resources are human beings it would be unrealistic to opt for 100% utilization. There is a second resource pool for the off-the-phone work that also needs to be entered into the model. However, the objective is only to identify the total amount of off-the-phone work, hence our primary focus is online resources since it affects the customer satisfaction and throughput of the system.

2.3.5 Off-the-Phone Work Frequency Factor

Since not all work is performed online, the model is designed to route a percentage of work to be done as off-the-phone work. Most of the activities performed in a typical call center generates off-the-phone work except for some activities like Referrals that are always done online. Based on historical data, an off-the-phone frequency factor should be calculated. After the entity is serviced online, it gets routed to off-the-phone activity or leaves the system as a successfully completed call based on the frequency factor.

2.4 Model Building

The model building phase is the one where simulation modeling expertise and creativity comes into the picture. The good thing about simulation modeling is that there is no such thing as "The Best Model." It is important to focus on achieving the primary objectives when building the model, but keeping in mind issues like secondary results and scalability. The model architecture of the simulation case study is depicted in Figure 3. The schematic flow chart is now modified and populated to reflect the system that is being modeled.

The model architecture clearly demonstrates the flow of the entities within the system. Based on service activity mix percentages, the entities will be randomly routed to the respective service activities. As soon as the entity arrives to the service activities it gets delayed by service process time. After the entity is serviced by the CSA it gets routed, either to exit the center or it goes to off-the-phone work activity and gets serviced. The numeric values for service activity mix, process times, and/or number of resources are not discussed, because it is proprietary information.

One of the challenges encountered during the model building phase was to construct the model in such a manner that queuing of entities takes place at the ACD, capturing the true ASA values. In other words it was structured in such a way that if there are no resources to take the call, entities would queue at the ACD (to mirror the real life environment). The model was build in BPSimulator™, which is has a good user interface and reasonably powerful engine to handle the model. Animating the model is a good verification technique, it can immediately pinpoint logical errors. It is recommended to construct a model in such a fashion that it can act as a communication tool. After the model was successfully built it was verified to reflect what it is supposed to do and validated to give the required confidence level in the output.

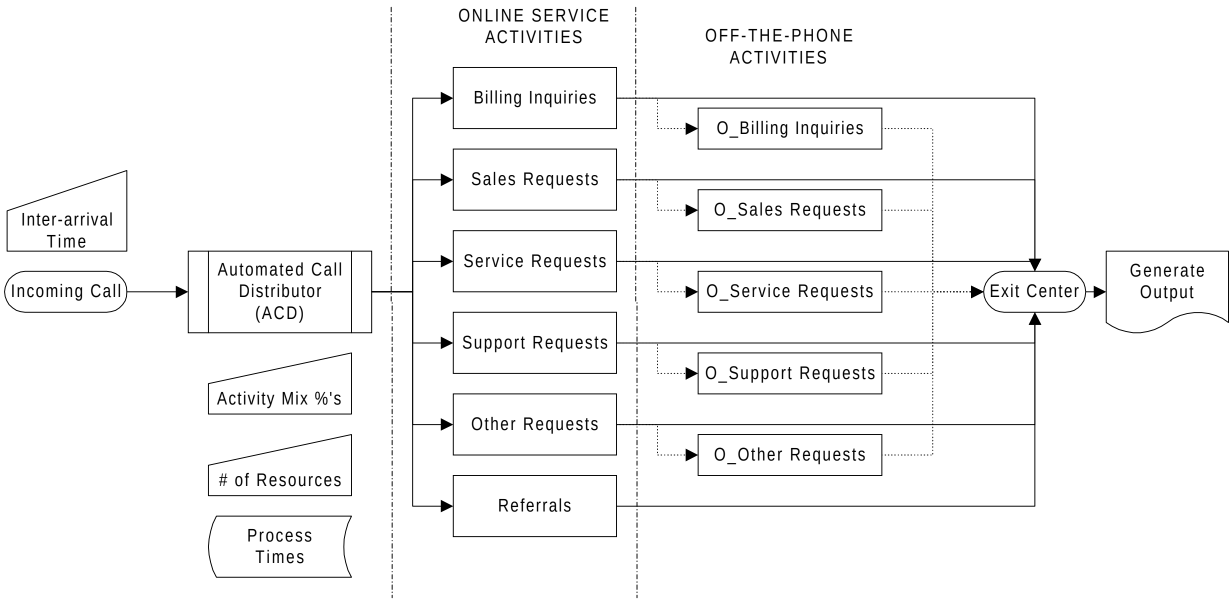

Figure 3: Model Architecture

2.5 Experimentation

During the experimentation phase, the model was run multiple times and some critical statistical tests were conducted to identify the steady state and run length of the model. Also, during the study it was identified that a day can be divided into three time intervals (i.e., morning 8.30 a.m. - 10.30 a.m., afternoon 10.30 a.m. - 3.30 p.m., and evening 3.30 p.m. - 8.30 p.m.) and still be able to capture the characteristics of incoming call pattern. The purpose was to determine online resources at various time intervals. The interarrival rate and number of resources will be variable inputs into the model. For each interarrival rate input, the number of resources will need to be adjusted with each run of the model. To optimize the online resources, the simulation results were analyzed for mainly two things. First, the queue time (ASA) which should be within the target range for the respective time interval and secondly, the resource utilization should fall under a range of 85% to 90%. This is so because we are dealing with human resources 100% utilization is not realistic and also, the inherent randomness in the arrival of incoming calls. Multiple runs where conducted to determine the required online resources, and total off-the-phone work time was calculated as a secondary result. Currently the model is being used to conduct various “what-if” analyses as a continuous process improvement tool. The model is also used from time to time to evaluate certain business scenarios to identify the best case.

3 CONCLUSIONS

The simulation case study discussed in the paper is a fairly simple case, as the purpose was to illustrate the use of simulation as a mainstream technology for call center management. Discrete event simulation was used in the case study to identify the optimal number of customer service agents needed to successfully meet the demands. The simulation case study helped the call center manager to staff appropriate number of resources, improve the quality of service levels, and increase customer satisfaction. The result is reduced operational costs, increased throughput, service levels and customer satisfaction. Simulation is a good visual tool to understand the behavior and process in various areas and widely used in many different types of industries.

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