Arena Simulation Training Guide for Simple Call Center

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Abstract: Arena simulation software is one of the most used software in the industry for studying discrete event process. The common medium for learning this software is by using the textbook which is quite difficult to understand and very time consuming as the book consists of many complex words and explanations. The objective of this study is to build training guide for a simple call center using Arena simulation. The call center problem description was obtained from textbook. Using the Arena student version software, a very detail step-by-step guide to model the simple call center was established. This was then followed by the simulation execution of the system and the analysis of the simulation result. From the analysis of data, the total attempted calls, completed calls and rejected calls from the model were recorded and observed. These result were compared with the text book result for model verification purposes. Finally, a new call center model was built using the training guide. The new model simulation was smoothly executed and all intended results were successfully generated. This indicates that the training guide can be a very helpful tool for beginners to learn building an Arena simulation model of a call center operations.

Keywords: Arena, Simulation, Training guide, Call Center

1. Introduction

Simulation refers to a wide variety of techniques and applications to simulate the ability of actual systems on a computer using suitable software. In fact, since the concept extends to many different fields, industries and applications, simulation may be an extremely general phrase. Nowadays, simulation is more common and effective due to presence of much better technologies such as computers and software. The advantages of simulation are improving insight into the effects of a system or change of process, manage inventory levels, employees, communications systems and better equipment, reduce times for delivery and abolish bottlenecks [1]. Simulation is commonly used in service, manufacturing, communications, government, and other segments of global economies to make better decisions, enhance processes, and prevent costly errors [2]. Examples of simulation programming languages used are GPSS, SIMSCRIPT, SIMULA, SLAM, Arena, AutoMod and Simio [3].

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Arena simulation represents an innovation in simulation technology by allowing enterprise-wide simulation. It is a systematic framework that encompasses all phases of a simulation project, from the analysis of input data to the analysis of output simulation data [4]. The simulation result can be a very vital input to manage and improve operational efficiency for many different type of industries. The efficiency and operational effectiveness of the telecommunications services are also non-exceptional in which call center is one of the important element of todays business. A call center is a centralized station to which present and future customers' phone calls are directed. A call center is gradually and rapidly becoming a strong service delivery strategy and it is an essential component of the activities of many companies in the world [5]. Call centers have provide a primary link between customer and service provider especially for airlines company, hotels, retail banks and credit card companies.

1.1 Problem Statement

A simulation model of a call center is important to help imitate the real life system of the call center system and to identify the problem that might occur in the system. It is generated by seizing available resources whenever they are needed through explaining how workers pass through their processing phases [6]. Studies by Gans et al. [7], Saltzman [8], Andhini [9] and Chuchual et al. [5] used Arena simulation software to simulate the process of call center but these articles and journals did not highlight the procedure or specific steps of using the Arena simulation software. The steps to build a simulation model can only be referred to the textbook and you-tube videos. This takes plenty of time in order to understand and interpret all the data and information given. Moreover, most of the time it is not easy to understand the learning material because these books consist of complex words and explanation. In response to this problem, this study proposes a guideline on how to build a call center simulation model using the Arena Simulation Software.

1.2 Objective and scopes

The objectives of this study are as below:

i.   To build a training guide for simple call center using Arena simulation.
ii.   To build a simple simulation model representing call center process by using the training guide.
iii.   To analyze the simulation result of the call center.

The scopes of this study cover the followings:

i.   The study focuses only on simple call center.
ii.   The project utilizes the student version of the Arena Simulation software.
iii.   The training guide is built based on existing software manual and textbooks.
iv.   The training guide does not cover complex animations.

2. Materials and Methods

2.1 Methods

Firstly, the problem statement was defined in which it was recognized that the currently available learning material from textbook is difficult to understand and has too much information. However, in order to provide a smooth future learning extension this study utilizes the same simulation model 5-1 from the Simulation with Arena textbook [10] as the designated call center. The training guide consists of all the method as well as the parameter needed for building the simulation model a simple call center. The simulation results analysis from the training guide model and the answer provided by the textbook

were compared to ensure the validity of the call center model. In fact, the training guide model was modified a few times before finally obtained the same answer with the textbook.

2.2 Data Analysis of The Training Guide Model

The training guide model was built based on the simple call center model from the Simulation with Arena textbook [10]. The data analysis of the training guide model was conducted by validating it with the textbook model. The percentage error was used to validate both call center models can be expressed as shown in the Eq. 1. The approximate value represents the value from the training guide model meanwhile the exact value represents the value from the textbook answer.

$$Percentage\ Error, \%\ error = \frac{Approximate\ Value - Exact\ Value}{Exact\ Value} \times 100\% \quad Eq.\ 1$$

3. Results and Discussion

3.1 Simple Call Center Simulation Setup

The description of the simple call center to be modelled in this guide are as the following:

1. One phone number for customers to call in to:
   - 26 trunk lines, one line is needed for each call (incoming or outgoing, either talking or on hold).
   - Arriving call finding no free trunk lines gets busy signal, goes away.
     - Count number of such rejected call.

2. Calls arrive with inter arrival time ~ EXPO (0.857) min.
   - First call arrives at time 0.

3. Three incoming call types
   - Initial recording time before deciding the type of service required ~ UNIF (0.1,0.6) min.
   - Probability independently for each call service requirement: Tech support (76%), sales (16%), order status (8%).

4. Tech support calls
   - For product type 1 (25%), 2 (34%) or 3 (41%)
     - Recording/select time ~ UNIF (0.1, 0.5)
   - Needs qualified tech-support person.
     - Two type 1, three type 2, three type 3 (no crossover to another type)
     - Separate FIFO (First-In-First-Out) queues for each type
     - Conversation time ~ TRIA (3,6,18) min. for all types
   - Then leaves the system.

5. Sales calls
   - All the same
   - Four sales staff, all the same
     - One FIFO queue feeding all sales staff.
   - Conversation time ~ TRIA (4,15,45)
   - Then leaves the system.

6. Order status calls
    *   All the same
    *   Handled automatically by phone system.
        ➢ No limit on number in process at a time, except for trunk-line limit.
    *   Conversation time ~ TRIA (2,3,4)
    *   After conversation, 15% of callers opt to talk to a person.
        ➢ Routed to sales staff, conversation lasts an additional TRIA (2,3,4)
        ➢ Sales calls have higher priority (non-preemptive)
    *   Center receives calls from 8 a.m. until 6 p.m. (10 hours)
        ➢ Must terminate arrival process at 6 p.m.
        ➢ Operate past 6 p.m. if it necessary to "flush out" all calls.

Figure 2 shows the snapshot from the training guide of the simple call center. The report from the previous research [11] explained the process to build a general model in Arena but this training guide is specifically meant for a call center model and consists more detailed explanations and infographic.
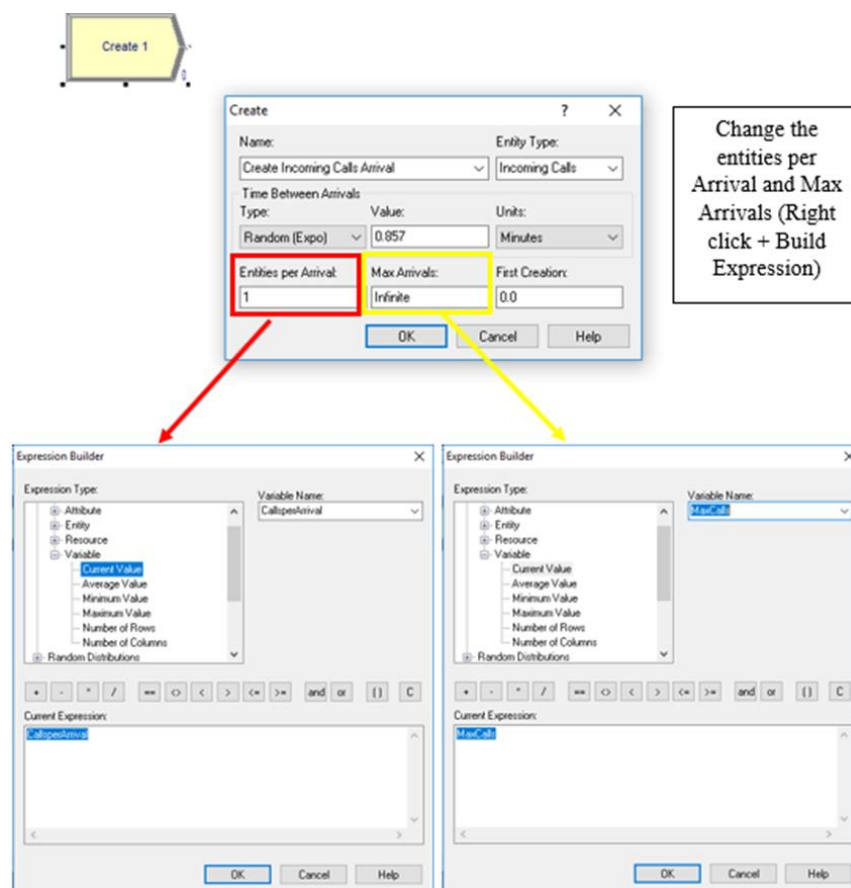
Figure 2: Snapshot of the training guide.

3.2 Validation of Training Guideline Model and Textbook Model

The validation of the simulation results between the model in the training guide and the actual problem in the textbook was performed for the total of attempted calls, completed calls and rejected

calls. The percentage error was calculated to measure the difference between the simulation model value and the exact value from the textbook answer. Table 1 shows the comparison between these values and it can be observed that the simulation model from the training guide produced results exactly the same as the textbook answer. This indicates that the training guide is capable of producing a valid model of a simple call center.

Table 1: Percentage error between the training guide model and the textbook answer

Parameters	Training Guide Model	Textbook Answer	Percentage Error (%)
Attempted Calls	734	734	0
Completed Calls	643	643	0
Rejected Calls	91	91	0

3.3 A New Call Center Model using Training Guide

In this section, a new model was built by using the above training guide. This new model of call center has one phone number for customers to call into 20 trunk lines. The number of rejected call that flush out during the busy trunk lines was counted. The arriving calls is exponential distributed at 0.857 minute where the first call arrives at time 0. There are 3 types of incoming call which are technical help call, sales call and order tracking call. The probability independently for each call are 70% for technical help call, 19% for sales call and 11% for order tracking call. The initial recording to decide the calls are uniformly delay from 0.1 and 0.6 minute. The technical help call is distributed about 31% for product A, 40% for product B and 29% for product C. The recording is UNIF~ 0.1,0.5. The technical help calls for each product need to be occupied with staff where there are two persons for product C and three persons for both product A and product B. The conversation time during the call for all type of products are minimum 3 minutes, most likely 6 minutes and maximum 8 minutes (TRIA~ 3, 6, 8).

The logic for the sales call is very similar to that described for the technical help call. The sales call required 4 sales staff and the conversation time is TRIA (4, 15, 45) minutes. Moreover, order tracking call are handled automatically by phone system. There is no limit on number in process at a time except for the trunk line limit. The conversation time for order tracking call is TRIA (2, 3, 4). After the conversation, 15% of callers opt to talk to a person thus the sytem will be routed to sales staff and the additional conversation time is TRIA (2, 3, 4). The sales call is non-preemptive call therefore it have higher priority in the system. The call center operates from 8 a.m. until 6 p.m. which exactly 10 hours a day unless it is necessary to flush out the call so it will operate past 6 p.m.

3.4 Simulation Result of New Call Center Model

Based on the simulation that had been executed, a report of category overview was obtained. There were 681 calls that going through the available 20 trunk lines of the call center system as shown in Figure 3. Furthermore, there were 680 attempted calls, 582 completed calls and 98 rejected calls that were successfully recorded during the call center operation which was for 600 minutes. The bar graph in Figure 4 shows the collected data of the total attempted calls, completed calls and rejected calls.

Replications: 1   Time Units: Minutes
Key Performance Indicators

System   Average
    Number Out   681

Figure 3: Category overview 1

User Specified

Counter

Count
                                    Value
Attempted calls   680.00
Completed Calls   582.00
Rejected calls   98.0000

Figure 4: Category overview 2

Based on literature review, Arena simulation had been used in various fields such as emergency medical services [12], customer service centers [13] and others. This strongly shows that the Arena simulation software is often used to imitate real-life situations. Consequently, the training guide of arena simulation specifically for a simple call center which was described above will be able to assist those who will be using this software for generating simulations of real-life situations in a more convenient way.

4. Conclusion

This study on Arena Simulation Training Guide for Simple Call Center was conducted to provide an easy guide for Arena software users to build any simulation model of call center. This study is intended to overcome the current issues on available textbook which was too difficult to understand due to the complex words and too much information. This study achieved the objective which is to build a training guide for a simple call center using Arena simulation. It has been shown that the training guide can be used to build simulation models of simple call centers. In addition, the simulation result of the new call center model was recorded and analyzed. Overall, the last model built using the guide recorded 680 attempted calls, 582 completed calls and 98 rejected calls during the 600 minutes call center operations. This fulfilled the last objective of the study involving the analysis of simulation result of the call center model.

Acknowledgement

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