Modeling and Simulation in McDonald’s Bambang

1. Kurt, L. Jhan Paul, M. Jay-vee, S. Fritz Jherald

Department of Computer Science, Technological University of the Philippines, Philippines

Abstract—This paper studies modeling and simulation wherein number of costumers are being determined in a specific amount of time. Any barriers or miscalculation might affect the number of costumers that may cause to the productivity of the specific fast-food location. To obtain a diagnosis of the system’s performance we will simulate the workflow running through preliminary architecture in compliance with the real time behavior to identify the bottlenecks and blockages in the flow trajectory.

# **INTRODUCTION**

Customer arrivals and service times are governed by statistical distribution such as exponential, gamma distributions, etc. These distributions provide a relevant range of values and randomness to the system. Therefore, using averages and experimental "Rules of Thumb" can be misleading or disastrous. Today's restaurants exhibit complex interactions between restaurant equipment, staffing levels, menu selections and customer order mix. Evaluation of how changes will integrate into this complex system often proves to be a challenging task. Small improvements have a significant impact when realized by 6,725 restaurants. One important tool which McDonald’s use to evaluate change is computer simulation.

Contrary to manufacturing systems, fast-food systems require a lot of labor. Additionally, the demand is typically sporadic and variable. Peak hours are when the majority of sales happen. Because of the fierce competition in the fast-food industry, it is essential that the service and production facilities be well thought out to handle peak demand. Computer simulation offers a precise way to assess restaurant changes without interfering with regular day-to-day operations. Before changes are made in the actual restaurant, their effects can be assessed on the computer to determine what will happen. Currently many fast-food restaurants tend to implement their new concepts and ideas and then observe and measure their employees and customers. This process is costly and could abuse both the employees and the customers. Simulation provides an alternative approach to testing. Through computer simulation, the new concept can be simulated, and the results will be studied beforehand. Modifications can be made, and the simulation is monitored again. After all the bugs are taken out of the system, the results and recommendations from the computer simulation can be implemented in the field.

# **MODEL DEVELOPMENT/IMPLEMENTATION**

* 1. **SIMIO Model**

A general-purpose SIMIO simulation application was used for simulation. Simio provides a systematic roadmap to improve your factory operations, to synchronize and fix the information contained in your Enterprise systems and to harmonize people and processes to finally deliver a production schedule which is fully executable. Simio’s patented risk analysis function allows variations in production schedules to simulate imperfect environments. This provides the necessary information to schedulers to allow them to optimize for peak performance. It also defines processes and objects step-by-step, graphically, with no programming required. Fast and easy portrayal of components allows analysis and removal of risk from complex systems.

The model has been developed in such a way that each "module" can be presented in detail or as a simple step in the system. For example, the kitchen is considered a module which can be modeled in detail (Sink (Entrance and Exit), Table, Registers, etc.) or can presented as a simple unit process. The following modules have been defined as:

* Dine-in module - Detailed modeling of dine-in customers requires that the following information be defined - the number and position of table and aisles, customer attributes like smoking vs. non-smoking, number of cars in the party, number of persons in party, number of waitresses and hostesses, zoning for waitresses etc. and all restaurant task assignments. By modeling the dine-in customers without detail, the only information which is important is the arrival rate and specific items ordered. All other details about dine in customers are ignored.
* Carryout module - Like Dine-in module where the Dine-in specific information is replaced with Carryout specific information. Detailed modeling of Carryout customers requires all information be included and accurate. Modeling the Carryout customers without detail simply puts demand on the kitchen based on the carryout arrival rate and specific items ordered.
* Take-out module - Similar to the Dine-in module where the Dine-in specific information is replaced with delivery specific information. Detailed modeling of take-out customers requires all information be included and accurate. Modeling the take-out customers without detail simply puts a demand on the kitchen based on the delivery phone call arrival rate and specific items ordered.

**FIGURE 1. Model created for simulating McDonald’s Bambang**

A screenshot of a computer

Description automatically generated with low confidence

Graphical user interface, diagram, engineering drawing

Description automatically generated**FIGURE 2. Drive-thru Model for customers outside McDonalds’ Bambang**

# **RESULTS AND DISCUSSION**

* 1. **Entity Configuration**

Throughout the model, entity configuration was used in events and user functions are called to execute in simulation subroutines. These subroutines make determinations such as:

* find a resource to perform a task
* which job to do next
* find a table for a given entity
* calculate specific food items for dine in, take-out, and drive-thru customers
* which resource to use
  1. **User Menus**

In addition to the configuration file, a user-friendly menu-driven system was developed which allows the user to change parameters of the restaurant in a user-friendly environment. The user menus include much of the same information as in the configuration files such as the three different customer types, capacity of all resources, job assignment, product mix, and arrival rates. The user menu will allow non-programmers to be able to utilize the simulation models.

* 1. **Animations**

Some animations were developed to be able to view the entire restaurant. The animations were used primarily for these purposes:

* As vital tools in debugging and validating the simulation model and understanding the true dynamics between the different restaurant modules.
* As an important tool for upper management to view the models. Animation allows management and other individuals to see the restaurants in action. Animation has been used in all simulation presentations

Following layouts that were developed:

* Location layout
* Drive-thru layout
* Table placement layout
* Counter layout
* Entrance and Exit layout
  1. **Data Requirement**

Obtaining the necessary data to feed the simulation model is a huge task in and of itself. We believe that to obtain an accurate simulation output, correct and precise input data must be used. The data necessary for the simulation model was voluminous and was obtained from two main sources:

* Main Frame Data Base - much of the required data was obtained through internal sources.
* Time and Motion Study - Time studies were performed in different parts of the country to collect production and service times for every activity "Task" that takes place in the restaurant such as "Greet Dine-In Customers."

# **CONCLUSION**

The validation process requires many steps, and it could be costly, and time consuming. However, Pizza Hut considers this process as an essential step and enough time must be spent on it to ensure model credibility. Therefore, the following steps were taken to verify and validate the simulation models:

* The data gathered along with the SIMIO were reviewed against the real system to ensure accuracy.
* Initial simulation runs were used to review the model output to point out any concerns or unreal output.
* Key performance measures of the system were defined. These measures were time in the system, waiting time to be seated, service time, etc.
* Both time study sheets and video cameras were used to collect the actual observation from a specific restaurant. This data was then entered into the simulation model and the simulation run was replicated a number of times to obtain independent identically distributed data points. Confidence intervals were calculated around these key performance measures. The outcome was very satisfactory when compared to the actual restaurant performance.
* Finally, the animation has added a great value to the validation process and to the credibility of the model. We conclude that the models accurately represent McDonald’s restaurants.

As the fast-food business grows more competitive, it is essential to have a sophisticated, highly flexible, powerful analytical tools available so that they can be used by engineers and analysts. Computer simulation helps us get better answers, faster at lower cost. Simulation modeling solves real-world problems safely and efficiently. It provides an important method of analysis which is easily verified, communicated, and understood. Across industries and disciplines, simulation modeling provides valuable solutions by giving clear insights into complex systems. Consequently, management turned increasingly to Operations Research for answers to operational questions ranging from the most efficient restaurant design to the optimum number of employees needed to serve customers as sales vary. The impact of simulation models has produced millions of dollars in savings, or profits, in a number of operational, design, and procurement areas.