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VIRTUAL KITCHEN SIMULATION

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ABSTRACT

KFC, a subsidiary of Yum! Brands, has identified the need to utilize advanced simulation to support kitchen performance improvement initiatives. To reach this goal, MOSIMTEC has supported KFC in developing several models. These models have several similarities and shared modeling approaches. The following sections provide the system descriptions and features of these modeling components.

1 CUSTOMER FLOW

A typical quick service restaurant has two customer flows; (1) Front Counter (a.k.a. Walk-In), and (2) Drive Thru.

A Front Counter customer goes to the Front Counter to place an order and make payment. The customer then waits for their food delivery at the waiting area. After receiving their food, the customer chooses dine in or carry out. Drive Thru customers place their order at a speaker box outside the restaurant, stop at window for payment, and then wait for the delivery of their food.

In the simulation model, customer arrivals follow a particular pattern selected by the user. The user can select either an arrival rate that varies by time or arrival data from real world historical observations. The simulated customers have behavior that can be configured by the simulation analyst. This includes preferred BALK logic (leave without ordering) and varying preference in choosing from menu items during different times of the day.

2 ORDER PROCESSING

When an order has been placed, the order goes through several steps. Each of these steps can consume materials/ingredients and use labor/equipment. Once the series of steps is complete for an order, the order is delivered to the customer. These order processing steps can be defined and configured in an input table, making it easy for the analyst to quickly play "what-if" analysis and explore the impact of menu changes.

3 MATERIAL SUPPLY AND PROCESSING

In a quick service restaurant, staff will consider anticipated demand in order to prepare the correct quantities of various ingredients. At the beginning of the simulated day, the model considers customer arrival data and customer preferences by time of day, to calculate ingredient demand across day parts. The cook resource in the simulation model utilizes this forecast to determine ingredient quantity to prepare.

Another configurable component of the model is the cooking system for batch processing. Batch processing may be used for items like biscuits or mashed potatoes, which are prepared in advance of actual customer orders, based on the forecasting described in the previous paragraph. As with order processing, each step can consume materials/ingredients and/or equipment/labor. Resource availability can impact the turnaround time for cooking activities.

4 ADDITIONAL LOGIC AND SUPPORTING TASKS

Additional logic exists in the model to change the behavior of the labor or customers. For example, when the cashier anticipates a long wait time a Drive Thru customer, the cashier will let the customer park at side of the restaurant. Moving this waiting customer leaves the window spot open to the subsequent customers in the Drive Thru line.

Cleaning tasks are critical to supporting the success of the restaurant. These tasks consume labor resources. When labor is idle, assigned workers will follow instructions in a user-defined table to perform cleaning tasks with varying levels of priority. Equipment maintenance may be applicable in the restaurant, and the user can specify requirements for any kitchen equipment via configurable model inputs. These maintenance tasks may either be based on time between events or based on usage counts.. Maintenance tasks consume labor resources and can impact the required labor cost and performance of a kitchen system.

The parameters mentioned above, along with others in the model, allow the user to represent the virtual kitchen at the desired level of detail. The user can complete what-if analysis and experimentation through configuring model inputs.

5 OUTPUT METRICS

In addition to 3D rendering of the restaurant operations, the model collects a range of output metrics. These output statistics are presenting at varying levels, which are summarized below:

- **Customer level**: customer waiting time for each step, order to delivery time, and customer throughput.
- **Order/product level**: financial information, containing cost and revenue from each product sold, availability of each product for inventory and food expiration reasons, and performance of the restaurant on each order/product.
- **Labor/equipment level**: overall utilization for each labor/equipment and utilization over specified period.
- **Other output metrics**: balked customer statistics for a specific the day, and food expiration volumes and associated cost.

6 BENEFITS

Given the configurable model and with qualitative and quantitative output metrics, the user can run analysis on various kinds of scenarios. This model allows better understanding of the impact of changes to the system for metrics like restaurant performance, resource utilization, and customer experience. Some example scenarios include:

- **Customer surge/product promotion**: what happens and how to cope with a customer surge or product promotion (discount)?
- **Testing new product**: how does new product impact current production line and what changes should be made to adapt to the new product?
- **Labor balancing/scheduling**: how should the restaurant balance the labor and improve labor scheduling given various system constraints?
- **Testing new features**: what impact do various opportunities have on the system? Examples of new ways of doing things include: adding unmanned order kiosks, adding another Drive Thru line, adding alternative ways of cooking some products, and changing customer flow.