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SIMULATION APPLIED TO THEME PARK MANAGEMENT

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ABSTRACT

This paper describes the application of computer simulation to a new and interesting problem area, the management of major theme parks. The operation and management of theme parks is becoming continually more difficult and competitive. The level of customer expectation for excitement and quality of experience is increasing at a much greater rate than the public's willingness to accept admission price increases. As a consequence, theme park management is asked to deliver more services, at a faster pace and with higher quality, with fewer and fewer seasonal employees. VMASC has begun to work with two local theme parks, Water Country USA located in Williamsburg, Virginia and operated by Anheuser-Busch, and Kings Dominion located in Richmond, Virginia and operated by Paramount Parks. The objective is to identify management issues and operational problems where simulation may serve as an important tool to assist in the decision-making process.

1 INTRODUCTION

The operation and management of major theme parks is becoming continually more difficult and competitive. The level of customer expectation for excitement and quality of experience is increasing at a much greater rate than the public's willingness to accept admission price increases. As a consequence, theme park management is being asked to deliver more services, at a faster pace and with higher quality, with fewer and fewer seasonal employees. Therefore, it seems prudent to attempt to harness the power of developing computer simulation technology (Casti 1997), which already is used to create and enhance theme park attractions, to assist park management to operate more efficiently and effectively.

The Virginia Modeling, Analysis and Simulation Center (VMASC), a consortium of industry, universities and government lead by Old Dominion University, was established during summer 1997 to promote the use of computer simulation for business enterprise management. The Center (Mastaglio and Schultz 1997) also attempts to facilitate the transfer of simulation technology between the Department of Defense and civilian industry through a Cooperative Research and Development Agreement with the United States Atlantic Command. During the past several months, VMASC has begun to work with the management staffs of two local theme parks, Water Country USA located in Williamsburg, Virginia and operated by Anheuser-Busch, and Kings Dominion located in Richmond, Virginia and operated by Paramount Parks. The initial focus of this work has been to identify management issues and operational problems where simulation may serve as an important tool to assist in the decision-making process. VMASC also has developed an initial prototype simulation of customer flow through the Water Country USA facility.

The purpose of this paper is to describe the application of computer simulation to a new and interesting problem area, the management of major theme parks. In Section 2, an assessment is made of how computer simulation tools can assist in the management of theme parks. The operation of a theme park is briefly described and the requirements for a simulation tool are identified. In Section 3, the design of a new set of simulation tools for the management of theme parks is described. Several of these tools are being designed to assist park managers to answer "what if" questions to assess the impact of change, to identify bottlenecks, and to investigate the effects of uncertainty. Another tool is being designed to provide to customers information useful for improving the quality of their experience at the park. The paper describes work in progress; a future paper will be required to assess the success of this work.

2 REQUIREMENTS ASSESSMENT

Water Country USA, located in Williamsburg, Virginia and operated in conjunction with Busch Gardens-Williamsburg by Anheuser-Busch, is a typical example of a small to medium-sized theme park. The park consists of sixteen major attractions, locker rooms and dressing areas, dining and concession facilities, customer parking area, pool and sunbathing areas, and functional areas for staff parking, office space, maintenance shops, and equipment storage. On a typical busy July day, the park will serve approximately 11,000 guests with a peak in-park load of approximately 7,000 customers. The park is staffed by a relatively small full-time staff to provide year-around management and technical functions, and several hundred seasonal employees to provide operational and customer support services during the operating season. The operation of a medium to large-sized theme park like Paramount's Kings Dominion in Richmond, Virginia is similar; however, there is a greater variability and complexity in the attractions and the scale of operation is two to five times larger. The management issues remain similar, however.

There are several independent variables, variables that affect park operation but which cannot be controlled by management, that must be taken into account. Independent variables include the state of the economy, the time of season, and weather conditions. These factors, together with the scheduling of special events or attractions and the long-term effectiveness of the park's marketing staff, determine the customer throughput and thus the gate revenue. Therefore, park throughput, or gate revenue, is considered to be an independent variable with respect to the near-term management of park operation. Another significant independent variable is unscheduled equipment maintenance and repair. If an attraction or customer service facility fails, it is necessary to close that area until repairs are completed.

There are at least three important factors, called performance measures, which park management attempts to control. The first performance measure, in-park revenue, refers to the income derived from the in-park purchase of goods and services by park customers. The revenue received from a customer purchasing lunch or renting a locker is an example of in-park revenue. Management attempts to maximize in-park revenue. The second performance measure, called operating costs, refers to the costs associated with operating the park. These costs consist of two components; facility operating costs and labor costs. The facility operating costs are usually fixed at or near some average value which is predicted based upon historical records. The labor costs are heavily dominated by the wages paid to the seasonal operating staff, many of whom are part-time employees. This labor cost represents the single largest controllable operating expense. The day to day staffing levels can be adjusted with very short lead times through careful management of work schedules and by holding a portion of the workforce in an on-call status. Clearly, it is important for management to keep labor costs as small as possible. The third performance measure, called customer wait-time, is a measure of the perceived quality of service experienced by customers. Since theme parks depend heavily on word-of-mouth advertising and repeat customer business, it is essential for management to keep the customer wait-time as small as possible. This performance measure is usually monitored as the percentage of the total in-park time spent waiting for access to attractions and services.

Control variables are the operating factors or parameters that park management can adjust to control or manage park operation. There usually are a relatively large number of control variables; several examples of the more significant control variables are identified in the following. One of the main control variables exercised by management is staff level control. As mentioned previously, the staff level can be adjusted very rapidly, often within one-third day intervals. Additional staff control is available by changing staff assignments. Each staff member is cross-trained to perform several different services or support functions, so that a staff member can be shifted from one task to another within a few minutes. Other important control variables are the operating schedule and throughput time of attractions. Attraction operating schedule control refers to the closing of certain attractions during periods of very low demand. For example, an attraction for toddlers may be heavily subscribed during the afternoon hours, but have no demand during evening hours. Closing this attraction during the evening hours decreases the staff requirement without affecting the perceived customer quality of experience. For many attractions, it also is possible to control the attraction throughput time. This is accomplished by adjusting the staffing level for the attraction, or by adjusting the attraction cycle time; that is, the time required to service one set of customers. Similar control is possible with service facilities such as dining facilities, concession areas, and ticket gates. These facilities usually have a number of service lines, and the number of service lines open at any given time is easily adjusted according to the anticipated customer demand.

It is clear that management cannot optimize all performance measures. At some point, reducing labor costs will begin to impact negatively on customer wait-time and on in-park revenue. The very best that management can do is to achieve some reasonable compromise among the conflicting performance measures. Because the relationship between the control variables, the independent variables, and the performance measures is extremely complex, it is not always clear how to adjust the control variables to effect the desired changes in the performance measures. It is here that simulation tools can most directly assist the management team.

Having briefly described the operation of a theme park, it now is possible to identify at least four requirements for a set of simulation tools designed to assist park management.

Operations Planning: A simulation tool requirement is to assist managers in understanding how changes to control variables affect performance measures for a given customer throughput level. Simulation tools should allow management to evaluate operating decisions before they are actually implemented, rather than by trial and error after implementation.

Training and Rehearsal: A simulation tool requirement is to assist managers to prepare in advance for unexpected changes in independent variables. Simulation tools must capture corporate knowledge for training the next generation of park management.

Visualization of Ideas and Concepts: It is often very difficult for management to explain new ideas and concepts to upper level management located at a distant headquarters or to employees who have a very focused and limited view of park operation. A requirement of simulation tools is that they assist others to visualize a concept and then to investigate the implications of implementing that concept.

Strategic Planning: A simulation tool must assist management with long term planning. Simulation tools should help planners investigate the effects of installing a new attraction or assess the revenue implications of a park enhancement. Simulation tools must decrease the impact of uncertainty on long range planning.

With the assistance of simulation tools, the theme park management staff is better able to address important questions like:

- How do we enhance the customer experience?
- How can we utilize the staff more effectively?
- How can we operate the park more efficiently?
- What will be the impact of investing in new technology?
- How should we respond if an unexpected upset occurs?

There is little doubt that appropriately designed simulation tools can be of significant assistance in the management of theme parks.

3 SIMULATION TOOLS

In this section, the design of a new set of simulation tools for the management of theme parks is described. Two simulation tools are being developed to assist directly in operations management and strategic planning. A third tool is being designed to serve as a customer information system utilizing an interactive web page as the delivery vehicle.

3.1 Enterprise Simulation

The enterprise simulation is a simulation of customer flow through the entire theme park facility. This simulation is being constructed using commercially available simulation development tools such as Service Model (Bateman et al. 1997), marketed by ProModel, Incorporated, and Arena (Kelton, Sadowski and Sadowski 1998), marketed by Systems Modeling Corporation. These tools facilitate the development of object oriented, discrete event simulations and have a convenient 2D graphical user interface.

The 2D background for the simulation is obtained by importing an AutoCAD overhead rendering of the theme park. Locations and interconnecting paths are placed on this background to model the routes along which customers can move, and to model customer flow through attractions and customer service facilities. Customers are represented as objects. During the simulation play, objects move from an initial location to a terminal nearest neighbor location during a time interval defined at the initial location. The identity of the terminal nearest neighbor location is also determined by decision logic at the initial location. Each object can be assigned one or more attributes. Attribute values are updated each time the object arrives at a terminal location, and these attribute values can be used in the decision logic which launches the object to the next nearest neighbor terminal location.

Independent model variables, such as customer arrival rate and customer departure rate, are realized through the appropriate construction of the decision logic at input and output locations for the park. The control variables, such as staff level, staff assignment, attraction schedule, attraction cycle time, customer service facility schedule, and customer service facility cycle time, are implemented through the control logic at the input and output locations for the attractions and customer service facilities. These variables can be set at the beginning of the simulation and later be changed manually by pausing the simulation. Alternately, the control variables can be changed in play using simple scripts which are keyed by a global simulation clock. Performance measures are calculated through the management of the object attributes. For example, the percentage of the total visit time spent waiting is computed through the manipulation of two attributes defined for each object. Attribute one counts the total time in park, while attribute two counts the total time spent in queues for attractions and customer service facilities; the ratio of attribute two to attribute one yields the desired performance measure.

3.2 Local Simulations

A local simulation is a simulation of a specific theme park area or feature. The purpose of this simulation is to view at the micro-level the details of a specific process or activity. The development process for a local simulation is identical to that used for the enterprise simulation. Information generated by a local simulation is often useful in understanding and modeling the components which constitute the enterprise model. Components of the theme park for which local models may be useful include customer parking, ticket gates, major attractions, dining facilities, and concession areas.

3.3 Customer Information System

The enterprise simulation tool is able to accurately estimate the queue length at each attraction under any predefined operating conditions. It may be attractive to use this new information to help park customers plan their park visit. As an example, using a simple kiosk system located near the park entrance, or even from the individual's home computer via the world wide web, a customer could review a list of attractions and request an itinerary. The information system could return a customized park map showing a route and estimated schedule. This itinerary could be computed to minimize wait time, or to minimize distance walked, or to follow a specific attraction order, or even to avoid specific obstacles of concern to a handicapped customer. If properly constructed, such an information system could become an extremely effective marketing and promotion tool. This tool might also provide management another means of more evenly distributing customers throughout the theme park.

A prototype version of the enterprise simulation was constructed for Water Country USA. This simulation implemented two independent variables, customer throughput and attraction upset, and one control variable, attraction scheduling. Only one performance measure, percentage of time spent waiting, was monitored. The simulation followed 11,000 objects through a 10 hour day and ran from start to finish in approximately 14 minutes on a 200MHz. Pentium PC. This prototype simulation, shown in Figure 1, clearly demonstrates the feasibility of

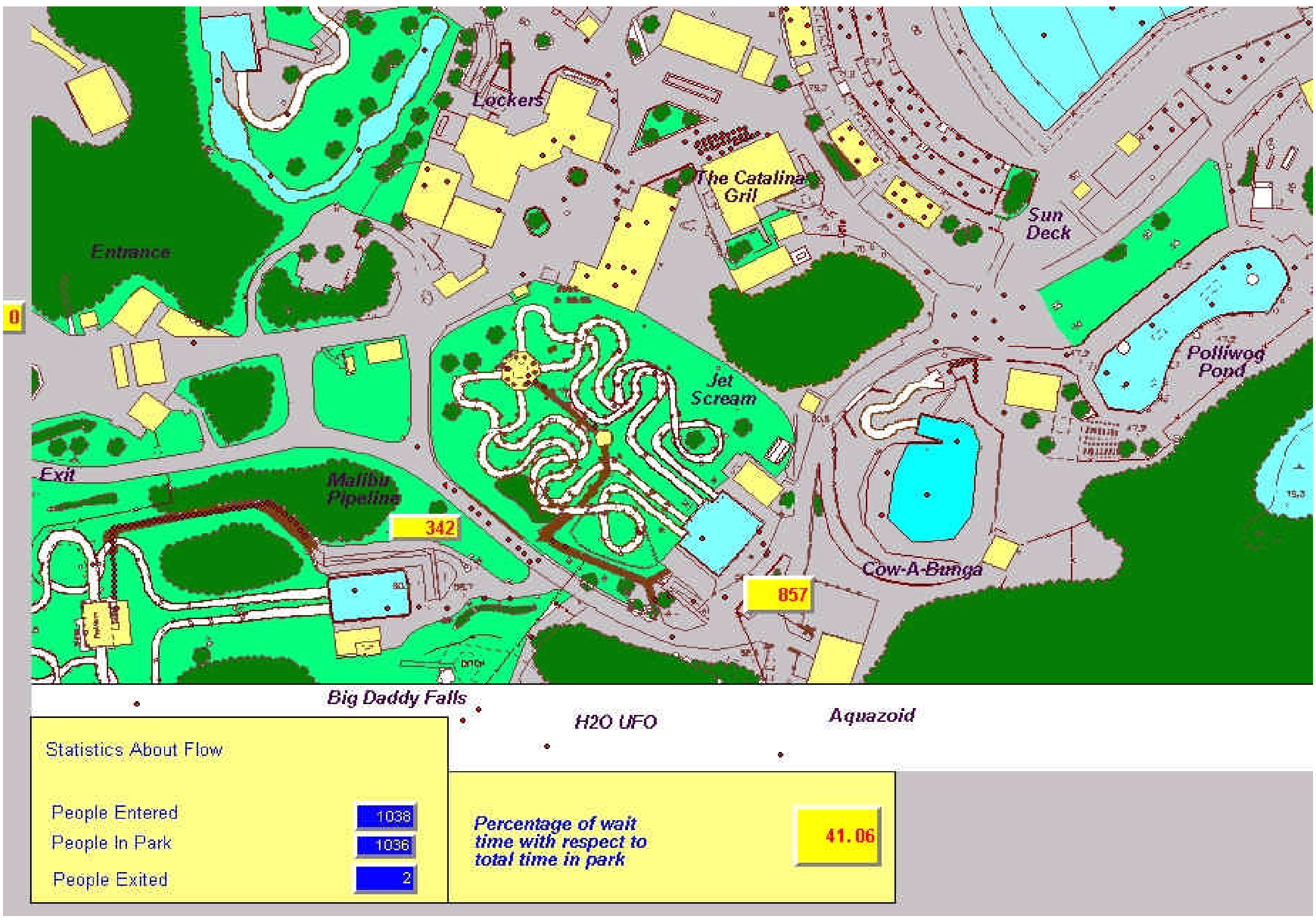

Figure 1: Enterprise Simulation Interface

constructing an enterprise simulation in which additional control variables and performance measures are represented.

4 CONCLUSION

This paper presents a new and novel application for computer simulation, the enterprise management of a theme park. The operation of a theme park is briefly explained and used to assess the requirements for a useful set of simulation tools. The design of three management tools, the enterprise model, the local model, and the customer information system, are described. A prototype enterprise simulation, constructed as proof of concept, demonstrates that the proposed tools can be developed using readily available, low cost simulation development tools.

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