SIMULATING SERVICE STATION OPERATIONS: A PLANNING TOOL FOR SOHIO MANAGEMENT

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ABSTRACT

SOHIO's service station layout simulator is presented as a planning tool assisting SOHIO management in making layout-related decisions. The need for a layout simulator at SOHIO is discussed and its role in the site-evaluation process is highlighted. An overview of the GPSS model is also included. Future plans involve the possibility of marketing the simulator to other oil companies on a nationwide basis through a timesharing network.

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I. INTRODUCTION

The Standard Oil Company of Ohio (SOHIO) is a major marketer of motor gasoline and other petroleum products (e.g., diesel fuel, heat oils, jet fuel) in the state of Ohio. The company also markets these products in the neighboring states of Pennsylvania, Kentucky, and Michigan under the brand name of Boron Oil Company; in the Northeast and Middle Atlantic states it markets under the name of BP Oil, Inc.

Highway-use motor gasoline is the company's major product; the company markets three different brands of motor gasoline, viz. OCTRON (regular), BORON (premium), and CETRON (unleaded), in ratios of approximately 60%, 15%, and 25%, respectively. Gasoline is marketed to the motoring public through retail outlets and in bulk, as wholesale, to large consumers.

The service station layout program is by far the most comprehensive simulator model available for evaluating the impact of alternative station characteristics through a very detailed simulation of every significant activity involved in the marketing of gasoline at the service station level. The model provides the flexibility of varying station size, station configuration, product mix, and manpower staffing and enables the user to study the resulting effects on customer service parameters at varying levels of customer arrival rates. Effective use of the model should result in a substantial reduction in capital-cost outlays for new builds achieved via a more efficient design or in a cost savings for existing stations through the elimination of excessive pumps, islands, canopies, etc. These costs could easily run into thousands of dollars per outlet.

II. WHY HAVE A LAYOUT SIMULATOR?

An analytic model results from management's need for objective analysis in their search for answers to questions which defy easy subjective resolution. A number of marketing-related issues facing SOHIO management, some of them long-standing, others sudden and critical, provided the impetus for the development of the layout simulator. Prominent among these were:

A. Changes in Marketing Strategy Throughout The Industry

Over the last three to four years, the strategy for marketing petroleum has been shifting towards consolidation into high volume, special purpose outlets. Conversions from the conventional full-service station to the gasoline-only outlet introduces new designs in the layout of islands, kiosks, and canopies. Outlets often increase from around 40,000 gallons/month to over 100,000 gallons/month in volume potential after conversion to gas-only. These increases result from product price reductions made to give customers benefits from the labor savings anticipated with streamlined service and volume gains. The number of additional pumps needed to support the increased volume becomes a key issue for marketing management especially in view of the high costs of new pumps. Service stations with 'forced-exits' present a design alien to management experience.

Entering into these uncharted waters, SOHIO management initiated the layout simulator development effort as a means of establishing an 'objective decision-aid' in an otherwise highly subjective evaluation.

B. Legalization of Self-Serve in Ohio: Split-Island Stations

Effective January 1, 1977, the State of Ohio legalized the dispensing of gasoline through self-serve outlets. As a result, a significant number of SOHIO stations were converted from full-serve to 'split-island' stations, i.e., stations with both full-serve and self-serve islands. Sohio management's opinion was divided on the question of whether BORON (SOHIO's premium brand gasoline pumps) should be provided on both the full-serve and self-serve islands at split-island stations. The dilemma was caused by the constantly declining product ratio (currently 15%) for BORON due to the auto population's shifting requirement from leaded premium to unleaded gasoline in recent years. The shrinking demand for premium gasoline dictated a single BORON pump for most split-island stations. Two schools of thought prevailed:

i) Field management insisted on the need for BORON pumps on both Full-Serve and Self-Serve islands; from a strictly marketing viewpoint, turning away customers due to product unavailability was unacceptable.

ii) Corporate management felt that the cost of additional pumps may not be justified on the basis of an occassional lost sale.

The layout simulator provides objective estimates of either i) the number of lost sales (drive-offs) if BORON capability is not provided on both sides of the station, or conversely, ii) the utilization of BORON pumps if they were to be installed on both islands.

C. Visibility vs. Overbuilt Stations

One of the important factors that impacts the volume potential of a station is its visibility. Visibility is often increased by starting with a spacious lot, installing a large number of islands/pumps and building a big canopy. While most managers agree on the need for 'good' visibility, the question of 'how much is enough' sparks many a heated debate amongst marketing personnel. An important input that must be included in any rational discussion on this issue is the 'cost of visibility'. The simulator provides management with an objective way to isolate the additional cost incurred solely for obtaining improved visibility and thereby a systematic cost/benefit approach is made possible.

D. The Side-Island Controversy

In conventional station designs, islands were generally placed parallel to the streets served by the station. Many stations, however, are located at intersections with a busy primary street and a very inactive side street. Station design based on the parallel island concept dictated the installation of side-islands along the secondary street. Are side-islands economically justifiable? Does their elimination result in significantly increased congestion or drive-bys? Management can again turn to the simulator for objective answers.

III. HOW THE SS LAYOUT SIMULATOR ENTERS THE DECISION PROCESS

Figure 1 shows the role of the simulator as a decision-aid in the new site evaluation process. A new-site's volume potential is estimated through a study of area demographics, traffic counts, pricing assumptions with respect to competition, and intangible factors such as visibility and accessibility. A number of alternative layouts are proposed. These can be tested through the simulator to estimate staffing and physical equipment requirements based on a study of waiting times, queue lengths, and conjestion on the lot. The staffing requirements translate to operating expenses (and, therefore, site profitability), whereas construction costs depend on the layout's physical characteristics (i.e., no. of pumps/islands/hoses, size of canopy, etc.). The profitability is then matched with the capital costs within an economic evaluation to estimate economic indicators, which in turn, guide management in the 'build/do not build' decision.

The simulator's input becomes specially critical in marginal cases where elimination of some excess islands or pumps could reduce construction costs sufficiently to tilt the balance and transform a doubtful proposition into an economically viable enterprize.

IV. AN OVERVIEW OF THE MODEL

Figure 2 presents an overview of the layout simulation model as a set of sequenced modules. Each module includes a set of well-defined decision-rules based on actual observations or the judgment of SOHIO marketing personnel. Before the simulator can be run, however, a station layout description has to be prepared and supplied to the model. This layout description is set up by the user through an inter-active front end (Figure 3) which includes very flexible and completely user-oriented layout and scenario generators.

We now proceed to a brief outline of the functions performed by each module in the simulation model.

A. Customer Generation

Customer arrival rates can be dynamically changed every (simulated) hour under the

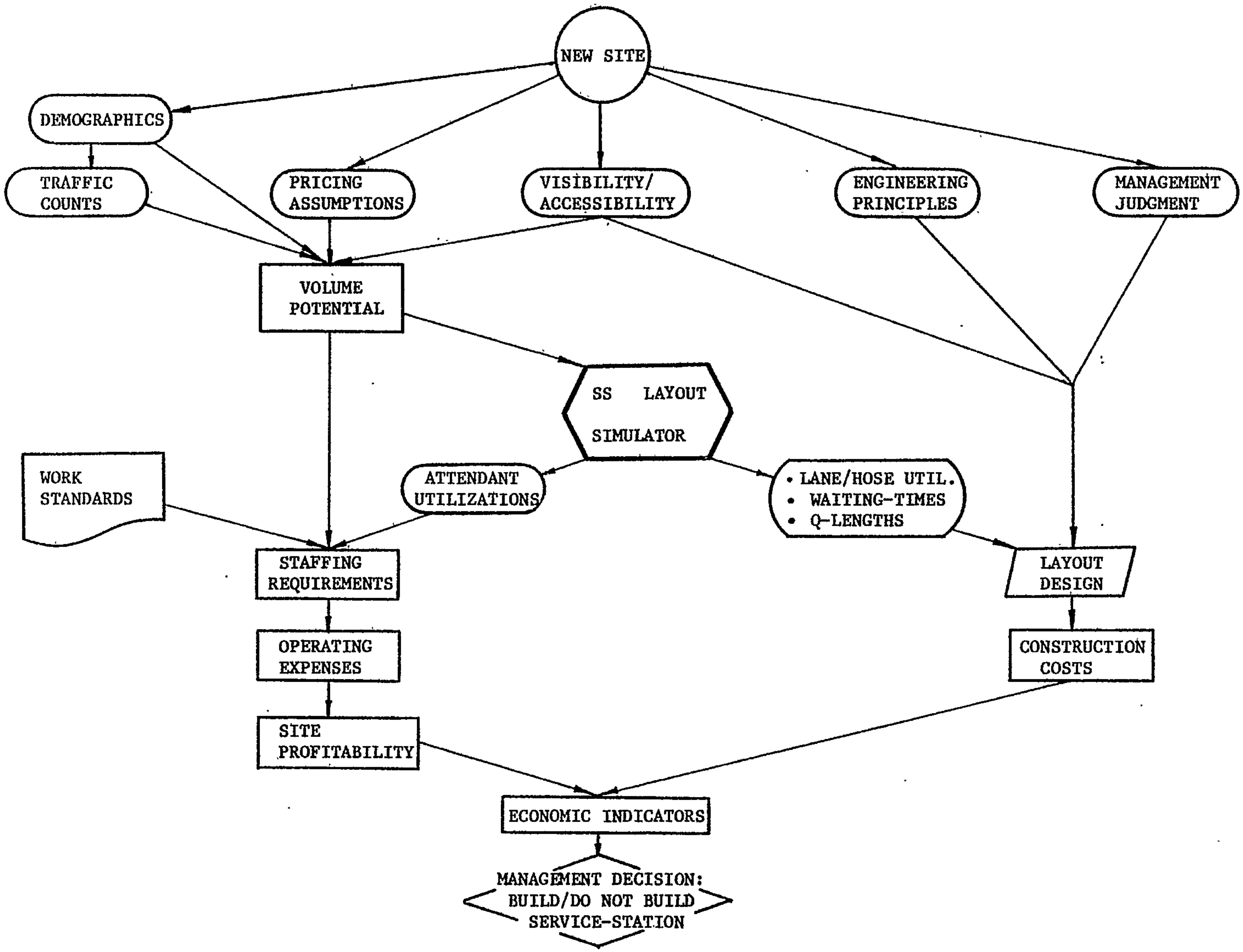


FIGURE 1: ROLE OF THE SS LAYOUT SIMULATOR IN THE NEW-SITE EVALUATION PROCESS

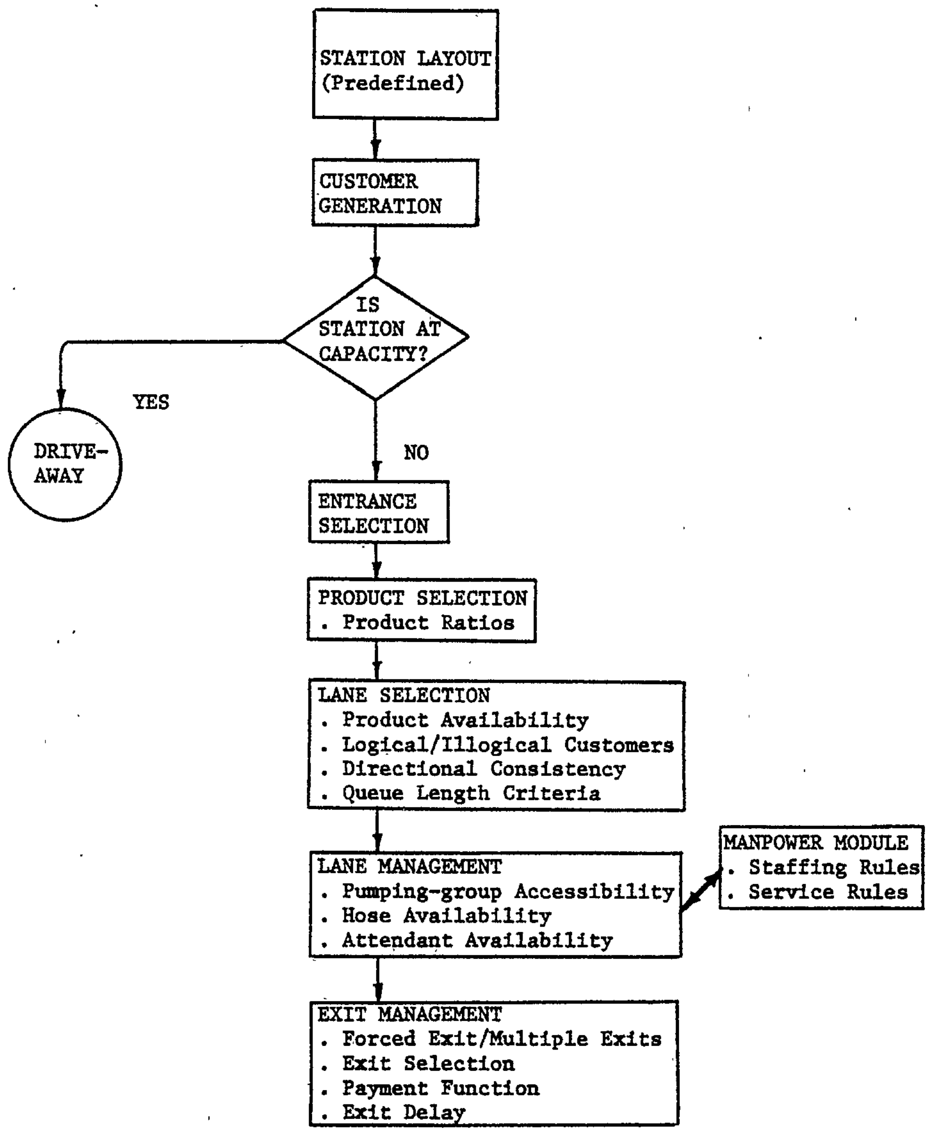
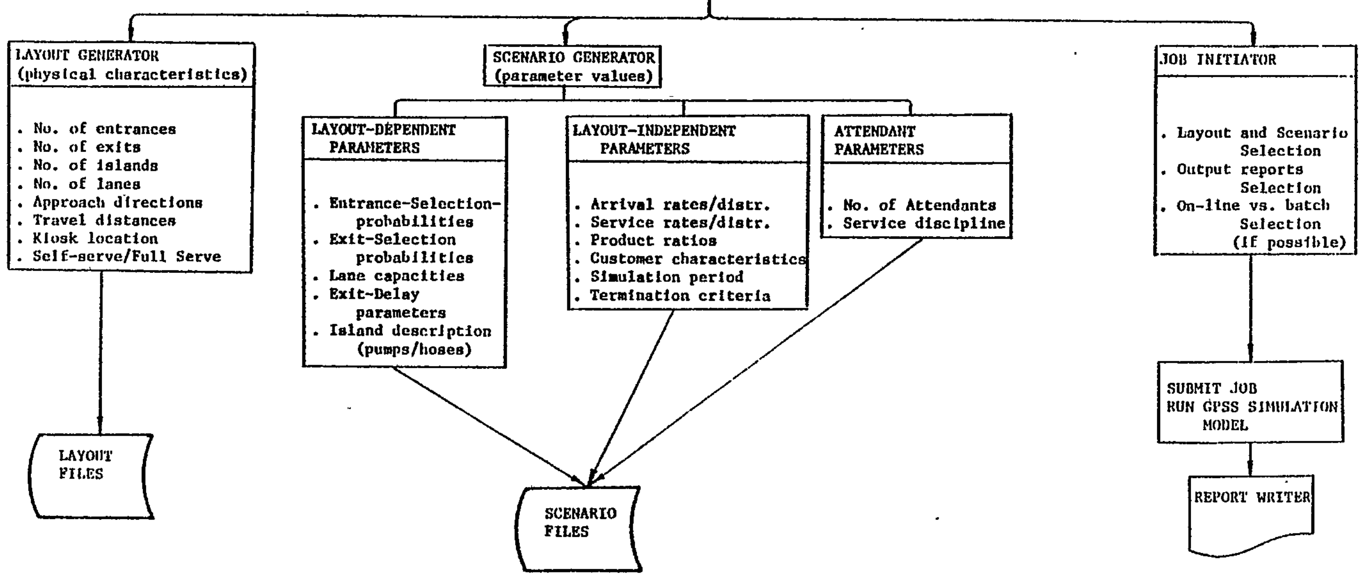


Figure 2: SIMULATION MODEL OVERVIEW

Figure 3: SIMULATOR FRONT-END



control of a user-specified function. At the beginning of each hour, the model will refer to the function and calculate inter-arrival times corresponding to the requested number of arrivals. If the station is already operating at capacity (also user-defined) excess customers are designated as 'drive-aways'.

B. Entrance-Selection

Operates on the basis of user-supplied data on selection probabilities.

C. Product-Selection

Based on the different types of gasoline sold at the station and the product ratios, a specific gasoline-type is assigned to each customer.

D. Lane-Selection

Four criteria are used sequentially to make the lane selection. They are:

i) Product Availability: Customers will select only those lanes which contain desired product.

ii) Logical/Illogical Customer: Logical customers will prefer lanes on the less active side of the station.

iii) Travel Direction Consistency: Customer will enter a lane in a direction consistent with the travel direction of existing cars in the lane.

iv) Queue Length: Customers will select a lane with the lowest queue length.

E. Lane Management

This module manages the customer's forward movement within a lane. The customer's current position in a lane is analyzed to determine what his optimal move should be, based on:

i) Pumping group availability
ii) Hose availability, and
iii) Attendant availability (for Attended Stations).

It is in this module that the customer is serviced and then transferred to the exit management module.

F. Exit Management

For the multiple exit station, an exit is selected through user-defined probabilities. For the forced exit station, a payment function determines the 'payment' delay time. In both cases, traffic conditions determine an exit delay.

G. Manpower Module:

Works in conjunction with the Lane Management module and assigns attendants to customers. Service is controlled by a set of service functions which include considerations such as:

i) Large/small purchases
ii) Window wash/hood check
iii) Single attendant servicing more than one car at the same time (i.e., service interruptions)
iv) Cash vs. Credit customers

V. FUTURE PLANS

The simulator model is in a continual state of development. New capabilities are added to the model to improve its utility to the user; the model must at all times reflect the changing nature of the market-place. The simulator is also being prepared for marketing to other oil companies on a nation-wide basis through a computer timesharing network. While it is an important tool for capital-cost reduction, its use is not expected to affect sales volume.

As long as gasoline marketing techniques (and, therefore, layouts) keep on changing, confronting management with layout decisions, the simulator will be a useful tool, introducing a ray of objectivity in an environment which is otherwise clouded by assumptions based on experience and, of course, 'gut-feel'.