

# Developments in Business Simulation & Experiential Exercises, Volume 13, 1986

## DEMONSTRATING THE ROLE OF SIMULATION IN STRATEGIC OPERATIONS PLANNING: A CASE STUDY IN BANK CHECK PROCESSING LOCATION ANALYSIS

Samuel G. Davis, The Pennsylvania State University  
Gary A. Kochenberger, The Pennsylvania State University  
Edward T. Reutzel, The Pennsylvania State University  
John E. Tyworth, The Pennsylvania State University

### ABSTRACT

Students of simulation in both logistics and operations management are not always given the opportunity to apply what they have learned in complex situations of a strategic nature. This paper presents a case study of such a situation that demonstrates both the use and usefulness of simulation in analyzing operation center location decisions for a statewide branch banking system. Linkages of the simulation model to other software, including LOTUS 1-2-3, are discussed.

### INTRODUCTION

A majority of deposits at commercial banks are received over the counter at their branches. Therefore, the elapsed time required to transport checks from branches to the processing center would normally be the most significant component of the time between receipt of a check at a branch and its eventual presentation for clearance. Potential processing delays become more acute as banks expand their branch networks. Since 1960, the number of commercial bank branches has more than doubled. In addition, the trend is toward locating branches more distant from the processing center. As branch networks continue to grow, the time from check receipt to presentation for collection will grow correspondingly due to requirements for transporting checks from receiving branches to the processing center.

There is a natural inclination for branch acquisition decisions to be made from a marketing perspective. Upon culmination of the acquisition agreement, the tendency is to continue operating the new acquisition autonomously for a period of time to ease the transition. As relationships evolve, the identity of the acquired banking unit is converted to the new organizational name, and the service image is enhanced by the acceptance of transactions for any account from any branch in the expanded network. In order to make the service enhancement feasible, it is necessary to integrate the check processing systems of the various banking units.

For each banking entity, checks received at branches are transported to their respective processing locations where checks are magnetic ink (MICR) encoded with dollar amounts for machine readability in preparation for computer capture of data and check sorting for clearance purposes. With integration, duplication in computer capture systems is eliminated and operations consolidated, although encoding sites may remain decentralized. As a result, check processing activities are dispersed requiring a significant transportation component to move checks from receiving branches to encoding sites and from encoding to capture sites. This increase in the logistics and complexity of the check processing operating environment leads to a recognition of the need to address strategic operational/organizational issues and consider alternative degrees of centralization and their respective costs and benefits. Specifically, the strategic questions related to check processing operations which must be addressed are:

- <> How many and which encoding sites should be used to serve the branch network?
- <> Which branches should be served by each encoding site?
- <> What resources and costs should be taken into consideration in evaluating the alternatives?

### Using Simulation

The introduction above describes a strategic logistics/operations management scenario that graduate students and upper-division undergraduate students can perceive as both complex and important. However, such a generic presentation is not well suited to teach or reinforce the principles of simulation as an aid to decision making. The case study that follows adds a specific context which allows students to utilize simulation software for analysis in a realistic setting. All of the software referred to below runs on an IBM PC with a DOS Version 2.0 or higher.

### THE FIRST NATIONAL BANK CASE STUDY

A typical scenario for the evolution to statewide banking occurs when a state passes legislation permitting banks to establish branches in any county contiguous to one in which it had a principal place of business [3, 1979]. It then becomes possible to have multiple principal places of business throughout the state. Banks would then often proceed to acquire smaller community banks throughout the state in order to reach the extended market that they target.

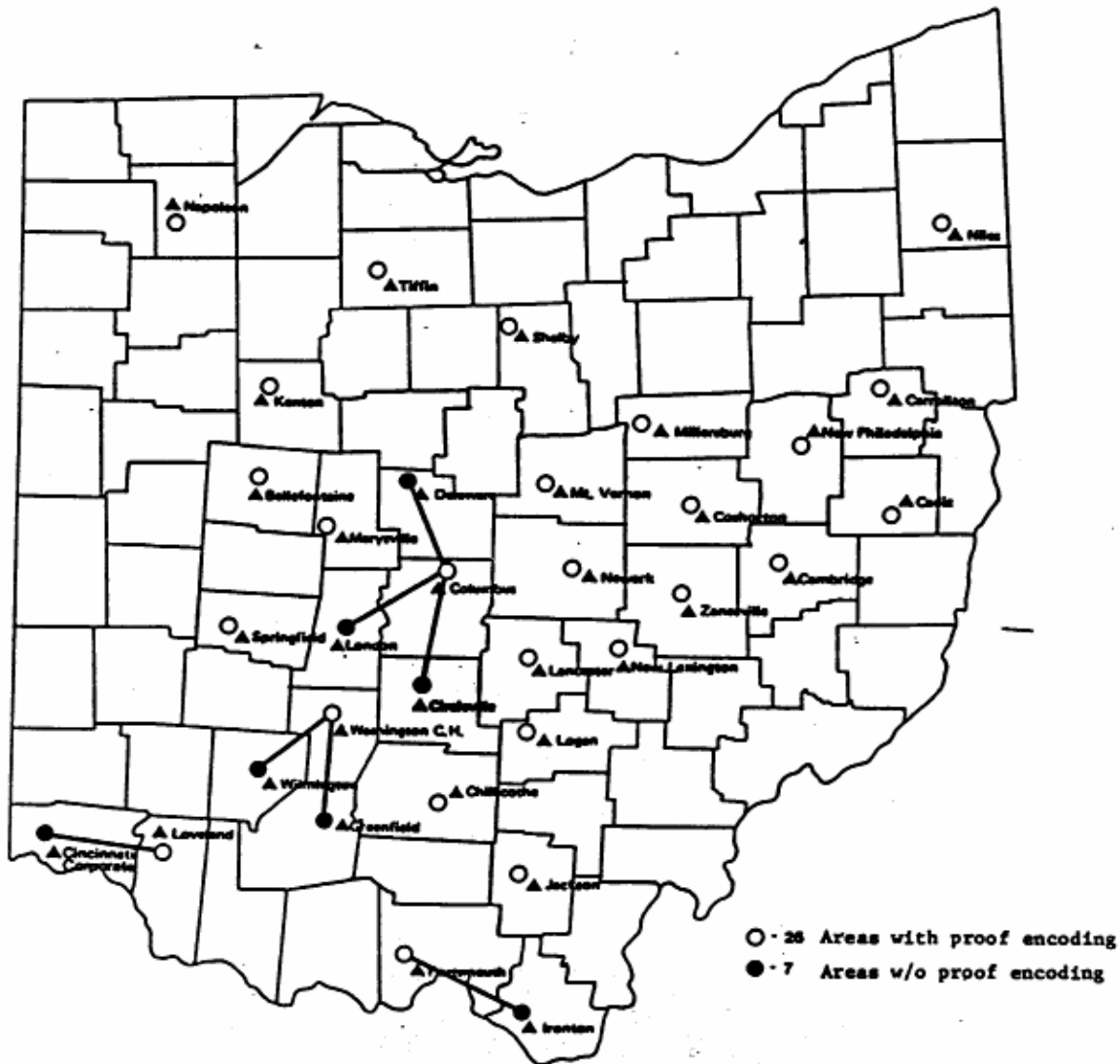
As the expansion continues, it often leads to conditions such as that characterized in Figure 1 for First National Bank, where the network consists of 161 branches distributed among 33 areas (ie., principal places of business). The check volume is encoded in 26 of these areas and eventually transported to the capture site for computer processing, sorting, and preparation for check clearance. Under these conditions, systems have been standardized thus enabling the strategic view of check processing. The management of First National Bank now wishes to examine the advantages of consolidating the dispersed encoding sites to achieve economies of scale.

### Study Approach

A comprehensive check processing simulation model

CHECKSIM(R) is utilized to provide the framework to view the entire check processing flow from receipt at the teller window until the completion of check processing operations in preparation for check clearance [1, 1982]. The CHECKSIM model is designed to generate efficient transportation routes for the messengers who pick up checks at branches for delivery to the processing center. Any routing scheme, including the use of shuttle points where vehicles exchange delivery work and pickup volume, can be accommodated. The simulation output reports detail the check volume delivered to the processing center by time of day, provide input to the encoder staffing decision process, and project clearing

FIGURE 1  
PRINCIPAL PLACES OF BUSINESS AFTER ACQUISITION



deadlines made and missed. The model provides a means for examining the float implications realized by alternative branch pickup and delivery schedules and encoding staffing patterns. The tradeoffs between the potentially conflicting goals of labor productivity, float minimization, and customer service considerations can be explicitly considered.

Although any number of branch locations can be accommodated by CHECKSIM, the scope of the model is restricted to scheduling the flow of checks through a single check processing center in a given simulation run. In order to address the strategic issue of how many processing centers are required and where they should be located to serve a statewide system, CHECKSIM must be executed for each encoding site and the results linked together for cost comparison purposes through the CHECKSIM interface to LOTUS 1-2-3.

Bank officers may be in a position to pre-identify several potential operating scenarios which represent alternative configurations for processing the check volume for the 161 branches. For example, First National Bank wants to consider the following scenarios:

- Option 1: the existing network structure for the thirty-three (33) areas extant after acquisition. Encoding operations consist of four (4) clusters and twenty-two (22) free-standing encoding centers (see Figure 1).
- Option 2: a moderate clustering concept that consolidates sixteen (16) of the twenty-six (26) areas with proof encoding into five (5) clusters. Encoding operations under this concept would total eight (8) clusters and seven (7) free-standing encoding centers.

For each clustering alternative, prototype pickup and delivery schedules are developed using CHECKSIM, providing reasonable expectations of volume flow into the encoding sites. Then, cost estimates for each clustering alternative are developed to include:

1. Encoding payroll and equipment.
2. Transportation labor, variable driving expenses, and fixed vehicle costs (vehicle acquisition/insurance).
3. Cost of funds (float opportunity costs).

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### 4. Fixed costs including space and supervision.

Where bank officers are in a position to identify a finite set of operating schemes to be evaluated, it is possible to totally enumerate the alternatives through successive executions of CHECKSIM to simulate a typical week for each scenario.

#### Data Collection Requirements

Before any analysis can be performed, it is necessary to collect the information required for execution of the simulation model and evaluation of the results. Included as an Appendix is a list of all data collection requirements for model execution. With the exception of road segment travel times (2c), these data are generally available and easily accessible.

#### Travel Time Data

Although travel times between successive stops on existing routes can readily be obtained, it is vital to provide the model with accurate travel times between each and every site pair to perform the transportation analysis phase. Possessing such intersite travel times is a necessary prerequisite for setting up routes in which the total travel time is to be minimized. The time estimates that are desired are analogous to the distance tables often seen on state road maps. Usually, such tables show the road mileage between pairs of major cities in a state. These mileages are put in a matrix, and one finds the correct mileage by locating the intersection of the row and column corresponding to the two cities of interest. Similarly, in bank transportation routing problems, we need to be able to determine good routes and travel times between bank locations.

One way to calculate intersite travel times is to estimate them by physically measuring distances to scale on a map using available mechanical measuring devices. For small road networks and small numbers of sites, this method is not too onerous and may be accurate enough. But for road networks of any size and for large numbers of sites, the work quickly becomes tedious, and it is easy to make errors. Consider, for example, a problem involving, say, 100 sites. The total number of interdistances is:

$$\text{Number of Interdistances} = n(n - 1)/2,$$

where  $n$  is the number of sites. Thus, for 100 sites, this number would be 4,950. Measuring all these distances by hand and estimating travel durations based on them would be a formidable job! Moreover, it is possible that times vary depending on the direction traveled due to one-way streets, traffic patterns, etc. Thus, a matrix for 100 locations may require up to 9,900 estimates ( $n * [n - 1]$ ).

Another way to obtain approximations for intersite travel times might be to base them on air distances ("the distance as the crow flies") as calculated between map coordinates. The argument given for these estimated travel times is that they may be all right if the road network is dense; that is, if there is almost a direct route between any pair of sites and the driving speeds can be assumed to be constant throughout the road system. Obviously, these assumptions will rarely occur in practical problems and can often be extremely inappropriate.

ROADDATA, an additional program package included with CHECKSIM, is designed to overcome the problems connected with the cumbersome and inaccurate methods just described [2, 1981]. The system reads in, as one part of its input, a numerical representation of the road

network. Using this input, the program determines the minimum travel time between each and every pair of sites. The program also identifies the exact path through the road network that must be taken in order to achieve this minimum time.

## ANALYSIS AND CONCLUSIONS

In order to compare and contrast the candidate operating schemes, it is necessary to simulate each processing center for each day of the typical week. Therefore, Option 1 requires a total of 130 executions of the simulation model ( $26 * 5$  days of the week), and Option 2 requires 75 executions. For each CHECKSIM execution, a cost summary record is prepared for import to LOTUS 1-2-3 to provide the ability to compare and contrast the costs and operating parameters of each alternative. This link between CHECKSIM and LOTUS 1-2-3 produces an annual cost summary of each alternative in tabular form (Figure 2) as well as graphically, if desired.

FIGURE 2  
ANNUAL CHECK PROCESSING COST COMPARISON  
FIRST NATIONAL BANK

Cost Element	Option One	Option Two
Transportation		
1. Vehicles	\$80,436	\$93,852
2. Variable Travel	\$64,705	\$79,752
3. Driver Payroll	\$334,182	\$392,910
4. Intrastate	\$215,537	\$140,469
Total Transportation Expenses	\$649,860	\$706,983
Encoding		
1. Equipment	\$406,689	\$376,142
2. Operator Payroll	\$953,600	\$1,758,707
3. Supervision	\$195,040	\$229,500
Total Encoding Expense	\$1,609,329	\$1,153,065
Float Expense (10%)	\$604,124	\$82,752
Total Expense	\$2,908,313	\$2,548,441

## PERSPECTIVE

The simulation capability provides valuable insights into the potential cost advantages of consolidation of encoding sites. In this setting, the increase in the labor productivity of encoding operators significantly exceeded the incremental increase in transportation costs associated with moving checks within a more dispersed branch system. It can reasonably be stated that conclusions drawn in the example are not necessarily generalizeable to all bank branch systems since the cost relationships are affected by the volume distribution by branch by time of day, the relative proximity of branches, the timing of processing cutoffs for check clearing purposes, as well as the relative magnitude of the cost parameters for the various cost components. The simulation capability afforded by CHECKSIM provides a facility to examine these relationships and easily test the sensitivity of a particular branch network configuration to variations in any of the cost or operating parameters.

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Students who are exposed to this case gain a meaningful appreciation of the role that simulation can play in a strategic decision-making context. They see the efficacy in combining different type of models (a simulation model vis-à-vis CHECKSIM and a network model vis-à-vis ROADDATA) and the potential to interface complex programs with popular software such as LOTUS 1-2-3. And, finally, they are drawn into the nuts and bolts of analyzing a realistic operating decision and the attendant data collection that is frequently overlooked in typical classroom experiences.

### APPENDIX

#### CHECKSIM<sup>(R)</sup>--CHECK PROCESSING SIMULATION MODEL DATA COLLECTION REQUIREMENTS

1. Branch Data
  - a. Volume by hour interval
    - Total items to be encoded
    - On-us check dollar volume
    - Transit check dollar volume
  - b. A listing of branch numbers, names, processing location, and closing hours by day of the week
2. Messenger Data
  - a. Work hours
  - b. A map with sufficient detail to indicate each bank location and the functional road network
  - c. Estimates of travel times for road segments for input to the ROADDATA system
  - d. Current messenger routes and volume delivered by time of day
3. Check Processing and Clearance
  - a. Encoding capacity by hour interval by processing location
  - b. Capture and sorting capacity by hour interval by processing location
  - c. Transit deadlines
    - Timing of processing cutoffs
    - Percentage of total transit corresponding to each deadline
4. Cost Data
  - a. Encoding costs per 1000 items processed
    - Equipment
    - Payroll
  - b. Transportation
    - Vehicle lease/acquisition and maintenance
    - Estimated variable travel costs per hour
    - Payroll/courier contract costs
  - c. Float costs (based upon funds rate and reserve requirements)

### REFERENCES

- [1] Davis, Samuel C., Nicholas Ceto, and J. Mac. Rabb, "A Comprehensive Check Processing Simulation Model," Journal of Bank Research, Vol. 13, No. 3, Autumn 1982.
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