Abridgment

Assessing Software to Meet the Financial Planning Needs of Transit Operators

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An evaluation of commercially available software products to meet the financial planning needs of transit operators is summarized, and the methodology used to establish functional and information processing needs of transit operators and to select potential products is reviewed. Four functional areas (ridership and fare analysis, cash management, tax revenue analysis, and expense estimation) are identified and the potential of two types of commercially available products (electronic spreadsheets and financial modeling languages) to address typical financial planning problems in these areas is described. The strong and weak points of each product type are identified.

Current economic conditions have increased the need for transit managers to do financial planning. Recent advances in microcomputer technology suggest that investments on the order of $5,000 in equipment and software could provide significant improvements in financial planning. Summarized in this paper is a staff study (1) that describes the extent to which commercially available microcomputer products requiring little programming experience can be used for financial planning.

METHODOLOGY

The methodology used is outlined below.

Activity	Output
Identification of current practice in financial forecasting	Current activities Promising solutions Constraints Needs
Financial management information processing activities	Inputs, functions, outputs Appropriate software
Review panel discussions	Feedback on activity definition Priorities Constraints
Product surveys	Currently available products Product capabilities
Problem scenarios and product capabilities	Issues Decisions Information processing requirements Match user requirements and product capabilities
Product assessments	Summary of product capabilities to meet user requirements

The first three steps identify the functional needs (2) and information processing activities (3) of transit managers. A review panel provided feedback on the ideas. Needs included ridership and fare revenue analysis, labor and maintenance expense estimation, tax yield and incidence estimation, and cash management. The financial planning activities required manipulation of small, high-quality data sets, model building, ad hoc inquiries of data bases, report generation, and continuous iteration. Table 1 identifies the functions, characteristics, and equipment requirements of financial planning within the context of all financial management activities.

Typical problem scenarios were defined based on the understanding of transit financial planning needs and activities. The problem scenarios were used to identify the key issues and decisions transit managers must make; this, in turn, established both the value of, and the need for, specific information processing requirements. Potential software products were first screened against these requirements; then, the ability of representative products to meet the requirements was documented.

Two types of microcomputer software were identified that appeared to have potential for financial planning applications and were inexpensive and easy to use. One type, the spreadsheet program, is a computer representation of a large piece of paper containing rows and columns that are displayed on the monitor. The program allows the user to create relationships between entries (such as the sum of a column) that are automatically recalculated when changes to the relevant entries are made. Labels, values, and formulas are typed in and appear on a portion of the spreadsheet shown on the display. The program remembers positional relationships so that changes (such as deleting or moving rows or columns) can be made without affecting what has been done before. A set of commands is available for printing what is on the screen. Compatible products include programs that plot, analyze, sort, or manipulate sets of data.

The second type, the financial modeling program, provides more flexibility in data manipulation and report generation than the spreadsheet program but takes longer to learn. Financial modeling programs generally handle more than one matrix, have more sophisticated logic such as branching and looping, and provide more commands for formatting and presenting output.

FUNCTIONAL AREAS

Expense Estimation

Expense estimation is vital to financial planning. Data on current expenses, service provided (e.g., platform hours), resources used (e.g., pay hours), and resource prices (e.g., wage rates) are captured and manipulated to determine the relationship between input and output variables. These models are then used to forecast future expenses based on changes in relevant variables. Reports are generated from either model results or data base inquiries. Various types of models described by Dooley and Spiller (1) include expense allocation, factor, resource estimation, and direct calculation.

Three scenarios were developed to typify expense estimation problems. The first required expense estimates for service changes by time of day, day of week, and route. The second scenario required estimates of the cost of various provisions in the labor contract (e.g., part-time labor), whereas the third required an investment analysis of articulated versus standard buses. Key information processing requirements derived from these cases included capturing data at the appropriate level of detail; linking to other data bases; doing arithmetic, logi-

Table 1. Financial management information processing activities.

Function	Information Processing Characteristics	Hardware and Software
Accounting and data base management		
Financial accounting and reporting	Well-defined procedures	Commercial software package on time-shared mainframe or stand alone minicomputer
Accounts receivable and payable	Transaction processing	
Payroll and personnel	Periodic standard reports	
Fixed assets		
Ridership sampling		
Accident and safety reporting		
Financial control		
Operator scheduling	Well-defined procedures	Customized software package on time-shared mainframe or stand alone minicomputer
Vehicle maintenance management	Transaction processing	
Inventory control	Real time information	
Vehicle scheduling	Standard reports	
Budget review		
Cash managment		
Financial evaluation and planning		
Performance analysis	Ad hoc inquiries	User programmed software or models developed with commercial generic software on small, mini-, or microcomputers
Service planning	Nonstandard reports	
Financial planning: pricing, investment, budgeting, and forecasting	Aggregated data	

cal, and statistical manipulation of data; modifying calculations based on changes in inputs; calculating expenses for multiple periods; doing logical branching and iteration; and generating multiple reports for multiple users.

For example, spreadsheets can be used to estimate the change in expenses associated with service changes. First, expenses (manually or machine entered) that vary linearly or are invariant to service parameters are allocated to those variables to derive unit costs. This can be done by manually entering the data on the work sheet and writing formulas in cells used to store sums and unit costs. To determine nonlinear costs, a separate work sheet could be used to record peak and off-peak pay hours and vehicle hours to adjust wage expense allocations by time of day. Some work sheets have regression packages that could be used to derive relationships from sample data. Spreadsheets can be used to calculate expenses using any set of equations that can be entered on the work sheet. Limited logic can be used by putting alternative formulas in a cell with Boolean operators. Each report must be laid out (what you see is what you get), so space (254 rows) is a limitation.

Financial modeling packages provide better data manipulation capabilities for estimating expenses. Because the data and programs are stored separately, branching is possible. For example, if different calculations are required for estimating driver requirements and then regular, guarantee, and premium hours for straight, split, and tripper runs, a modeling language would be easier to use than a spreadsheet. Modeling languages can also create a variety of reports from the same set of data. Modeling languages usually have graphics that are integrated into the package, whereas spreadsheets require that the data be transferred to another package. The two limitations of the financial modeling packages reviewed are the lack of an external interface (all data must be entered manually) and a relatively small data set capacity (2,000 cells).

Ridership and Fare Analysis

Transit ridership data and the relationship between ridership and fare and service are essential for monitoring existing transit operations, preparing fare revenue estimates for the budget, and forecasting the effect of future changes to transit services.

Three scenarios were developed to illustrate functional requirements in this area and the associated software information processing needs. The first problem scenario involved the monitoring of service and the assessment of performance to resolve allegations of insufficient and inequitable allocation of transit service on routes serving the central city. The second problem scenario addressed the need to consider alternative fare and service levels and their effect on ridership and fare revenue in preparing the transit agency's operating budget. The third problem scenario involved long-range transit planning to improve the central area circulation. Information processing needs derived from these problem contexts included area, time, and user windowing; linkage to nonridership data files; incorporation of user-defined models; and user-defined report and output file formats.

For example, spreadsheet programs could be used to provide a window for a preselected sample of routes serving the central city and outlying jurisdictions, respectively, to resolve allegations of insufficient and inequitable allocation of service. Aggregate ridership measures (e.g., total passengers served, total boardings per route-mile) and revenue and cost measures (e.g., revenue to direct operating cost ratio) could be computed for each sample of routes. Financial modeling software, however, could provide additional and more sophisticated modeling capabilities. Cumulative boarding and alighting counts (and graphics) could be developed. Occupancy profiles for each matched pair of routes in the two samples could be derived. Integration of graphics (for example, the occupancy profile) within reports is more easily done with financial modeling software. In addition, financial modeling software includes more sophisticated statistical routines that would permit ridership and fare revenue models to be calibrated. Both types of software are limited to small data sets. Automatically linking the preselected sample of city and suburban routes to other data files to compute, for example, service provided would be difficult (i.e., bus-hours per route and per sample, and scheduled and in-service frequencies).

Cash Management

Efficient cash management involves transit agency control of the disbursement and receipt of funds to yield maximum public benefit. Because high interest rates make the holding of excess cash expensive,

determination of the optimal cash balance is a central component of cash management.

Three problem scenarios were developed to illustrate functional requirements of cash management activities. The first problem involved the need to develop a cash budget for a new demand-responsive service for the elderly and handicapped. The second problem scenario required simulation of the effects of a 1/2 percent increase in interest rates on long-term bonds to be used to finance the purchase of new buses. The last problem required a reconciliation of reported fare revenues versus expected revenues for four bus routes using a transaction log and detailed reporting of cash receipts for every bus run for the routes in question. Key information processing needs derived from the foregoing problem contexts included cash budget forecasting capability, what-if analyses, audit trail for sources of funds, user-defined models, transaction logs and processing, linkage to other software and data files, and a query capability.

For example, both spreadsheets and financial modeling software can be used effectively to prepare cash budgets or to conduct what-if analyses. Transaction processing and linkage to other software and data files, however, are not well supported by either type of software. Although financial modeling software provides additional financial operators and functions (e.g., lead and lag operators), user-defined models particularly when applied to determine optimal cash balances are not usually well supported.

Tax Revenue Analysis

Planning transit service requires the prediction of tax revenue yields that will be available to the operator to subsidize transit operations. Securing new revenue sources requires the prediction of both the effects (who benefits) and the incidence of the tax (who pays).

Three cases were developed to illustrate functional requirements in this area. In the first case it was intended to finance transit development in two intersecting corridors through a value capture policy, i.e., by taxing the incremental increase in property values. Projections of tax revenue yields during a 15-year planning period in each corridor were needed. The second case focused on determining tax revenue yields from alternative allocations. The third case required determining trade-offs between necessary cost savings and potential tax increases.

Information processing needs derived from these cases included user-defined models, geoprocessing of data, and a forecasting capability. Spreadsheets and financial modeling software could both support tax revenue models based on allocation formulas, the product of tax base estimates and tax rates, or fund dedication ratios. Financial modeling software often has additional statistical routines that would permit the calibration of models that relate a specific tax base to various economic and policy variables. If either a spreadsheet or financial modeling software product had strong data base operators (e.g., search and selection capabilities), the geoprocessing of tax records would be feasible (e.g., manipulation of property tax assessment data for census blocks that comprise the transit development corridors in question in case 1).

SUMMARY AND CONCLUSIONS

Two generic classes of microcomputer software that have been identified as meeting, at least to some degree, financial planning functional requirements and associated information processing needs are spreadsheets and financial modeling software. The software assessments of five representative commercial products documented by Dooley and Spiller (1) support the following conclusions:

1. Both the spreadsheet and modeling language software are most suitable for ad hoc analysis, querying of a small high-quality data set, and quick report and graphics generation.
2. None of the software products that were reviewed is suitable for work requiring transaction processing.
3. A major limitation in each of the software packages that were reviewed is its inability to communicate with other software; thus, integration with in-place financial information systems at transit agencies may not be easily resolved.

Although the success of the methodology described in this paper awaits validation in the field, it appears to represent a paradigm for making informed decisions about potential decision support and productivity improvement investments in software. The methodology is applicable to a wide range of transit information processing requirements.

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