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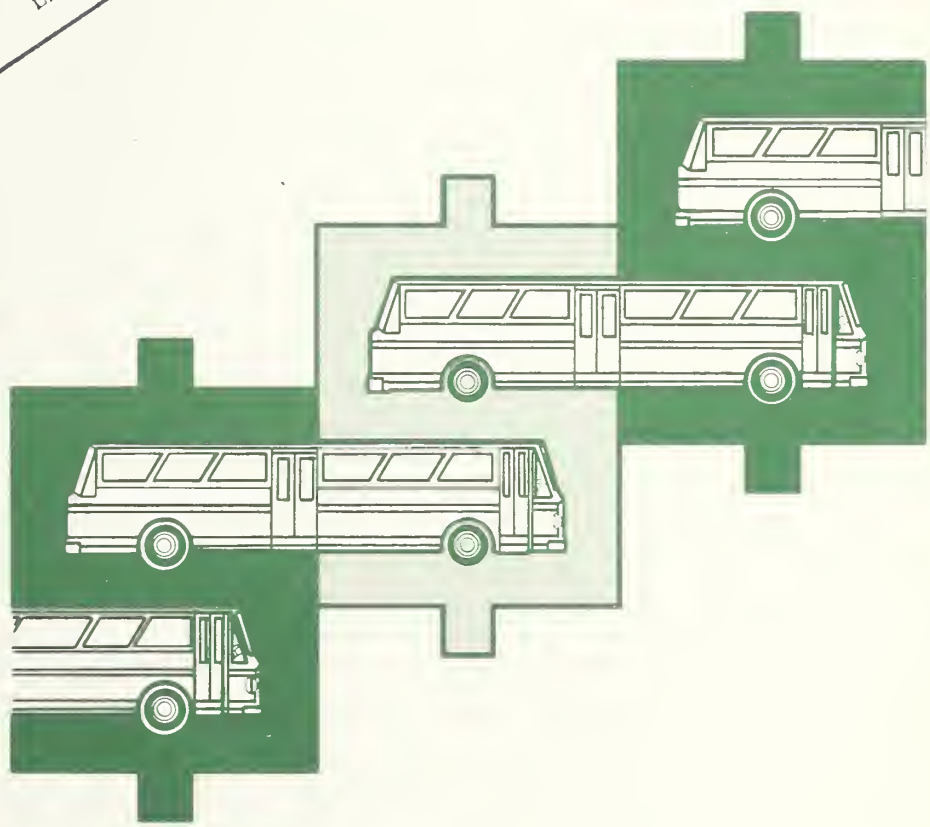
Department
of Transportation
**Urban Mass Transportation Administration**

# Financial Planning in Transit
## Use of Commercially Available Microcomputer Software





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**UMTA Technical Assistance Program**

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16. Abstract

This report addresses the potential of using commercially available microcomputer software for transit financial planning activities. Discussions with transit operators identified the need for inexpensive, easy to use software for ridership and fare revenue analysis, expense estimation, non-fare revenue forecasting and cash management. Specific requirements for data input, manipulation and output were developed based on three prototypical problems in each functional area. Two electronic worksheet programs and three financial modeling packages were considered as representative of the type of products available.

The representative products were examined, using the defined information processing requirements, to determine how they could be applied to solve typical transit financial planning problems. This review was conducted through actual use of the products or a review of their user manuals. It was concluded that, despite some limitations, these products could meet most of the processing requirements and would provide significant assistance to transit operators throughout the financial planning process. An appendix is provided which summarizes the functions, source, approximate price, hardware configuration requirements and program limits of each product.

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## Operations and Planning Support (OPS)

The Urban Mass Transportation Administration has undertaken a variety of technical assistance programs, one of which is the sponsorship of Federal involvement in, and the stimulation of private development and exchange of, a wide range of transit management aids. This particular effort has evolved under the general label Operations and Planning Support (OPS), a collection of technical support activities involving research and review, development and demonstration, and information dissemination. This document is one of several which provides background and summarizes the activities conducted as part of the OPS program. These documents provide information on the availability and use of management tools, and on concepts and proposed designs of new tools to encourage critique and feedback from the transit industry and other interested parties.

A large portion of the work in the OPS program is devoted to the application of computer-based tools that can support work of individual departments within a transit agency. Examples include operations analysis and planning, vehicle driver scheduling, maintenance management and financial/budget analysis including capital asset and cash flow management. Many transit agencies are already using computerized systems for such activities as payroll, accounting, maintenance and scheduling. Tools which are identified or developed through Federal activities will complement or supplement many of these existing capabilities. Though the tools may be usable on computer installations of any size, initial development is emphasizing microcomputer implementations. Inexpensive systems centered on microcomputers offer many advantages when applied to decentralized, departmentally-oriented operations. However, these systems retain the potential to share an agency's data and information through a variety of communications interfaces. Thus, information produced through the individual units may be brought together and organized as additional sources of management information.

Technological breakthroughs continue to extend the computing power and data-handling capabilities of these desk-top systems. Very powerful systems are now within the financial reach of even the smallest transit properties, and these same systems can extend computing power to each appropriate organizational element in the larger properties.

## Financial Analysis

One of the major task areas of the OPS project is the development and dissemination of improved financial analysis methods. This work involves several activities, including: identification of industry needs, development of new techniques for cost and revenue estimation, forecasting and analysis, documentation of exemplary financial practice, development of general purpose transit financial forecasting software, identification and review of commercially available planning, accounting, and budgeting software and the development of a financial forecasting course.

This report builds on earlier work which is documented in the report, which identified industry needs and developed specific methods for ridership/revenue forecasting, tax revenue estimation, cash management and expense estimation. The microcomputer software industry has developed many general purpose packages which have the potential for improving the quality and responsiveness of transit financial planning yet are inexpensive and easy to use. The information in this report is intended to assist transit operators in assessing the applicability of spreadsheet and financial modeling software to the financial analysis problems facing these agencies.

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Transit agencies who currently have or are contemplating the acquisition of microcomputer hardware or software should contact the following UMTA sponsored support center to obtain additional information about applications and other users:

Transit Industry Microcomputer Exchange
Department of Civil Engineering
Rensselaer Polytechnic Institute
Troy, NY 12181
Phone: 518-270-6227 weekdays 1-4 pm EST

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User Feedback

UMTA would be delighted to receive comments on the utility of this document, other commercially available or agency developed programs used for financial planning, transit operations or maintenance management or applications of the programs described in this document. Comments should be addressed to:

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## Purpose

Today's transit manager is often confronted with situations, such as rising costs and declining revenues, which require more comprehensive and responsive financial planning. At the same time, new tools are appearing daily in the form of microcomputer-based software which has the potential, for a modest price, to help the manager analyze alternative responses to these economic crises. This report is intended to assist transit managers in determining the applicability of these commerically available microcomputer products to their need to analyze the effects of changes in fare and service policy, labor contracts and revenue sources.

## Needs Analysis

The report draws on extensive contact with transit financial managers to identify the primary types of financial planning activities and the way related information is used within the industry. Financial planning activities currently accomplished with manual procedures include fare revenue forecasting using elasticities, expense estimation using allocation (unit cost) models and tax yield forecasting models. Disaggregate demand modeling, labor cost forecasting using resource estimation models, tax incidence analysis and maintenance cost estimation from vehicle history data are promising procedures which are of interest to several properties, but they require more data manipulation capability than currently available. An analysis of transit agency information processing activities concluded that financial planning (including pricing, investment, budgeting and forecasting): (1) uses a relatively low volume of data abstracted from the financial accounting and control system, (2) requires flexibility in determining what data is used and how it is processed and reported and (3) requires rapid turn-around of results so that many alternatives can be considered. A panel of transit operators (meeting as part of UMTA's Operations and Planning Support Project) confirmed that traditional data processing resources such as time sharing on mainframes or turnkey minicomputers were often either

unavailable, or required programming expertise beyond their own knowledge. However, all agreed on the need to be able to easily access existing data resources when doing financial planning.

## Product Identification

Based on the results of the needs analysis, two types of commercially available microcomputer software products were selected for review: electronic spreadsheets and financial modeling languages. Electronic spreadsheets are representations of larges pieces of paper containing rows and columns, which allow the user to define relationships between entries such that the effects of changing the value of one variable can be automatically reflected in all other variables. Financial modeling languages offer sets of commands which perform arithmetic, statistical and financial operations on a set of data. Users interact with both types of products using a keyboard and monitor and obtain reports on printing devices. Five products were selected as representative of these types of products based on their sales in the marketplace and their compatibility with the most popular microcomputer hardware and operating systems. A notice was posted in the Commerce Business Daily to give other vendors the opportunity to have their products included in the report.

## Application Assessments

In order to determine the applicability of spreadsheet and financial modeling languages, typical transit financial planning tasks were identified in four functional areas: ridership and fare revenue estimation, tax yield and incidence analysis, cash management and expense estimation. Each financial planning task involves the following information processing activities: data acquisition and processing (e.g. list expenses by function and object class), model calibration (e.g. determine unit expense per mile), model application (e.g. calculate expenses for each function based on vehicle miles and unit expense) and report generation. Based on the task scenarios and the financial planning methods currently available or actually used by transit operators, desirable information processing characteristics were identified. Then, by either actually using the product or by examining the product reference

manual, it was determined how each product could be applied to each task for the functional areas described above. A table was prepared for each functional area showing how each product would be applied to each information processing characteristic. The results of these application assessments are summarized below.

Spreadsheet programs are useful for estimating ridership and fare revenue changes at the system or route level using price or service elasticities or pre-calibrated demand models. Time series ridership models can be developed using regression packages available with most financial modeling languages. Service planners will find both types of programs helpful for preprocessing ridership data and presenting useful graphs of trends. Calibration of disaggregated models and multi-dimensional sorting or selecting of origin and destination data are more efficiently done with custom programs.

Top management will find spreadsheet and financial modeling programs useful for estimating tax revenues from new development projects under various assumptions and examining the impact of alternative allocation formulas for local subsidies. Financial modeling programs have more robust logic such as iteration, looping and branching than spreadsheet programs which the user might consider for more complex applications. Neither type of program has the powerful data base capability needed for selecting and manipulating tax records. Most of these types of programs have established ways to fetch data from other computers, but the specific procedures require experience to implement.

The report examined cash management activities as diverse as recording farebox revenues and optimizing the securities portfolio. Neither spreadsheets nor financial modeling languages are designed to handle a high volume of transactions (such as accounts payable). However, many of the products can be designed to access summary data from the accounting system and this information could be analyzed together with expected farebox receipts and grants to provide the treasurer a good picture of the agency's need for cash. The sensitivity of major transactions to timing can be analyzed. Many

financial modeling languages have a goal seeking capability that would enable the treasurer to determining appropriate cash to meet a given level of solvency.

Budget preparation, with its many changes, appears an ideal application for both spreadsheet and financial modeling programs. Many products of both types have a worksheet consolidation capability which would enable a budget director to supervise the preparation of departmental budgets and then easily combine the results for a director's review. Spreadsheet programs can be used to estimate expenses as a function of the amount and distribution of service based on past experience or productivity factors. Alternative wage rates, fringe benefits and inflation estimates can be examined. Financial modeling languages can be used to estimate labor requirements. Programs with statistical packages can be useful for developing models of absences for work force planning. Investment alternatives can be evaluated using built-in financial functions such as net present value. Neither spreadsheets nor financial modeling programs are recommended for run-cutting or for examining the impacts of alternative work rules due to the myriad of options and the computer memory which would therefore be required.

Although this report analyzed only twelve scenarios, the reader can examine additional applications by identifying the information processing characteristics of a new application and then reviewing the tables in the report. A final section of the report provides additional guidance by identifying the key characteristics of each product. In addition, references are provided on transit financial planning research, product reviews and actual implementations of spreadsheets and financial modeling languages at transit agencies. Appendices are included which identify the specific hardware and software configurations, price, program limits and vendors of the products reviewed; other vendors which responded to the CBD announcement and other available spreadsheet and financial modeling products.

# 1. INTRODUCTION

Current economic conditions together with diminishing Federal operating subsidies have placed an increased emphasis on financial planning within the transit community. Transit agencies must be able to analyze their current operation to determine the financial impact of changes in policy variables such as service levels, fares, labor utilization, subsidies and investments. Forecasts of revenues and expenses over several years must be made to anticipate crises. Numerous alternatives must be analyzed in a timely manner to respond to federal, state and local constituencies. More and better analysis is clearly required yet resources are shrinking. This has created the need for analytic tools which are powerful yet easy to use, and are inexpensive to purchase and operate.

The explosive growth of the microcomputer industry has been fueled by software which meets the needs of business users. An investment on the order of five to ten thousand dollars in hardware and software can provide significant improvement in financial planning activities. Many products are available which can be used directly by financial managers and require no knowledge of computer programming.

Thus, on the one hand, a clear need exists within the transit industry for inexpensive yet powerful financial planning tools, while on the other hand, the market place is producing software for the general business community which purports to be able to meet these needs. Despite the claims of the vendors of these products, the question remains, can they be useful and productive tools for analyzing the specific financial planning problems faced by transit managers?

This report attempts to answer that question by exploring the match between user needs and market supply. By examining specific transit problems and identifying the desirable data input, manipulation and output requirements associated with solving the problem, the report will help the transit manager identify the characteristics of the software he needs. By examining how representative software can be used in response to these needs, the report will help the reader select the most appropriate type of software.

Section 2 identifies specific functional areas for detailed review. Four functional areas were identified: ridership and fare revenue analysis, tax revenue forecasting, cash management, expense estimation. Section 3 describes electronic worksheets and financial modeling languages. Section 4 identifies the specific information processing requirements for each functional area and identifies how each product could be used to meet those requirements. Section 5 summarizes the product capabilities. Appendix A describes the functions, configuration requirements and limits of each product.

# 2. IDENTIFICATION OF NEEDS

## 2.1 METHODOLOGY

Figure 2.1 presents an outline of the report. First, the types of financial planning tasks which transit operators either were doing or wanted to do were identified. For example, forecasting ridership when fares change and estimating next year's operating expenses are financial planning tasks. Second, the information processing environments for these tasks were identifed. The information processing environment defines the characteristics of the process through which the user transforms data into information to solve a problem. For example, how much data must be processed and how fast, how much flexibility in input and output of data is required and how much user control and knowledge of the process is required or needed? Third, feedback was obtained from transit operators to insure that the tasks and environment had been defined accurately. Next, the types of products which appeared capable of performing the tasks and were compatible with the way these products would be used at a transit agency were determined. At this point the products and tasks were defined and an approach was needed to determine more specifically whether the products could do the job.

To determine specific information processing requirements, several typical problem scenarios for each task were defined. Information processing requirements define the specific capabilites of the product to accept, manipulate and output data. Problem scenarios define typical situations which require analysis or decisions on the part of transit agency managers. The problem scenarios establish the value of the information processing requirement. Hence, by determining the capability of the product to process the information in the way needed to solve the problem, the potential value of the product for transit specific tasks was determined. Finally, by examining the strengths and weakness of each product with respect to a set of specific tasks, its potential value for financial planning was determined.

It should be emphasized at the outset that this report examined existing procedures and products. Since new procedures and particularly new products are being developed all the time, the reader should use the process and results described here as a starting point, but should continuously update his/her knowledge of both procedures and product capabilites.

## 2.2 IDENTIFICATION OF CURRENT PRACTICE

Discussions were held with twenty-six transit properties to determine the current state-of-practice in the financial forecasting of major cost and revenue accounts (1). These discussions were also designed to identify how transit properties are responding to particular problems and what organizational and information processing constraints they face. Four major areas were examined: fare revenue estimation (based upon fare structure and

| ACTIVITY | OUTPUT |
|---|---|
| Identification of Current Practice in Financial Forecasting (Section 2) | Current Activities<br>Promising Solutions<br>Constraints<br>Needs |
| Financial Management Information Processing Activities (Section 2) | Inputs, Functions, Outputs<br>Appropriate Software |
| Review Panel Discussions (Section 2) | Feedback on Activity Definition<br>Priorities<br>Constraints |
| Product Surveys (Section 3) | Currently Available Products<br>Product Capabilities |
| Problem Scenarios and Product Capabilities (Section 4) | Issues<br>Decisions<br>Information Processing Requirements<br>Match User Requirements and Product Capabilities |
| Product Assessments (Section 5) | Summary of Product Capabilities to Meet User Requirements |

FIGURE 2-1 OUTLINE OF SOFTWARE ASSESSMENT METHODOLOGY

ridership projections), labor costs, maintenance costs, and subsidies. The selection of properties, while not random, was chosen to reflect a wide range of practice. The financial planning issues, approaches and constraints within each area are summarized in the following sections and characterize the current needs of operators.

### 2.2.1 Ridership and Fare Revenue

Most transit operators recognized that their approaches to estimating ridership and therefore revenues need reevaluation, especially in light of probable increases in fares and/or revision of the fare structure beyond what could be linearly extrapolated from past trends (1). The estimation of revenues given an understanding of ridership was considered fairly straightforward.

Most operators estimated ridership manually using quite simple rules of thumb. Typical approaches mentioned in (1) include the use of past trends and aggregate elasticity measures tempered by information on the local economy. Promising approaches included more disaggregate elasticity factors (type and time of day, type of rider), the consideration of exogenous variables (such as the price of gasoline) and time series models. These findings are similar to those cited in (2) and (3).

The process of estimating ridership seemed to be constrained by the availability of data, and an understanding of the relationship between service and/or fare changes and ridership and the lack of the capability to manipulate the data. Because simple-to-use methods were often not available, relevant questions often went unanswered. Most of the attention was focused either on the next year's (budget) implications or in evaluating current operations for inefficient routes. In only rare instances has a great deal of effort been devoted to planning beyond the one year horizon.

### 2.2.2 Labor Costs

Operators were concerned with forecasting the impact on expenses of changes in service levels (e.g. vehicle miles or hours), service types (e.g. peak vs. off-peak), and service provision (work rules or part time drivers).

Several approaches were used to forecast labor costs. In relatively stable properties, past trends were used with modifications made to wage rates to account for contract provisions. Several properties have developed expense estimation models which relate service levels to labor prices and productivity factors (4,5). The degree of disaggregation varies from one factor for each function to different formula for each line item in the budget. Other properties have attempted to simulate or abstract the significant variables affecting driver assignments to model the incremental changes in expenses resulting from temporal or spatial service changes (6,7). Finally, driver assignment programs such as RUCUS (8), HASTUS (9) or RAM (10) are run for a variety of scenarios to determine the impact of alternative work rules and driver types.

Currently most properties are required to accumulate and report costs by function and object class for Section 15 reporting (11) and have established financial accounting systems to do so. Appropriate methods and software to take accounting data and develop unit cost models (e.g. the unit dollar cost per vehicle-hour) would assist in the analysis of operating expenses. This approach could use simple models in which a small amount of required expense data could be entered manually. More sophisticated modeling to capture the marginal cost of various types of service based on the current driver assignment would provide a more accurate forecasting of service changes. These models would require more data and probably custom programming but would still use a small amount of data. Work rule simulation models based on either actual or simulated runcutting would be more accurate in forecasting driver costs but would require extensive data bases.

### 2.2.3 Maintenance Costs

Maintenance costs are a significant budget item over which managers have considerable discretion. Maintenance costs are forecast using past trends in labor and parts utilization modified by expected price changes. Several properties are developing more sophisticated approaches to inventory and vehicle maintenance management (1). Costs are seldom related to specific maintenance policies.

Maintenance management is dominated by accounting and control issues (12). Keeping track of buses (maintenance scheduling, failure monitoring, status tracking), parts (costs, use and availability) and labor (costs and status) require fairly large data bases of information operating in a real time transaction or periodic reporting environment. The recent emphasis on the need to consider life cycle costs in vehicle purchase decisions has increased the importance of monitoring vehicle maintenance history and developing an ability to predict future maintenance expenditures. "Models" which relate historical vehicle data to maintenance policies could use simple software but the form and information processing requirements of these models are unknown at this time.

### 2.2.4 Non-Fare Revenues

As a result of Federal policy, state and local funding will increase in importance over the next decade. Transit operators will be exploring alternative sources of operating assistance through a variety of broad based local or state taxes, user charges, or benefit sharing plans.

Currently, most transit properties rely on metropolitan planning organizations, state agencies or independent consultants to forecast the yield from broad based taxes or user charges. These organizations have been used in the past, either because they have the experience or the data used to forecast tax yields, or because, by law, they must be used to provide independent estimates of revenues to be used to finance bonds. Parker (13) reports that most changes in non-fare revenue sources require both state authorization (for

changes in local financing) and local referendum (to implement change). The success of these changes are based on the issue of who pays and who benefits. Transit operators need tools to determine both the yields and incidence of taxes to convince the public of the benefits of new revenue sources.

Predicting tax yields for broad based taxes such as property, sales and income taxes are relatively straightforward given an existing calibrated model. Forecasting incidence may require a large disaggregated data base and considerable information processing capability (14).

### 2.2.5 Needs Summary

Discussions with transit operators involved in financial forecasting have identified several functional areas for which procedures and data exist but information processing capabilities do not. These include forecasting ridership using elasticities or pre-calibrated models, disaggregated unit cost or marginal cost models, and revenue yield forecasting. Several other areas such as disaggregate demand modeling, maintenance cost modeling using vehicle histories, labor cost estimation using work rule simulation programs and tax incidence analysis require large amounts of data and more powerful data manipulation capabilities.

## 2.3 FINANCIAL PLANNING ACTIVITY IDENTIFICATION

As part of the Operations Planning and Support Program (15) sponsored by UMTA, a review panel of selected operators was established to provide direction and feedback on the project's research and development activities. As part of the review panel's activities, a meeting was held in June 1982 to discuss information needs and priorities for the application of automated management tools. Prior to the review panel meeting, attendees were provided with draft copies of prototype scenarios developed by the TSC project staff (16) which described, among others, financial accounting and control, monitoring and evaluation, and planning scenarios. These scenarios represented the project team's conceptualization of current practice. Panel members provided feedback on the scenarios and participated in workshops to define their current activities and priorites.

Discussions with the transit operators suggested that financial information management involves data management, control, evaluation and planning activities. The data management activities involve keeping track of relevant operational and financial data, (e.g. Section 15) accumulating the data in meaningful categories (for both internal management and external reporting requirements) and reporting it at appropriate levels of detail and timeliness to inform transit management of the financial and operational condition of the property.

Financial control activities overlap with several operational control functions. Driver scheduling, maintenance management, and inventory control are essential operational control functions with significant impacts on the budget. Since the budget provides the authority to spend money, expenditures and receipts must be tracked against this authorization. Hence, there must be a close relation between the budget and the financial and operational accounting systems. Cash management is a financial control activity closely related to budget control activities. Cash management seeks to first secure cash or cash equivalents and then to maximize cash earning power or minimize its cost by matching receipts and outlays.

Financial evaluation activities focus on establishing relationships between resources used and service provided or consumed. Key functions include performance measure development, trend analysis, cost accounting, and expense modeling.

Financial planning activities include pricing, investment, budgeting and forecasting, often using previously calibrated models. Budgeting is the activity used to plan next year's operation and obtain authorization from the approving authority. The budget is an abstract of the transit agency's priorities concerning resources and their allocation and implicitly reflects the organization's goals and objectives. In the development of a budget the primary focus is on changes from last year's budget. A limited number of scenarios and new options are considered. The work is done primarily by line managers with the administrative staff providing coordination and support. Iteration on alternatives is done depending on the complexity of the changes to be made, if any, and the sophistication of the available information processing tools.

While budgeting represents the short term (one year) planning of the agency, forecasting represents the medium to long term financial planning activity. The purpose of forecasting is to predict costs and revenues for given service levels over several years using the best available internal and external information. Major policy options (including doing nothing) are examined. Many scenarios are considered. Forecasting work is done primarily by administrative staff. The relationships estimated for revenues and expenses during forecasting tend to be more "model" oriented and wider in scope than those used during budgeting. Policy variables affecting fare structure (price and type), service levels, resource utilization, and exogenous variables such as demographics, regional employment trends, and legislation are examined during forecasting.

Figure 2-2 places the financial planning activities in context with other financial management information processing requirements. Accounting, operations control, and planning have different information processing characteristics. Accounting/database management and operations control are dominated by high transaction volumes which are processed with well defined procedures and produce standardized reports. Operations require more customization from property to property and the information needs to be processed in real time. Because of the volume of transactions both of these applications have traditionally been installed on what are considered mainframe computers. Costs are high for the purchase of software or its

| Function | Information Processing Characteristics | Hardware/Software |
|---|---|---|
| **Accounting/Data Base Management** | | |
| Financial Accounting and Reporting<br>Accounts Receivable/ Payable<br>Payroll and Personnel<br>Fixed Assets<br>Ridership Sampling<br>Accident and Safety Reporting | Well defined procedures<br>Transaction processing<br>Periodic standard reports | Commercial software package on time-shared mainframe or stand alone minicomputer |
| **Financial Control** | | |
| Operator Scheduling<br>Vehicle Maintenance Management<br>Inventory Control<br>Vehicle Scheduling<br>Budget Review<br>Cash Management | Well defined procedures<br>Transaction processing<br>Real time information<br>Standard reports | Customized software package on time-shared mainframe or stand alone minicomputer |
| **Financial Evaluation and Planning** | | |
| Performance Analysis<br>Service Planning<br>Financial Planning<br>Pricing<br>Investment<br>Budgeting<br>Forecasting | Ad hoc inquiries<br>Non-standard reports<br>Aggregated data | User programmed software or models developed with commercial "generic" software on small mini or micro computers |

FIGURE 2-2 FINANCIAL MANAGEMENT INFORMATION PROCESSING ACTIVITIES

customized implementation. Operating costs on time shared machines can also be expensive. Development or implementation time can be lengthy. Consequently, the risk of implementing these systems is high.

The financial planning activities described above, with the possible exception of database management and budgeting, use a relatively low volume of data or data abstracted from financial accounting and operations control systems. The information processing characteristics for financial planning and evaluation require flexibility in determining what data is used and how it is processed and reported. The information should be reported fairly rapidly because many variations will be tried.

## 2.4 TRANSIT REVIEW PANEL DISCUSSIONS

The transit review panel discussions provided feedback on TSC's definition of functional needs and information processing activities. A complete list of review panel participants is provided in Appendix B. Review panel members confirmed the importance of ridership and fare revenue estimation and maintenance management tools as top priorites. Sharing data between departments, particularly since the cost of data capture is so high, and linking financial planning to transit operations (i.e., amount of service provided and associated costs incurred and revenues returned) was considered essential. Operators emphasized simple-to-use software which was easy to learn and permitted simple yet extensive data manipulation. Software for budget preparation was identified as a high priority.

Several key facts about information processing emerged from our discussions with review panel members. First, in large properties (more than 250 buses), fairly extensive data processing capability exists, yet little of it is available for planning and evaluation activities. Innovation was difficult unless the data processing manager was particularly attuned to these needs. In medium and small size properties, decisions were made by fewer people, but money was tight and little programming experience was available. Second, while the need for evaluation and planning information processing support was increasing, most existing software was unresponsive. Third, a link between the data accumulated by the accounting and operation control systems and any planning and evaluation tools is necessary.

# 3. PRODUCT IDENTIFICATION

Based on the analysis of financial planning functions and activities and discussions with transit operators, it was determined to investigate the usefulness of low cost software with a high data manipulation capability which required little computer expertise to use. To determine the availability of commercial products, transit consultants were contacted to determine whether each firm had developed microcomputer based financial application software for transit operators. Contact with transit consultants revealed that no firm had developed such software although several were in the process of doing so. A review of products in software directories (17) and microcomputer trade journals (18) indicated that two types of commercially available software might have the characteristics needed. These types of software were electronic worksheet or spreadsheet programs, and financial modeling language programs.

A spreadsheet program is a computer representation of a large piece of paper containing rows and columns that appears on a display screen. The program allows the user to create relationships between entries (such as the sum of a column) which 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 which plot or analyze data series and sort and manipulate sets of data. A financial modeling program provides more flexibility in data manipulation and report generation than the spreadsheet program, but requires more effort to learn. Financial modeling programs generally handle more than one matrix (spreadsheet), have more sophisticated logic and provide more commands for formating and presenting output.

In order to adequately determine whether spreadsheet and financial modeling programs are useful for transit financial planning, it was necessary to review in detail the reference manuals or actually use specific products. Hence, representative products were selected. These products were selected based on the number of units sold and their compatibility with hardware found at most transit properties (Apple, IBM, CP/M machines). Two spreadsheet programs, VisiCalc™ (a registered trademark of VisiCorp) and Calcstar™ (a registered trademark of Micropro International) were selected. Three financial modeling programs, MicroPlan™ (a registered trademark of Chang Labs), Plan80™ (a registered trademark of Business Planning Systems) and DSS/F™ and DSS/A (a registered trademark of Addiston Wesley Publishing Co.), were selected. To assist the reader in understanding the application assessments, summaries of product features are provided in Appendix A.

There are many other spreadsheet and financial modeling language products on the market besides those selected for review. An announcement was placed in the Commerce Business Daily (issue number PSA-8373 dated July 11, 1983 page 29) which described the intent of this report and invited vendors to submit a letter of interest if they wanted their products considered. Vendors who submitted letters of interest and their products are listed in Appendix C.

These products will be considered in future reports. Appendix D lists other spreadsheet and financial modeling languages which were reviewed in addition to the five discussed in this report, in the August 1983 issue of Software News.

It should be noted that general purpose accounting (general ledger, accounts receivable and payable), payroll and data base software programs are available for microcomputers and may be appropriate for the financial accounting and control functions discussed in Section 2. These products were not examined in this report; however, they will likely be the subject of future UMTA Technical Assistance or OPS reports.

# 4. PROBLEM SCENARIOS AND PRODUCT APPLICATIONS

## 4.1 METHODOLOGY

### 4.1.1 Problem Scenario Development

The final step in refining user functional requirements and information processing needs was to develop a detailed information needs assessment and to construct prototypical problem scenarios that transit agencies are likely to face based on the previous discussions and our review of the literature. Questions that were addressed included:

a. What are the financial planning issues which must be faced and the decisions which must be made?

The focus on decisions is important because it establishes an inherent value to the process and identifies a needed output. Any decision involves costs and benefits. Issue identification relates the variables under control of the manager to the various costs and benefits.

b. What information is necessary to resolve the issues and make decisions?

The information needed for a decision refers to processed data which can be captured, stored, manipulated and reported in a meaningful way to aid the decision making process.

c. What information processing capabilities are needed in the decision making process?

By information processing capability we mean the specific manner in which the software must accept, manipulate and report the data used to solve or analyze a problem. While the information processing capabilities that we identify are generic, it should be recognized that the protypical cases span a continuum from the simple to the complex in terms of the application of information processing capabilities to their resolution. Microcomputer software technology is continuously evolving. For some information processing capabilities, current software may fall within the 'simple' end of the continuum while for other capabilities the current state-of the-art is at the sophisticated 'complex' end. As microcomputer software matures, more complex applications will be supported.

Information processing capabilities must add value to the decision making or operational process. Keen (19) and others have shown that information processing improvements will be adopted if the risk and/or cost is low and the manager perceives value. Information processing capabilities add value by increasing understanding, expanding the number of alternatives, improving response time, improving communication or control, saving time or money, increasing teamwork or improving the use of existing data.

### 4.1.2 Application Assessments

Based on a review of the user's manual or actual use of the product, the salient features and limitations of the software product and its required hardware were determined. For each functional area, it was determined how each product would be used to solve the prototypical problems using the set of defined information processing capabilities. This information is tabulated in Tables 4-1 through 4-4. Each Table corresponds to a particular functional area. Within each Table, the use of each product is described with respect to each desired information processing capability. The description is intended to provide the reader with information on how each product would be used. Each Table also includes a summary of the match between the product's characteristics and each information processing requirement. Although the results of the assessment process are only qualitative, they can provide the potential user with enough information to make a decision on the generic characteristics of the software he/she needs.

## 4.2 RIDERSHIP AND FARE REVENUE ESTIMATION AND REPORTING

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 impact of future changes to transit services.

### 4.2.1 Prototypical Cases

The following prototypical problem contexts were developed in order to illustrate some of the desirable functional capabilities that transit ridership software should support.

#### a. Case 1: Service Monitoring and Performance Evaluation

Complaints have been made concerning the equitable distribution of transit service between the central city and the outlying counties within the transportation district. Councilmen from the city cite complaints of insufficient service based upon observation of excessive crowding on buses and long waiting times due to excessively long and irregular headways. Since the city pays a subsidy to the transit agency based on route miles of service rather than vehicle-miles of service within its boundary, the councilmen's constituents believe that they are subsidizing the counties and receiving inferior service. The transit manager has been requested to prepare ridership profiles for routes serving both areas and to include measures of revenue and cost for each route which will be used to resolve the subsidy issue.

#### b. Case 2: Short-Range Transit Planning and Operation Control

It has been two years since the last general fare increase and despite increases in ridership and tight management controls, if nothing is done the deficit to be financed locally next year is expected to increase twenty

percent. The transit agency has a good political standing in the community, yet recent legislation has capped local spending and county managers insist that they can increase their subsidy contribution only five percent, the limit on their own increases. Three options are being considered: (a) a general fare hike (b) fare hikes on peak or premium services, and/or (c) service reduction on routes with the lowest farebox recovery ratios. The manager has been asked to analyze the alternatives and recommend several solutions.

c. Case 3: Long-Range Transit Planning

In the last five years, there has been substantial new private development and restoration in the central business district. The mayor has just announced that the city has received a community block grant which the city intends to apply to a major civic center to be sited on the west side of the central business district. In view of both private and public development activities, the mayor has asked the transit authority along with the city's planning and traffic departments to redesign the central area circulation system and to provide new park-and-ride commuter express bus services to the district. Estimates of the costs and revenues for both the new service and the expected changes to existing service are required.

Although the cases are hypothetical examples, they nevertheless illustrate a number of desirable functional capabilities. A generic analytical framework for ridership and fare revenue analysis which underlies the three prototypical cases considered above is summarized in Figure 4-1. As Figure 4-1 shows, the methodology assumes the implementation of multiple datasets which can be used to develop user-specified ridership and fare revenue models (e.g., linear regression model or logit model to predict ridership) and for direct access and database manipulation within and across datasets.

### 4.2.2 Information Processing Requirements

a. Area, time, and user "windowing"

This software capability has relevance for both management reporting, and the calibration and use of ridership and fare revenue models. In case 1 (ridership analysis), the ability to pre-specify a set of routes (city vs. county) for which ridership profiles are constructed is essential to addressing the relevant issues. In case 2 (fare increase), there is a requirement to focus the analysis of ridership counts not only on specific routes but also during different time intervals, e.g., peak and off-peak service, and different types of service, e.g. local and express. In case 1 there is a requirement to focus the analysis of boarding and alighting counts at the trip level and to determine the origin and destination of city and county users. Similarly, management reports, if they are to provide useful information, must present aggregate ridership data and future estimates by, for example, route, route set, time interval, and/or user subgroup. Ridership data for sampled trips (a single bus run on a route), sampled boarding and alighting counts by stop, passenger surveys, non-user surveys, etc. must also be processed or "aggregated" to provide statistically reliable estimates of ridership measures. In general, there will often be a need to address issues

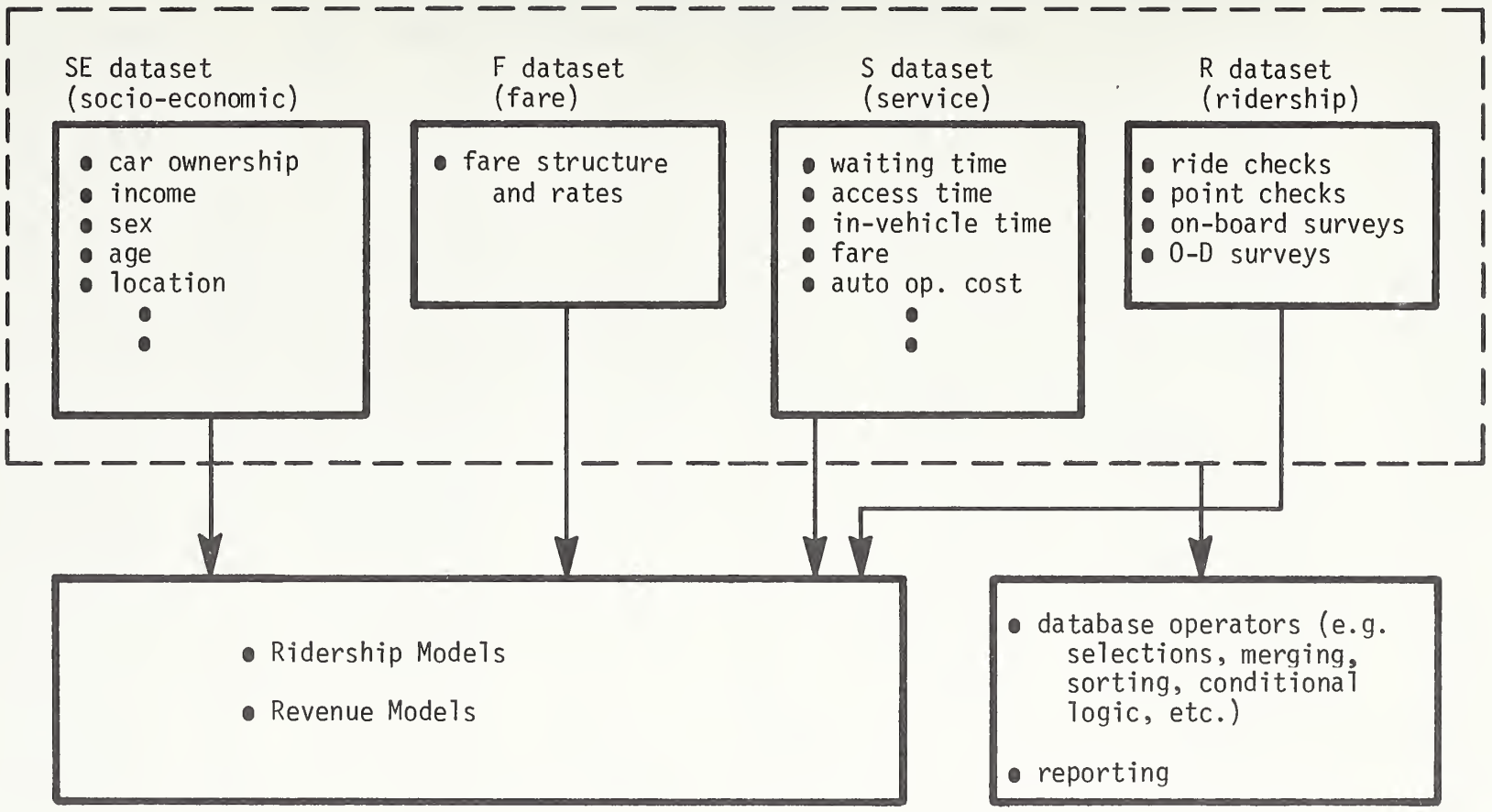


FIGURE 4-1. GENERIC FLOW CHART FOR RIDERSHIP AND FARE REVENUE ANALYSIS METHODOLOGY

which have differential impacts on ridership and related measures by area, time of day, and/or target user subgroup. Examples of microcomputer applications using Visicalc™ software include Old Colony Planning Council's "Ridership and Revenue Projections" (20) and Berkshire County Regional Planning Commission's "Impact of Transit Fare Changes" (21).

b. Linkage to non-ridership data files

Many applications require information concerning the amount of service supplied in conjunction with demand measures. In case 1, there is a requirement to access scheduling data files (e.g., vehicle block and driver run data) to determine the number of buses and bus hours allocated to each set of routes (based upon specification of the routes and a service time interval). An example of a microcomputer program which builds schedules is NCTCOG/ATE's "Microcomputer Software for Transit Scheduling and Analysis" (22). To develop estimates of subsidy per passenger and passenger trip in case 1, direct bus revenue by route, and direct operating cost exclusive of joint costs and contribution to fixed charges (capital costs) must be determined from accounting and operation files. In cases 2 and 3 (new service plan) projected revenue changes must be matched with projected expense changes. An example of a microcomputer program for collecting and processing route performance data is Multisystem's "Transit Data Management System" (23).

c. Incorporation of user defined models

One of the most important functional capabilities is the ability of the software to support user defined models which transform input data to desired output data.

In case 1 (ridership analysis), the user may want to develop, print, and plot cumulative boarding and alighting curves, bus occupancy levels, and total passengers served for each route in each group of routes by aggregating boarding and alighting passenger counts by station for a sample of trips on each route.

In case 1, the user must compute fare revenue by multiplying the number of passengers on the route by the average fare (also developed from a user specified model based upon the fare structure and the ridership profile by class of rider on the route). Subsidy calculations are then based upon the defining equation: direct operating subsidy = direct revenue - direct operating cost. To compute the subsidy per passenger trip, pairs of transit routes with transfer volumes must be identified and the sum of the unlinked passenger trip counts for each pair of routes adjusted by subtracting the transfer volume passenger count for that route pair (assuming, at most, one-transfer trips). An example of a microcomputer application using Visicalc™ software is San Francisco Muni's "Fare Revenue Projections" (24).

In case 2 (fare increase), the difference between total expenses and total revenue must be reduced by a given amount. Since there are numerous ways of achieving this objective, models which allow iterative (and also interactive) consideration of the alternatives are essential. These models may range from aggregate elasticity and unit cost models when considering general fare hikes to specific route level demand and cost models which account for time of day and type of service variations. If route level models

are used, the interaction between the various routes in the system must be considered. Simple models which allow both user judgement and can easily be explained to policy makers are needed during the decision making process. Since public hearings are likely to be held, the capability to quickly make changes and evaluate the results are important.

In case 3 (new service plan), the ability to process origin-destination survey data and transit ridership data for subsequent traffic assignment is required to test alternative CBD transit networks using a bus network design model. Transit ridership software should also be able to support the user in defining cordon boundaries and computing passenger and bus flows to, from, internal to, and external to the cordon boundaries. The user may also wish to develop ridership models to predict station access volumes at park-and-ride stations in order to develop adequate parking capacities.

d. User defined report formats, and output file formats

In case 1 (ridership analysis), the report must show subsidy per passenger and per passenger trip by route. In addition, transit routes with transfer volumes above a certain user supplied threshold must show a special symbol annotation, and the transfer volume in each direction for the pair of transit routes indicated on the report. In case 2 (fare increase), agreed upon route changes need to be returned to the scheduling and driver assignment programs. In case 2 different users require different reports. Top management is concerned with bottom line figures. Departmental managers need reports which show the effects of changes on their specific functions. Different user groups need to be informed on the potential impact of changes on them. In case 3 (new service plan), the city, civic center developers, and outlying park and ride lot owners need information on expected service changes and the resulting physical requirements.

In case 1, the cumulative boarding, alighting and bus occupancy functions might be graphed along with tabular printout. In case 1, bar or pie charts illustrating the city and county subsidies (total or disaggregated by route) for alternative subsidy formulas would clarify the issues. In case 2, specific routes may be modified by either price or service changes. Graphical output highlighting these changes would assist the decision making process. In case 3, revenue for each type of change and graphs showing project schedules could assist in the project's implementation.

### 4.2.3 Application Assessments

Table 4-1 describes how each product would be used with respect to the ridership and fare revenue estimation information processing requirements discussed above. Column 1 identifies the product. Each product is considered with respect to the set of desirable information processing requirements listed in Column 2. Column 3 is a summary of the application discussions contained in Column 4. The application discussions are intended to provide the reader with enough information to make a decision on the generic characteristics of the software he/she needs. Product application discussions

TABLE 4-1

PRODUCT APPLICATION FOR RIDERSHIP AND FARE REVENUE ESTIMATION

| Product Name | Desirable Information Processing Capability | Product Match* | Application Discussion |
|---|---|---|---|
| 1. "Visi" family<br>*S = Strong match<br>A = Adequate match<br>L = Limited match | o area, time and user windowing | S | Ridership count data (similar to Section 15 Trip Survey Sheets) is beyond the capability of VisiFile (24 fields max), although the survey form itself and the daily record sheets for Section 15 contain numerous computed fields which could be handled with VisiCalc. Trip survey records using fields 1-8 and 20-26 could be transferred from VisiCalc to VisiFile and the daily record sheet and annual report to UMTA could be calculated. VisiFile would allow selection and processing of data by area, time and user windowing. Specific areas of VisiCalc matrix or VisiTrend VisiFile records may be worked on. Visicalc is limited to 2 dimensional arrays.<br><br>Summation (@ SUM (list)) commands exists in VisiCalc; however only VisiFile has a select feature. If user had subgroup data by time of day, route, user subgroup etc. and different elasticities for each, they could be entered separately and then aggregated.<br><br>VisiTrend can calculate ridership models with up to five independent variables, 645 total observations, using multiple linear regression. Previously calibrated models can be entered on VisiCalc matrix (63 x 254). Stratification would have to be done carefully. Results of several matrices could be stored in another file for aggregation. |
| | o linkage to non-ridership data files | A | Data can be read by all three "Visi" programs if it is in DIF format, which is documented. Some programming would be required. These programs accept 2 dimensional arrays only. |
| | o incorporation of user defined models | S | Models can be written on the VisiCalc worksheet to relate variables in several cells to another cell. Arithmetic and logical operators are available. VisiTrend has multiple linear regression with five independent variables, data series smoothing and data transformation capabilities. VisiFile has computed field capability. |

TABLE 4-1 (continued)

PRODUCT APPLICATION FOR RIDERSHIP AND FARE REVENUE ESTIMATION

| Product Name | Desirable Information Processing Capability | Product Match* | Application Discussion |
|---|---|---|---|
| 1. "Visi" family | o user defined report formats and output file formats | S | All three "Visi" products have user defined reporting. VisiCalc users see on the monitor what the report will look like. VisiPlot generates graphical output with user defined labeling. VisiTrend and VisiFile allow the user to create and store report formats. Output files are limited to DIF formats.<br><br>VisiPlot provides graphical output of up to six data series, in six colors or shading in a variety of forms. |
| 2. Calcstar and Datastar | o area, time, and user 'windowing' (focusing and extracting a subsection of a dataset) | S | The cursor controls allow any "window" of the array to be shown. In addition, there is a command which is specifically designed to isolate a specific section of data on the screen display (EDGE command). The software supports only a two-dimensional array and there is no provision for operating on multiple tables simultaneously.<br><br>There is a system function (SUM) to calculate the sum of a given list of values.<br><br>Calcstar has a regression analysis which allows ridership models to be calibrated (a target ridership level can also be inserted as an input and the system will compute the level of the independent variable, e.g., fare, necessary to achieve the target ridership level). There seem to be no software commands which can select specific row or column combinations. |
| | o linkage to non-ridership data files | A | Calcstar does not have a software interface to external files. Datastar does provide search and retrieval capabilities for multiple files and multiple records, which have previously been entered using Datastar. |
| | o incorporation of user defined models | S | Logical and arithmetic operators are supported by the software. A conditional logic statement( IF-then-else) can also be used. The cell contents in the array can be expressed using the system function, logic and arithmetic operators and references to the contents of any other cell or list of cells. |

TABLE 4-1 (continued)

PRODUCT APPLICATION FOR RIDERSHIP AND FARE REVENUE ESTIMATION

| Product Name | Desirable Information Processing Capability | Product Match* | Application Discussion |
|---|---|---|---|
| 2. Calcstar and Datastar | o user defined report formats and output files | S | Calcstar provides numerous report generating capabilities. Column widths can be adjusted independently. Text and numeric data can be used and switched easily within and between rows and columns, and subsections of the screen display can be developed into a report.<br><br>The software does not have a graphics routine. |
| 3. Microplan | o area, time, and user "windowing" (focusing and extracting a subsection of a dataset) | A | The software handles two dimensional arrays only. Tables can be combined using the Consolidation Module. Entries are limited to less than 1000 per table. Large data sets based upon point check, riding check, and on-board surveys would have to be preprocessed. Two commands which limit computations to subranges of rows and columns would require the user to enter data in a specific row and column sequence since these commands operate on a continuous sequence of rows or columns. The software enables the user to view parts of the Table on the screen.<br><br>The software can support any specific row and column list summation.<br><br>Ridership models which are already calibrated can be entered and exercised using the software. |
| | o linkage to non-ridership data files | A | Any data can be entered into a single Table. The LINK command in the Consolidation Module can be used to read an externally generated text file into a row or column of a table. |
| | o incorporation of user defined models | A | Formulas may be incorporated into the Tables to compute row and column values. There is no conditional if-then-else logic. |

TABLE 4-1 (continued)

PRODUCT APPLICATION FOR RIDERSHIP AND FARE REVENUE ESTIMATION

| Product Name | Desirable Information Processing Capability | Product Match* | Application Discussion |
|---|---|---|---|
| 3. Microplan | o user defined report formats and output files | S | Format and report option settings can be viewed on the output file formats screen and saved as a file for the production of future reports. This includes report option settings, row descriptions, column descriptions etc. Table reports may also be written to a file and interfaced with word processing software for report production.<br><br>The software does not, however, support a graphic routine. |
| 4. Plan80 | o area, time, and user 'windowing' (focusing on a sub-section of the dataset) | S | The software handles only two-dimensional arrays and relatively small datasets (e.g. 40 rows and 100 columns). The software does have a flexible row and column delimiter command (e.g., FOR ROWS=(ROW1, ROW3, ROW5) which allows any list of rows/columns to be listed for which computations will be made using only that list.<br><br>The software permits any row or column summation and can be used in conjunction with row and column delimiter command. Software not only has @SUM command to aggregate a row or column or group of rows/columns, but also a @CUM command to provide a cumulative sum.<br><br>Since there is no estimation routine, already calibrated ridership models must be entered. Calculations are limited to relatively small sized data sets. |
| | o linkage to non-ridership data files | A | Plan80 can retrieve data from internal files using the PUT and GET commands, from DIF files (VisiCalc format) or from other external files which have been edited to identify the name of the row or column to which the data will be transferred. |

TABLE 4-1 (continued)

PRODUCT APPLICATION FOR RIDERSHIP AND FARE REVENUE ESTIMATION

| Product Name | Desirable Information Processing Capability | Product Match* | Application Discussion |
|---|---|---|---|
| 4. Plan80 | o incorporation of user defined models | S | The software includes numerous built-in commands. If-then-else logic is supported; the INCLUDE command allows the user to develop subroutines which can be called in applications and several important mathematical functions are available( max, min, sum, cum, lookup tables, IRR). Lag and lead operators which allow shifting of values are also available. |
| | o user defined report formats and output file formats | S | Report generation capabilities are well designed and extensive.<br><br>There exists a graphic analysis mode which allows the user to define what variables are to be displayed and how they are to be displayed. Graphics can be displayed on screen or printed in reports. |
| 5. DSS/F and DSS/A | o area, time, and user 'windowing' (focusing on a subsection of a dataset) | S | Both DSS/A and DSS/F handle only two-dimensional arrays. DSS/F supports several commands which allow the user to scan his matrix and/or extract selected rows and/or columns (e.g., QD provides a quick display of selected rows and columns, EXTRACT selects specific rows and columns). DSS/A allows the use of logical operators (e.g., SELECTIF) to select data from the database meeting certain conditions. DSS/A also has a SELECTROWS command, and a GROUP command which allows consolidations.<br><br>DSS/F provides a SUM command to aggregate data values in a row or column and a CUM command to provide cumulative totals. In DSS/A, the REPORT mode allows the user to define column footings in reports, one option of which is to provide totals.<br><br>DSS/A supports an estimation routine, thus ridership models can be calibrated. Commands also exist to select specific row and/or column sequences. |

TABLE 4-1 (continued)

PRODUCT APPLICATION FOR RIDERSHIP AND FARE REVENUE ESTIMATION

| Product Name | Desirable Information Processing Capability | Product Match* | Application Discussion |
|---|---|---|---|
| 5.DSS/F and DSS/A | o linkage to non-ridership data files | L | Neither DSS/A nor DSS/F has a software interface to communicate with external data files or programs, although a "data interchange" software module is under development. Within a user-defined data structure, however, DSS/A and DSS/F allow any type of data. |
| | o incorporation of user defined models | S | DSS/F's modelling language supports many row operator and column operator functions (e.g., LAG, LEAD, logical operators, MIN, MAX, etc.). In addition, each cell of the matrix can be independently computed. DSS/A supports powerful statistical estimation and analysis routines including regression analysis, ANOVA, and crosstabulations. DSS/A also has several database management commands which allow the user to easily query his database. While neither DSS/A nor DSS/F support optimization in the classical sense, it can "goal seek," i.e. invert a user defined model for revenue estimation so one could specify a series of target revenues and have the model "back into" a solution for the required ridership to meet those goals. |
| | o user defined report formats and output file formats | S | Both DSS/A and DSS/F have extensive report generation capabilities. DSS/A is has no limit on row and column column label lengths, thus reports can be made which are quite readable. DSS/F supports a JOB sequence routine which can be invoked. This allows a model and sequence of reports with already defined formats to be executed without creating the model and report formats from scratch.<br><br>DSS/A was specifically designed to integrate graphics and text reports. Its GRAPHICS mode can be invoked at anytime, with control transferred back to the other modes of operation using the CONTINUE command. DSS/F also has a graphical analysis routine. DSS/F graphics can be made either one at a time at the terminal using the printer, using a predefined graph specification file, or using a slide presentation on the screen. The graphics routine is invoked in DSS/F by typing END, then X and DSS:GR for executing the graphics file( DSS:GR). |

* S = Strong match between product and desirable information processing capability and product characteristics
A = Adequate match; L = Limited match

are summarized as strong (denoted by an "S"), adequate (denoted by an "A") or limited (denoted by an "L"), corresponding to the match between product characteristics and user requirements.

## 4.3 TAX REVENUE YIELD AND INCIDENCE ESTIMATION

Planning transit services requires the prediction of the level of tax revenue that will be available to the operator to subsidize transit operations. Securing new revenue sources requires the prediction of both the impact (who benefits) and the incidence of the tax (who pays). The objective of tax revenue estimation is to predict tax revenue yield to the transit operator from specific tax sources under various economic and policy assumptions. Prototypical problem contexts which show examples of the type of problems to be solved are developed in order to illustrate some of the desirable functional capabilities that tax revenue applications software should support. A summary of a generic analytical framework for tax revenue estimation is given in Figure 4-2. This framework underlies the prototypical cases considered below.

### 4.3.1 Prototypical Cases

#### a. Case 1: Joint Development

The transit agency is participating in a joint development effort involving the implementation of the first stage of a fixed rail high-capacity network and new private development in each corridor. Two orthogonal routes with transfer facilities are planned as the first implementation, and it is intended that a share of the cost of transit construction can be secured through adoption of a "value capture" policy (i.e., taxing the increase in property values brought about as a direct result of the transit improvement). Projections over a 15 year project horizon are requested of the time stream of future tax revenue yields along each corridor.

#### b. Case 2: Allocation Formulas

Alternative allocation formulas are being debated before the legislature. The transit general manager has asked his staff to prepare projections of tax revenue yields over the next five years for each alternative allocation formula.

#### c. Case 3: Tax Rate Changes

Transit ridership has declined by five percent over last year. Revenue from state and local taxes, however, are dependent upon the level of ridership through the allocation formula. The transit operator wishes to know (a) what savings in cost must be achieved to meet the expected tax revenue yield considering fare revenue and tax yield losses due to lower ridership levels;

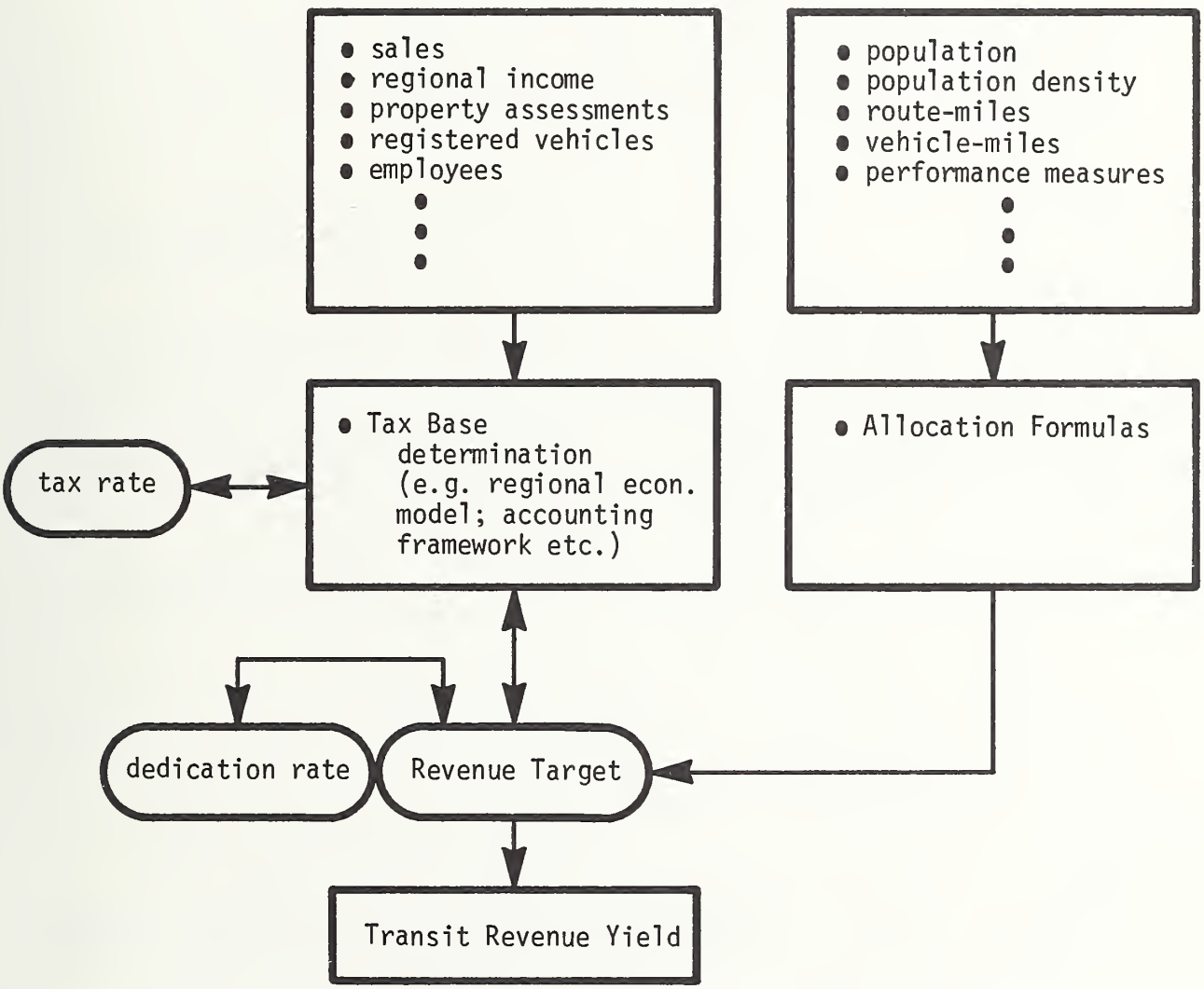


FIGURE 4-2. GENERIC FLOWCHART FOR TAX REVENUE YIELD AND INCIDENCE ESTIMATION

and (b) what increase in the tax rate must be requested from the legislature to achieve a tax revenue yield sufficient to offset the fare revenue and tax yield losses due to lower ridership levels?

### 4.3.2 Information Processing Requirements

These cases illustrate several desirable functional capabilities:

a. Support a modelling framework

Each of the above cases requires an estimation of tax revenues. In case 1 (joint development), the transit operator would use the software to define the appropriate allocation formula, and compute the tax revenue yield based upon a geographically defined tax base data file (see below). In case 2 (allocation formulas), alternative allocation formula models would be used to compute the tax revenue yield. In case 3 (tax rate changes), the transit operator would use the software to compute the tax revenue yield incorporating the effect of the loss of ridership on its allocation and adjusting for normal growth of the tax base. In addition, a revised fare revenue level accounting for the loss of ridership would also be computed (using the transit ridership software), and the difference between expected total costs and the sum of tax revenues and fare revenues would be computed to determine the "savings" in cost that must be made to keep within expected total revenue levels. Finally, a revised tax rate can be estimated which will yield sufficient revenue to offset the difference between total costs and fare revenues (adjusting for the loss of ridership, and normal growth in the tax base).

b. Selecting, sorting and other database operations

Case 1 (joint development) requires that the user be able to identify corridors within set boundaries in order to extract property assessment records to compute the relevant tax base (Figure 4-2). Since the routes intersect with overlapping access areas within the transfer station, the software must also have the capability to allow the user to adjust for potential double counting in processing geographically defined data. An APTA survey of transit finance mechanisms (25) indicated that the greatest reliance was on property tax assessment. The ability of the software to select property assessment records corresponding to user-defined criteria will also allow more sensitive projections of tax revenue yields since the user can decompose the service area into multiple jurisdictions and explicitly model the differential growth of the tax base between jurisdictions within the region.

c. Forecasting capability

Each of the above cases requires that tax revenue yields ultimately are projected. The software should support alternative projection techniques; these might include trend projection, moving averages, as well as more complex time series and multivariate techniques.

### 4.3.3 Application Assessments

Table 4-2 describes how each product would be used with respect to the tax revenue forecasting information processing requirements discussed above. Column 1 identifies the product. Each product is considered with respect to the set of desirable information processing requirements listed in Column 2. Column 3 is a summary of the application discussions contained in Column 4. The application discussions are intended to provide the reader with enough information to make a decision on the generic characteristics of the software he/she needs. Product application discussions are summarized as strong (denoted by an "S"), adequate (denoted by an "A") or limited (denoted by an "L"), corresponding to the match between product characteristics and user requirements.

## 4.4 CASH MANAGEMENT MODELS

Efficient cash management can assist the transit manager in stretching his operating budget, particularly since the high level of interest rates makes the cost of holding excess cash expensive. Thus, cash management is an important component of a financial analysis routine. In this section, we develop a brief statement of desirable functional capabilities that a cash management software module should support. A generic framework for cash management is summarized in Figure 4-3.

### 4.4.1 Prototypical Cases

Prototypical problem contexts, based upon this generic methodology, are developed to illustrate some of the desirable functional capabilities that a microcomputer based cash management application software should support.

#### a. Case 1: New Service

A small transit agency has been granted a contract to initiate new demand-responsive elderly and handicapped service. The general manager requires a cash budget projection.

#### b. Case 2: Interest Expense Projections

The controller wants to know what the effect will be on next month's cash balance of a rise of 1/2 percent in the interest rate on long term bonds which will be issued to finance the purchase of new buses. A listing of all securities held by the transit agency with their current maturity date, interest rate, and money earned to date is also requested.

#### c. Case 3: Cash Control Analysis

An ongoing audit reveals some discrepancies between reported fare revenues on bus routes 2, 8, 9, and 12 and what could normally be expected based upon the level of ridership. The controller desires a transaction log

TABLE 4-2

PRODUCT APPLICATION FOR TAX REVENUE YIELD AND INCIDENCE ESTIMATION

| Product Name | Desirable Information Processing Capability | Product Match* | Application Discussion |
|---|---|---|---|
| 1. "Visi" Family<br>S = Strong match<br>A = Adequate match<br>L = Limited match | o support a modelling framework | S | VisiTrend could be used to analyze, model and forecast tax revenue based on aggregate levels (county, city etc.) which is fairly consistent with level of data detail. Ability to transform data or compute time series could be used to test assumptions on base and tax rate. VisiFile could hold census tract data if fields were abstracted to relevant data. (maximmum of 24 fields). VisiTrend supports linear regression. |
| | o selecting, sorting and other database operations | A | If the number of data fields for which information was required were small (<24) and the number of geographic tracts were few (<1000), users could key in relevant property assessment information for later sorting. If individual property assessments were needed, then Visi software would not be adequate. |
| | o forecasting capability | S | Once models are developed, VisiCalc or VisiTrend could be used with appropriate plotting. Regional economic models could be included depending upon the local planning capabilities. |
| 2. Calcstar and Datastar | o support a modelling framework | S | Calcstar can implement tax yield estimation using formula allocation and/or dedication rates applied to a user defined tax base as an input. It also has a regression routine which would allow limited model building to estimate tax bases. |
| | o selecting, sorting and other database operations | S | Datastar has a flexible data entry procedure which would support geocoded data structures. The search by indexed key routine would allow records in the same geocoded area to be scanned and retrieved. |
| | o forecasting capability | S | Calcstar can support growth trend projections and single variable linear regression. |

TABLE 4-2 (continued)

PRODUCT APPLICATION FOR TAX REVENUE YIELD AND INCIDENCE ESTIMATION

| Product Name | Desirable Information Processing Capability | Product Match* | Application Discussion |
|---|---|---|---|
| 3. MicroPlan | o support a modelling framework | S | The software is suitable for an implementation of the tax revenue model framework with the exception of estimation of a tax base model. An already calibrated tax base model, however, could be used. |
| | o selecting, sorting and other database operations | A | The cannot sort or merge records, or access records based upon a sequence of geocodes. The user can combine different Tables and access external files using the Consolidation Module. |
| | o forecasting capability | A | Some forecasting techniques (e.g., time growth rates) can be supported. |
| 4. Plan80 | o support a modelling framework | S | The software does not have an estimation routine to develop tax base models, but otherwise is suitable to implement the tax model framework |
| | o selecting, sorting and other database operations | A | The cannot sort or merge records, or link different files and/or data items; however, the FOR ROW(COL)= command does allow selected rows and columns to be accessed, providing some data management capability. Also Plan80 can read the output of many data base systems and user programs in the form of text or DIF files. |
| | o forecasting capability | S | The software supports forecasts based upon a constant amount or a constant growth rate. |
| 5. DSS/F and A | o support a modelling framework | S | DSS/A software can be used for tax revenue estimation. The user can define, for example, alternative tax formulas and compute tax yields based upon each alternative. |
| | o selecting, sorting and other database operations | A | The SELECTIF command in DSS/A can be used to extract specific planning units. The RANK command allows sorting of files. DSS/F also has an EXTRACT command to select certain rows and/or columns, and an APPEND command to combine two or more files. |
| | o forecasting capability( projection of tax revenue yields) | S | Forecasts from a regression model can be made using DSS/A. Time trend or growth rates can be used in DSS/F. |

* S = strong match between desirable information processing capability and product characteristics
A = adequate match L = limited match

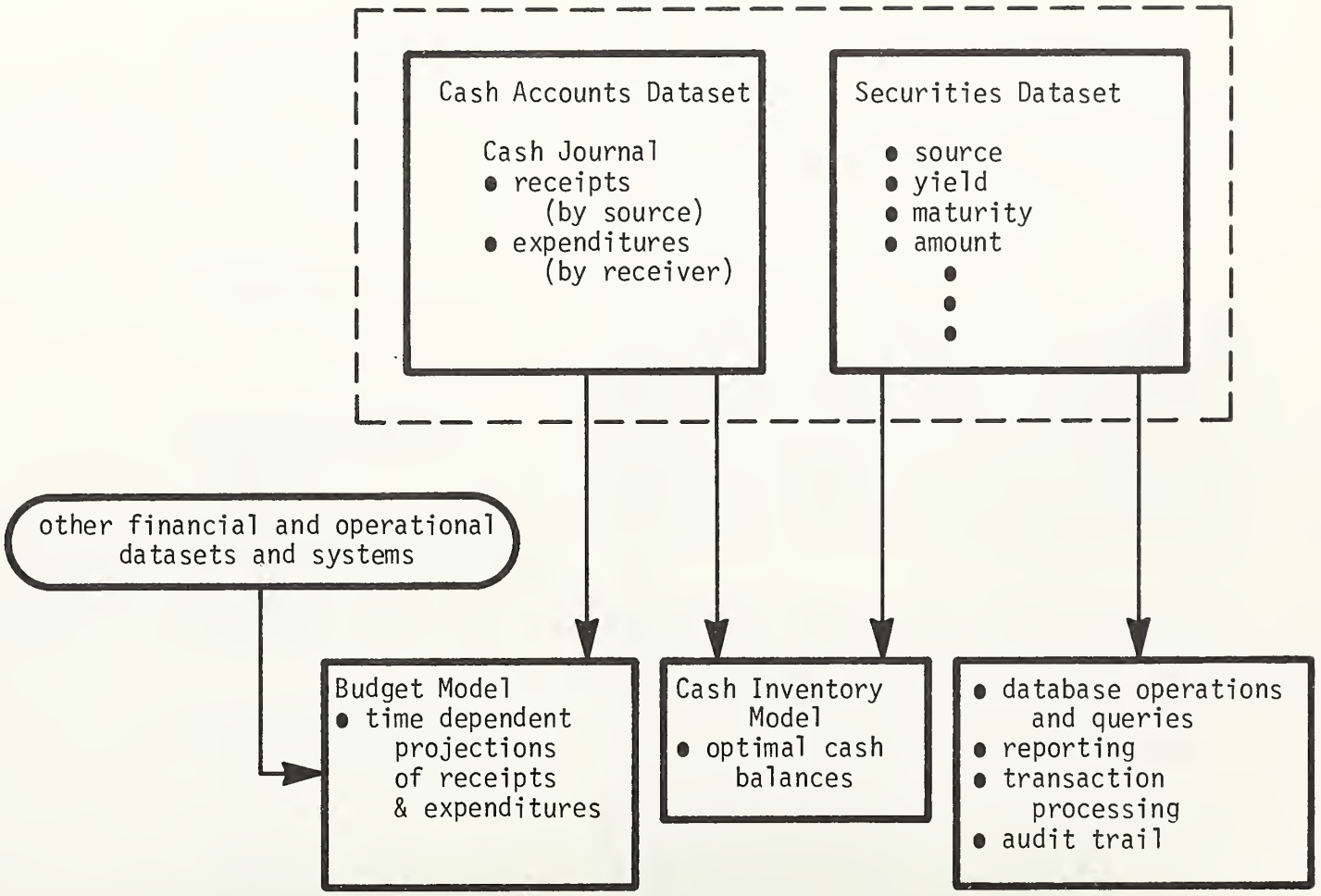


FIGURE 4-3 GENERIC FLOWCHART FOR CASH MANAGEMENT METHODOLOGY

covering the time period in question, and a listing of all cash receipts for bus runs on the routes in question.

### 4.4.2 Information Processing Requirements

These cases illustrate several desirable functional capabilities that a cash management software module should support.

a. Cash budget forecasting capability

The projection of cash receipts and cash disbursements over various time intervals is critical in determining the optimal level of liquid assets to hold. Projections of the cash budget allow the operator to determine whether a cash deficit will occur, and to examine alternative ways of financing it. For small and intermediate sized transit operators providing specialized services under contract and/or reimbursable agreements as in case 1, the preparation of cash budget projections can assist the operator in avoiding potential cash flow problems; e.g., based upon an analysis of future cash budgets, the operator may choose to submit vouchers when equipment is ordered rather than received, thus providing sufficient lead time to receive funds to pay equipment suppliers.

b. "What if" analysis

The ability to simulate the effect of changes in assumptions and problem parameters as in case 2, e.g., different interest yields and maturity schedules of marketable securities, or changes in the credit terms of suppliers, on the net cash flow position of the transit property is an important feature that the software should support. A "what if" capability will allow the operator to develop alternative future scenarios, and to work out their implications along with associated probabilities. Ideally, the user should be able to input alternative parameter option settings with the software providing a simulation of future cash budgets, or a cash-marketable securities model, or whatever the user is working on.

c. Audit trail for sources of funds

Transit operators depend upon multiple sources of funds. From the perspective of efficient cash management, the aggregate of cash on hand should be managed irrespective of the specific cash balance accounts by source of funds. Legal, administrative and internal management requirements, however, impose the need to maintain the identity of the source of funds. Thus, the software should allow the user to develop data structures which permit the encoding of the source of funds for cash receipts and cash disbursements, e.g., identification of cash receipts from governmental Title programs, local tax contributions by jurisdiction and fare revenue collections by vehicle, bus route, etc. This functional requirement is critical to respond properly to case 3.

d. User defined models

The optimal mix of cash and marketable securities, fundamentally, requires balancing the cost of holding excess cash against the transaction cost of converting securities to cash. There exist a number of inventory theoretic models which can assist the transit manager in developing an optimal cash balance. The software should allow the user to incorporate cash management models, or to develop his own model.

e. Transaction logging and support

Cash management requires a high volume of transactions. One of the most important functional capabilities of the software is to support the user in a transaction oriented environment. This would include the provision for automated recordkeeping and status monitoring of all cash transactions. In addition, the software should keep a transaction log on a secure file of all user interactions in order to provide an audit trail and enhance the security of the system. In case 3, for example, a transaction log is critical to resolve the issues in question.

f. Linkage to other software and data files

Cash management in a transit property can not exist in isolation. Prediction of cash receipts from fare revenue requires access to the transit ridership software module. Cash expenditure predictions for equipment and supplies will require access to a maintenance management module. Thus, linkage to other software and databases is considered critical.

g. Query capability

There are a number of questions that a transit manager may wish to address: What securities will mature next week? What was last week's cash balance? What are the earnings to date on the transit property's cash balances? The software should support the user in a query mode.

### 4.4.3 Application Assessments

Table 4-3 describes how each product would be used with respect to the cash management information processing requirements discussed above. Column 1 identifies the product. Each product is considered with respect to the set of desirable information processing requirements listed in Column 2. Column 3 is a summary of the application discussions contained in Column 4. The application discussions are intended to provide the reader with enough information to make a decision on the generic characteristics of the software he/she needs. Product application discussions are summarized as strong (denoted by an "S"), adequate (denoted by an "A") or limited (denoted by an "L"), corresponding to the match between product characteristics and user requirements.

TABLE 4-3

PRODUCT APPLICATION FOR CASH MANAGEMENT

| Product Name | Desirable Information Processing Capability | Product Match* | Application Discussion |
|---|---|---|---|
| 1. "Visi" Family<br>*S = strong match<br>A = adequate match<br>L = limited match | o cash budget forecasting capability | S | Data from the Financial Accounting System is needed to determine periodic cash receipts and disbursements (fares, passes, payroll). These could be entered on a worksheet and then supplemented by major accounts receivable and payable transactions (tax revenue, grants, fuel purchases, major vehicle payments, bond interest). Time series could be transferred to VisiTrend/Plot for presentation. Experimental models could be developed on a worksheet which would gradually evolve to a level of detail beyond worksheet capacity. |
| | o simulation | S | Aggregate model of cash flows could be used for policy analysis of when to borrow and when to invest. |
| | o tracing trail for source of funds | L | Visi family is not a transaction system. Aggregates from the Financial Accounting System could be entered on the VisiCalc worksheet and used for analysis or projections. |
| | o user defined models | A | The software cannot be used for optimization models but could be used for policy decisions. |
| | o transaction logging and support | L | VisiCalc has only 254 rows for recording and processing transactions. No access security is provided. |
| | o linkage to other software and data files | A | Interface is provided to "Visi" family files through DIF format. Most of the data (for example, anticipated disbursements) will have to be entered manually. |
| | o query capability | S | Microcomputer could be used as a dumb terminal to a bank's central computer for the purpose of cash balance monitoring. Investment and debt issues could be kept in VisiFile. |
| 2. Calcstar and Datastar | o cash budget forecasting capability | A | Some important cash budget functions are not supported (e.g., lead and lag operators); however, cell contents can be referenced in formulas to compute data values. In addition, the COPY command allows copying data values entry to entry. |

TABLE 4-3 (continued)

PRODUCT APPLICATION FOR CASH MANAGEMENT

| Product Name | Desirable Information Processing Capability | Product Match* | Application Discussion |
|---|---|---|---|
| 2. Calcstar and Datastar | o simulation | S | The RECALC command in Calcstar, which recalculates cell values in the table based upon defining formulas is a command which operates on either a particular entry or all entries in the array. Thus, changes in a formula or data value can be simulated. There is also an error protection screen which will write an error message in cell entries affected if illegal operations are computed (e.g., dividing by zero). |
| | o tracing trail for sources of funds | A | Neither Datastar nor Calcstar provides user security, a user transaction log, or password protection. Records of receipts and expenditures could be kept with the source of funds indicated in a particular data field using Datastar's FORMGEN program to design the data collection form to provide a tracing trail for source of funds. |
| | o user defined models | L | Optimization models are not supported by Calcstar. |
| | o transaction logging and support | A | Datastar is designed for on-line data entry of user designed data collection forms. |
| | o linkage to other software and data files | S | Datastar is compatible with CP/M supported programming languages. Calcstar can create BASIC and Datastar files. |
| | o query capability | S | Although a full query capability is not provided in Datastar, the search and retrieval routines are useful. |
| 3. Microplan | o cash budget forecasting capability | S | The software has several functions (e.g., lag and lead operators) which are specially designed for cash budget forecasts. |
| | o simulation | S | "What if" experiments are easily supported. |
| | o tracing trail for source of funds | A | The software is not designed for this, but user could keep track of source of funds for revenues and expenditures by using different tables, or coding his variables to indicate source of funds. |
| | o user defined models | L | The software can not implement optimization models. |

TABLE 4-3 (continued)

PRODUCT APPLICATION FOR CASH MANAGEMENT

| Product Name | Desirable Information Processing Capability | Product Match* | Application Discussion |
|---|---|---|---|
| 3. Microplan | o transaction logging and support | L | Microplan can accept only 1000 data values in each table. No special access security is provided. |
| | o linkage to other software and data files | A | The software provides an interface to other data files using the LINK command in the Consolidation Module. |
| | o query capability | L | The software does not support a query language. |
| 4. Plan80 | o cash budget forecasting capability | S | The software contains built in functions useful for cash management applications. Several important operations ( e.g., shifting by lead or lag periods) are supported. |
| | o simulation | S | The interactive command (:INTERACTIVE) allows "what if" experiments to be made. |
| | o tracing trail for sources of funds | A | The software does not have a sorting capability, but the user could keep track of sources of funds for revenues and expenditures by proper labeling of rows, columns, or by using separate Tables. |
| | o user defined models | A | For optimization models the software requires that models be run several times until results converge. |
| | o transaction logging and support | A | Plan80 can extract summary results from a compatible data base management system. |
| | o linkage to other software and data files | A | Plan80 can retrieve data from internal files using the PUT and GET commands, from DIF files (VisiCalc format) or from other external files which have been edited to identify the name of the row or column to which the data will be transferred. |
| | o query capability | L | No query language is provided. |
| 5. DSS/F and DSS/A | o cash budget forecasting capability | S | DSS/F supports several logical operators which are useful in developing cash budget/flow applications. These include lag, lead, spread, lookup tables, and tax loss carry forward routines. |
| | o simulation | S | "What if" experiments are well supported by changing individual cell values, row or column calculations, or even an entire model. |

TABLE 4-3 (continued)

PRODUCT APPLICATION FOR CASH MANAGEMENT

| Product Name | Desirable Information Processing Capability | Product Match* | Application Discussion |
|---|---|---|---|
| 5. DSS/F and DSS/A | o tracing trail for source of funds | S | Planning units are represented as rows in DSS/A. Thus revenues and expenses could be kept track of for each source of funds represented as a row in the database. The size of the internal workspace depends on the hardware, a 64K Apple II can use 1919 cells while a 256K Apple III can use approximately 7000 cells. DSS/F can access up to 32,000 cells and DSS/A can access up to 50,000 cells through user control of which data are selected for the work area. |
| | o user defined models | A | Limited optimization using "goal seeking" can be implemented with DSS/F to seek input values which yield the desired output value. |
| | o transaction logging and support | A | DSS/A does provide data file security. The number of data cells depend on the machine and program design (see above comments). |
| | o linkage to other software and data files | L | DSS/A and DSS/F can communicate with each other by passing data files( rows and/or columns). Programs can read PASCAL text files, so user could modify other data files so they could be read by DSS/F and A. |
| | o query capabilitiy | A | DSS/A provides a SELECTIF command to select rows of the active file that meet a specified true/false criterion for use in subsequent commands. |

* S = strong match between desirable information processing capability and product function
A = adequate match L = limited match

## 4.5 EXPENSE ESTIMATION

Expense estimation is an integral part of financial planning. Budgets are developed by estimating future expenses from data on past expenses, service provided, resources used (e.g. number of drivers, payhours, gallons of fuel) and prices (wage rates, payroll taxes).

Modelling is an essential element in expense estimation since the transit manager wants to know the relationship between the controllable variables (service and resources), exogenous variables (prices) and the expected expenses. The types of models commonly used are listed in Figure 4-4 and are summarized below:

a. Allocation models are used to develop unit expenses by first assigning expenses to those service variables which most likely cause the expense and then dividing the assigned (or allocated) expenses by the service variable (e.g. $/miles) to arrive at a unit expense. The derived unit expense is then used to project future expenses by multiplying the unit expense by the anticipated amount of service. Expenses can be allocated to service variables or considered fixed for the analysis period. Expenses can be allocated at varying levels of detail. Changes in resource prices can be estimated if expenses are allocated by object class (wages, fuel, fringe benefits) as well as by function (operations, maintenance). Reference (6) describes this approach in more detail including several examples. Reference (26) describes a microcomputer application using VisiCalc™ of the allocation approach which uses system level variables and can be used to forecast expenses over three years. An example of a microcomputer program which uses allocated costs is Turnquist's "Transit Operations Planning Model" (27).

b. Factor models are used to estimate budget line item expenses (e.g. operating labor) as a product of service levels (e.g. platform hours), prices (e.g. $/payhour), productivity (e.g. payhours/platform hour) and various other factors such as fringe benefit and overhead rates. The factors are derived from historical expense, service, price and resource data. Each factor can be adjusted independently under various assumptions. This approach can be applied to all major line items as shown in reference (5). A microcomputer application of this approach using VisiCalc™ is documented in reference (28). This approach is useful in project planning where data from another location and mode needs to be used at a new location.

c. Resource estimation models are used to determine the number of operators (or other employees) as a function of service requirements (platform hours). The models are based on current work assignment practices. Expenses are then determined from the resource estimates (people, payhours) and prices (wage rates, benefit rates). These models are described in reference (6). They are designed to be sensitive to incremental changes in service, particularly temporal variations. An example of a microcomputer program using this approach is Tri-Met/Booz-Allen's "UBUCKS" (29).

d. Statistical models are used to estimate either expenses (e.g. dollars) or resources (e.g. payhours) as a function of service levels (e.g vehicle hours, peak vehicles) and characteristics (e.g. speed, time of day). Applications of statistical (usually regression) models include: estimating driver payhour requirements using samples of current work assignments (6), estimating operating expenses from a sample of similar properties (6) and estimating fare revenue from a time series of monthly fare revenues, fares and ridership (30).

e. Direct estimation models are used to estimate detailed resource requirements from the service schedule and then expenses from the resource requirements and prices. This approach would involve creating new schedules and runcuts (work assignments) for each scenario and is desirable during financial planning only if significant changes are occurring in work assignment procedures.

As shown in Figure 4-4, expense estimation involves data capture, manipulation and reporting. Data capture involves selecting and sorting the information needed for either model building or reporting. Data manipulation involves the arithmetic, logical or statistical processing of the data to either calibrate or apply the models or generate the reports. Report generation involves the presentation of relevant reports at the appropriate level of detail. Reports may be in tabular or graphical format.

### 4.5.1 Prototypical Cases

This section contains problem scenarios which are intended to typify situations which would be assisted by the development of expense estimation models, data manipulation and reporting capabilities. Following the presentation of the cases, specific information processing functions will be discussed which represent software requirements.

#### a. Case 1: Service Changes

A revenue shortfall of five percent is projected for next year requiring a corresponding reduction in operating expenses. The manager has asked the director of operations to prepare several scenarios for service cuts and the estimated cost savings. The scenarios to be considered include: (a) elimination of Sunday service, (b) reduction in peak hour frequencies, (c) proportional reductions in service, e.g 150 service hours per day cut but the current temporal distribution maintained, and (d) eliminate routes with less than a thirty percent farebox recovery ratio.

#### b. Case 2: Contract Negotiations

The labor contract expires at the end of the current fiscal year. The general manager would like to negotiate a three year contract with a five percent annnual wage increase that is offset by a five percent annual productivity gain. He would like an estimate of the expenses which could be saved through a reduction in the scheduled and unscheduled absence rates, employment of part time labor, and the elimination of report time.

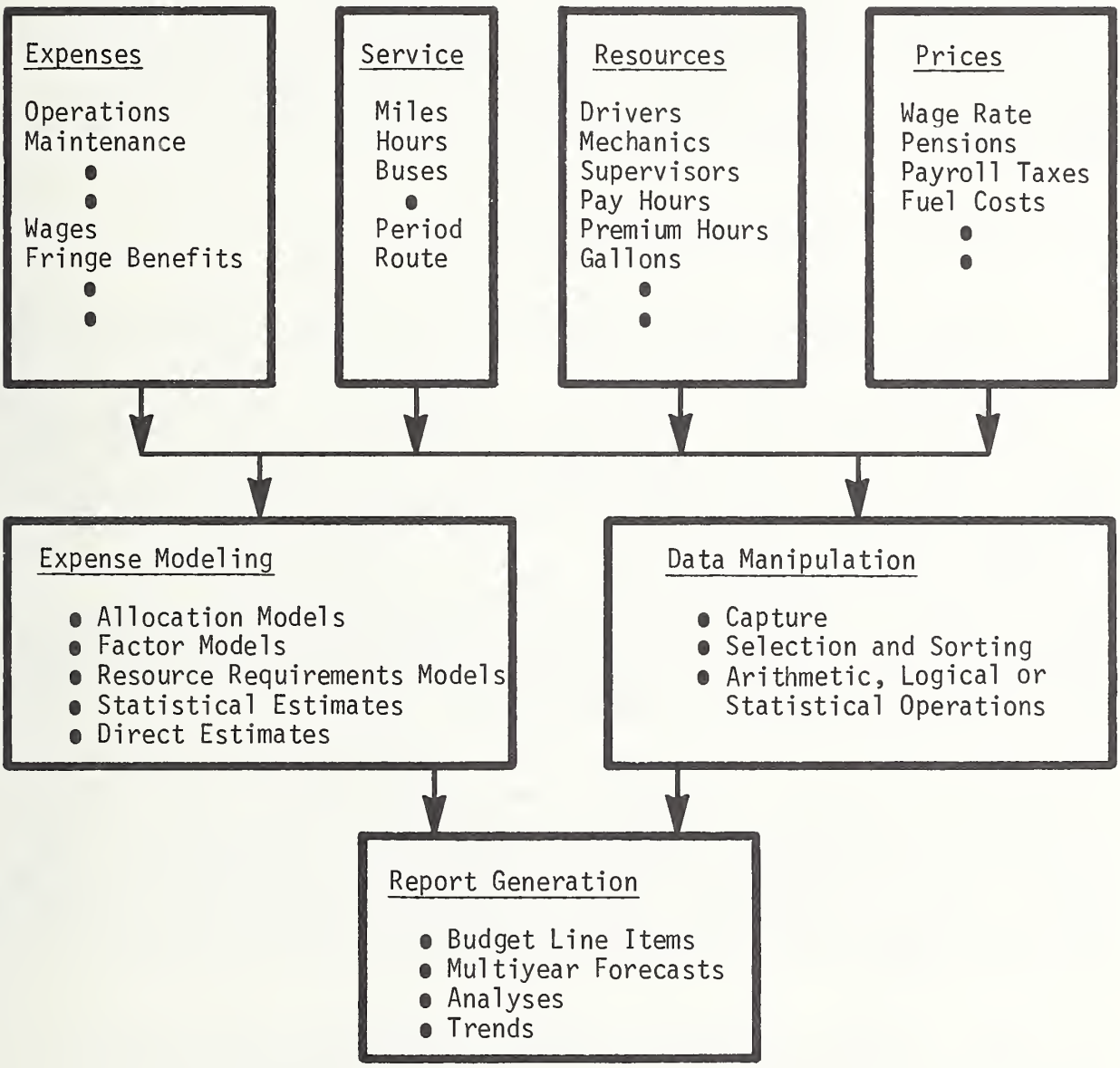


FIGURE 4-4. GENERIC FLOW CHART FOR EXPENSE ESTIMATION METHODOLOGY

c. Case 3: Investment Alternatives

The transit authority is currently running express route commuter services between three shopping centers (origins) and downtown and office park locations (destinations). These services are very popular (thirty percent standees). The authority is considering purchasing articulated buses and running at the same headway or buying more standard buses and increasing their frequency on the current routes. No changes to the right-of-way are anticipated nor are any required to run the articulated buses. The general manager wants to compare the costs of operating the two alternative types of vehicles on the given routes.

### 4.5.2 Information Processing Requirements

a. Capture expense, service, resource, price and work assignment data at the appropriate level of detail

This requirement refers to the need to obtain data at the level of detail needed to estimate the causes of various expense items. In case 1, expense and service data need to be disaggregated by day of the week (Sunday service), time of day (peak hour) and route (farebox recovery). Functional (operations, maintenance), object class (wages, fuel, fringe benefits) and garage level disaggregation would also be helpful. In case 2, resource (payhour) and price (wages and fringe benefit) data need to be processed by employee type (regular, extraboard and part time) and assignment type (straight, split, tripper). In case 3, expense and productivity data need to be determined by vehicle type. Data from other properties currently using articulated buses need to be obtained and put in comparable form.

These types of data can be obtained from either hard copy reports and entered manually into the microcomputer and then manipulated (select, sort, disaggregate, aggregate), or they can be obtained by direct access to machine readable data if appropriate linkages for data transfer are available. For example, in case 2 information from the operator time keeping system could be used for absence rate analysis. Often, actual data (such as month and year to date budget items) need to be accessed and compared with the estimated (budgeted) expenses.

Listed in order of increasing complexity, these requirements may be summarized as follows: (1) capture expense, service, resource, and price data; (2) capture work assignment data; (3) relate historical data from other locations; and (4) link to other machine readable data bases.

b. Support calibration of user defined models

This requirement refers to the need to manipulate the data to calibrate the various types of expense estimation models described above. Case 3 (articulated bus purchase decision) requires the development of factor or cost allocation models to estimate the differential labor, other operating (fuel) and maintenance costs of two types of vehicles. If cost allocation models are used some peak hour differential should be included to estimate the incremental cost of adding peak hour service with the existing fleet.

Case 1 (alternative service reductions) requires the calibration of resource estimation models. Under the assumption that work rules will remain unchanged, data on driver assignments and payhours for each type of service (weekend, peak, off-peak) need to be manipulated to obtain average payhours and premium hours per platform hour for each type of assignment (straight, split, swing, tripper). Calibration of resource estimation models includes establishing the relationship between payhours, premium hours, drivers and various fringe benefits in order to estimate the total wage package.

Case 2 (contract changes) involves calibration of several sophisticated modeling applications. Calibration of an absence rate model (see reference (31)) to determine the impact of absences on the size of the extraboard involves analysis of payroll and attendance data and the calibration of an overtime versus extraboard expense model. Selection, sorting and statistical analysis of the data are often required. Development of estimates of part time labor savings can be accomplished at various levels of detail. If automated runcutting tools are available and inexpensive, various work rules governing the deployment of part time and regular drivers can be examined. Manipulation of existing runcut data to determine candidate tripper assignments for part time versus using regular or extraboard operators and paying the guarantee could be used to approximate potential savings. Report time changes can be estimated by straightforward time and wage rate calculations, if the number of driver assignments remain unchanged.

Listed in order of increasing complexity, expense model calibration requirements may be summarized as follows: (1) tabulate expected budget line items and resource requirements; (2) provide flexibility in allocating expenses; (3) manipulate data to calculate factor rates; (4) determine shift requirements, worked hours, penalty hours as a function of service and (5) determine relationships between work rules and resource requirements.

c. Apply user defined models

These requirements are discussed separately from model calibration because the computational complexity and volume of data to be processed may be substantially different. For example, processing a month's work shift data to calibrate a resource estimation model requires statistical processing, yet the application of the resulting relationship may be a single arithmetic operation.

In all cases, initial budget line item expenses and resource requirements (especially labor requirements) will likely be revised several times during the budget approval cycle. Software which permits quick revision of individual entries and recalculation of row and column totals is essential.

In case 3 (articulated bus purchase), budget expense items need to be calculated as a function of service levels, productivity rates and prices. In case 3 expense forecasts for several years are needed and these data must then be used to calculate life cycle costs for each alternative. In case 1, the incremental expenses for changes in service by time of day, week and route need to be calculated from previously calibrated models. Sensitivity analyses (determine the impact of specific variable changes) are often required in conjunction with the estimation of detailed or aggregated expenses.

In case 2 (labor negotiations), estimates of shift requirements, payhours and premium hours as a function of previously calibrated abscense rate and part time labor models are required. This may involve rough estimates using sorted run assignment data or application of work assignment models which calculate specific driver requirements.

In case 1 (service reductions), application of cost allocation models and resource estimation models would be required. Application of previously calibrated models involves arithmetic operations and the ability to modify various service variables by time of day, week, and location. Some logical operations to invoke various program options may be required. The sofware should be able to show the sensitivity of various parameters, calculate performance measures and forecast expected expenses over several time period.

Listed in order of increasing complexity, information processing requirements for model application include: (1) modification of budget line items and recalculation of expense totals by subunit (division, garage) and system; (2) predict budget items as a function of service, productivity and price changes; (3) determine sensitivity of expenses to user controlled variables; (4) forecast changes in expenses over time and calculate life cycle costs; (5) determine incremental cost of service changes by day, time and location and (6) estimate future shift requirements and driver assignments

d. Generate reports for multiple users for more than one time period in a variety of presentation formats

In all cases, reports of budget line item expenses by function, object class, department, mode and system need to be produced. In addition to detailed reports, summary and management level reports need to be produced for multiyear forecasts and trends. Generation of reports for external sources, if different from internal requirements should be possible using the same data. Graphical output is desirable.

### 4.5.3 Application Assessments

Table 4-4 describes how each product would be used with respect to the expense estimation information processing requirements discussed above. Column 1 identifies the product. Each product is considered with respect to the set of desirable information processing requirements listed in Column 2. Column 3 is a summary of the application discussions contained in Column 4. The application discussions are intended to provide the reader with enough information to make a decision on the generic characteristics of the software he/she needs. Product application discussions are summarized as strong (denoted by an "S"), adequate (denoted by an "A") or limited (denoted by an "L"), corresponding to the match between product characteristics and user requirements.

TABLE 4-4

PRODUCT APPLICATION FOR EXPENSE ESTIMATION

| Product Name | Desirable Information Processing Capability | Product Match* | Application Discussion |
|---|---|---|---|
| 1. "Visi" Family<br>*S = strong match<br>A = adequate match<br>L = limited match | Data Capture<br>(1) Capture expense data at appropriate level of detail | S | "Visi" family is not a financial accounting system so user would have to enter aggregated financial data in VisiCalc. Section 15 level A contains 44 functions and 46 object classes which would easily fit on VisiCalc matrix as worst case. A more likely categorization is about 50 cells of relevant data. Driver wage (similar to 321 report) data and absence data are also required. Again, financial system aggregates by employee type (regular, part time, extra board) would be used. |
| | (2) Capture work assignment data | A | "Visi" is not a runcutter or maintenance shop scheduler. The results of a runcut could be put in VisiFile for sorting by platform hours and payhours by driver assignment (straight, split, tripper) by time (peak, base) and type (weekday, Saturday) of day and tripper allocation. After sorting, aggregation, averages, etc. can be performed by VisiCalc. |
| | (3) Link to other data | A | "Visi" family provides a standard data interchange format (DIF) between "Visi" programs. Data from existing data bases can be put into DIF format with custom programming for direct entry into the microcomputer. |
| | Model Calibration<br>(1) Tabulate expenses and resources | S | Budget line item expense and resource data can be entered and easily modified throughout the approval process. Limitations (either rows, columns or memory) may occur if extensive departmental or modal disaggregations are used or if monthly entries are required. |
| | (2) Provide flexibility in allocating expense | S | VisiCalc can be used for the allocation of dollars for each Section 15 functional and expense category to fixed or variable, hours or miles, or other category. Alternative allocations can be tried and summations made. Appropriate unit costs can be estimated easily. |
| | (3) Calculate factor rates | S | Arithmetic manipulation of aggregated expense and resource data can be done using VisiCalc. |
| | (4) Use historical data in new situation | S | VisiFile could be used to organize and VisiCalc/VisiTrend could be used to analyze expense data from other agencies. |

TABLE 4-4 (continued)

PRODUCT APPLICATION FOR EXPENSE ESTIMATION

| Product Name | Desirable Information Processing Capability | Product Match* | Application Discussion |
|---|---|---|---|
| 1. "Visi" Family | (5) Determine shift requirement relationships | S | Models based on current assignment procedures, such as sample-based estimates of average platform hours per payhour by driver and assignment type, could be developed using the VisiTrend regression package. |
| | (6) Determine work rule/assignment relationships | L | Work assignment analysis requires manipulation of schedule data bases, iteration and optimization heuristics. |
| | Model Application | | |
| | (1) Modify budget line items | S | VisiCalc can be used to generate new budget documents based on modifications to any item. May encounter limits on multi-department budgets. No worksheet consolidation capability. VisiCalc Advanced Version can consolidate worksheets. |
| | (2) Predict line items | S | Factor and expense allocation models can be applied. Sensitivity analyses can be performed through continuous iteration. |
| | (3) Forecast changes over time and calculate life-cycle costs | S | Calibrated expense equations and inflation factors can be entered on the worksheet to project expenses by month or year. Present value calculations are built in. Some logical branching on conditions is possible. VisiPlot and VisiTrend available for analysis of time series data. |
| | (4) Determine incremental cost of service changes | A | Previously calibrated models can be entered on the worksheet. Models using arithmetic operations, limited logical branching, or direct user entries are feasible. More complex models with multiple branches and large data sets can be done but would be difficult to use. |
| | (5) Estimate impact of work rules on work assignments | L | VisiCalc row and column manipulation could possibly be used to cut runs from a set of blocks as aid to manual process. |
| | Report Generation | | |
| | (1) Produce summary data for multiyear forecasts and trends analysis | S | Reports can be designed on worksheet or transferred from VisiCalc workwheet to VisiTrend via DIF file for presentation. |
| | (2) Produce line item budget reports | S | If worksheet has capacity (a function of machine memory), budget reports can be printed directly from the worksheet. |

TABLE 4-4 (continued)

PRODUCT APPLICATION FOR EXPENSE ESTIMATION

| Product Name | Desirable Information Processing Capability | Product Match* | Application Discussion |
|---|---|---|---|
| 1. "Visi" Family | (3) Produce graphical output | S | VisiPlot can be used to produce graphs from VisiCalc worksheet, VisiTrend analyses or projections, or as independent tool. |
| | (4) Produce comparisons between estimated and actual expenses | A | Actual amounts can be entered via custom programmed interface with accounting or statistical data base or entered manually. Arithmetic analysis of variances can then be done on worksheet. |
| | Data Capture | | |
| 2. Calcstar and Datastar | (1) Capture expense, etc. data at appropriate level of detail | S | Datastar's FORMGEN program allows the user to design his data collection form. |
| | (2) Capture work assignment data at appropriate level of detail | A | Calcstar has the following array limits: 127 rows, 255 columns. These are addressing limits and the actual amount of data that can be stored depends on the memory size of the computer. It may be possible to capture work assignment data by creating a record for each driver and using the DATASTAR program to handle the records in a file structure. Datastar could then be used to edit, scan, search and retrieve individual records. |
| | (3) Link to other data bases | L | Data can be transferred between "Star" products but no external interface exists. |
| | Model Calibration | | |
| | (1) Tabulate expenses and resources | S | Budget line item expense and resource data can be entered and modified throughout the budget approval process. Limitations (either rows, columns or memory) may occur if extensive departmental or modal disaggregations are used or if monthly entries are required. |
| | (2) Provide flexibility in allocating expenses | S | Expense items can be entered as rows, and causal factors as columns. |
| | (3) Calculate factor rates | S | Arithmetic manipulation of aggregated expense and resource data can be done using Calcstar. |

*S = strong match
A = adequate match
L = limited match

TABLE 4-4 (continued)

PRODUCT APPLICATION FOR EXPENSE ESTIMATION

| Product Name | Desirable Information Processing Capability | Product Match* | Application Discussion |
|---|---|---|---|
| 2. Calcstar and Datastar | (4) Use historical data from other sources | S | Datastar provides a capability to match records and query a data set which has already been entered. Data can then be transferred to Calcstar worksheet. |
| | (5) Determine shift requirements | A | Simple models (regression with one independent variable) based on current assignment practices can be developed, e.g. sample based estimates of platform hours per payhour by driver and assignment type. |
| | (6) Determine work rule/ assignment relationships | L | Work assignment analysis requires manipulation of schedule data bases, iteration and optimization heuristics. |
| | Model Calibration | | |
| | (1) Modify budget line items | S | Calcstar can be used to generate new budget documents based on modifications to any item. May encounter limits on multi-department budgets. No worksheet consolidation capability. |
| | (2) Predict line items | S | Factor and expense allocation models can be applied. Sensitivity analyses can be performed through continuous iteration. |
| | (3) Forecast changes over time and calculate life cycle costs | A | Calibrated expense equations and inflation factors can be entered on the worksheet to project expenses by month or year. No present value calculations are built in. Some logical branching on conditions is possible. |
| | (4) Determine incremental cost of service changes | A | Previously calibrated models can be entered on the worksheet. Models using arithmetic operations, limited logical branching, or direct user entries are feasible. More complex models with multiple branches and large data sets can be done but would be difficult to use. |
| | (5) Estimate impact of work rules on assignments | L | The scan by index feature of Datastar may allow the user to key the starting and ending times of drivers and then select all records with the same start and end times as an aid to manual runcutting process. |
| | Report Generation | | |
| | (1) Produce summary data for multiyear forecasts and trends analysis | S | Reports can be designed on worksheet or transferred from Calcstar worksheet to Wordstar word processor for presentation. |

TABLE 4-4 (continued)

PRODUCT APPLICATION FOR EXPENSE ESTIMATION

| Product Name | Desirable Information Processing Capability | Product Match* | Application Discussion |
|---|---|---|---|
| 2. Calcstar and Datastar | (2) Produce line item budget reports | S | If worksheet has capacity, budget reports can be printed directly from the worksheet. |
| | (3) Produce graphical output | L | No graphics are provided. |
| | (4) Produce comparisons between estimated and actual expenses | A | Actual amounts must be entered manually from accounting or statistical data bases. Arithmetic analysis of variances can then be done on worksheet. |
| 3. Microplan | Data Capture | | |
| | (1) Capture expense data at appropriate level of detail | S | Provided the data set is not too large, the user can enter any expense items categorized by different types for each row and column (limit of 1000 data values per Table). Alternative Tables could be used to disaggregate by mode or department. |
| | (2) Capture work assignment data at appropriate level of detail | A | Each Table holds only 1000 data items, but they could be linked together using the Consolidation Module. |
| | (3) Link to other data bases | A | External data can be transferred into Table rows or columns using the LINK command in the Consolidation Module. |
| | Model Calibration | | |
| | (1) Tabulate expenses and resources | S | Budget line item expense and resource data can be entered and easily modified throughout the approval process. Departmental Tables could be combined using the Consolidation Module. |
| | (2) Provide flexibility in allocating expenses | S | Expenses can be listed by rows, causal factors by columns, and the software can select operations for specific row/column combinations. |
| | (3) Calculate factor rates | S | Arithmetic manipulation of aggregated expense and resource data can be done using Microplan. |
| | (4) Use historical data in new situations | A | Historical data must be entered manually. Once entered, data can be manipulated by program commands. |

*S = strong match
A = adequate match
L = limited match

TABLE 4-4 (continued)

PRODUCT APPLICATION FOR EXPENSE ESTIMATION

| Product Name | Desirable Information Processing Capability | Product Match* | Application Discussion |
|---|---|---|---|
| 3. Microplan | (5) Determine shift requirement relationships | A | Microplan program commands can be used to estimate relationships if data sets (1000 entries) are small and no logical branching is required. |
| | (6) Determine work rule/ assignment relationships | L | Work assignment analysis requires manipulation of schedule data bases, iteration and optimization heuristics. |
| | Model Calibration | | |
| | (1) Modify budget line items | S | Microplan can be used to generate new budget documents based on modifications to any item. May encounter limits on multi-department budgets. No worksheet consolidation capability. |
| | (2) Predict line items | S | Factor and expense allocation models can be applied. Sensitivity analyses can be performed through continuous iteration. |
| | (3) Forecast changes over time and calculate life cycle costs | A | Calibrated expense equations and inflation factors can be entered on the worksheet to project expenses by month or year. Present value calculations are built-in. No logical branching on conditions is possible. Limited analysis of time series data is possible using built-in functions (e.g. lead, lag) |
| | (4) Determine incremental cost of service changes | A | Previously calibrated models can be entered on the worksheet. Models using arithmetic operations, or direct user entries are feasible. More complex models with mutliple branches and large data sets would be difficult to use. |
| | (5) Estimate impact of work rules on work assignments | L | Row and column manipulation could possibly be used to cut runs from a set of blocks as aid to manual process. |
| | Report Generation | | |
| | (1) Produce summary data for multiyear forecasts and trend analysis | S | Multiple reports can be programmed using worksheet data. |
| | (2) Produce line item budget reports | S | Departmental budgets can be prepared (within 1000 cells) and later consolidated. |

TABLE 4-4 (continued)

PRODUCT APPLICATION FOR EXPENSE ESTIMATION

| Product Name | Desirable Information Processing Capability | Product Match* | Application Discussion |
|---|---|---|---|
| 3. Microplan | (3) Produce graphical output | L | No graphics capability. |
| | (4) Produce comparisons between estimated and actual expenses | A | Actual amounts must be entered manually from accounting or statistical data bases. Arithmetic analysis of variances can then be done on worksheet. |
| 4. Plan80<br>* S = strong match<br>A = adequate match<br>L = limited match | Data Capture<br>(1) Capture expense data at appropriate level of detail | A | Provided the dataset is not too large, the user can enter any expense item categorized by different types for each row and column. (Limit of 2000-4000 entries) |
| | (2) Capture work assignment data at appropriate level of detail | A | Size limitations of software may limit application's use for work assignment analysis. |
| | (3) Link to other data bases | A | Plan80 can retrieve data from external files which have been edited to identify the name of the row or column to which the data will be transferred. |
| | Model Calibration<br>(1) Tabulate expenses and resources | S | Budget line item expense and resource data can be entered and modified throughout the budget approval process. Limitations (either rows, columns or memory) may occur if extensive departmental or modal disaggregations are used or if monthly entries are required. |
| | (2) Provide flexibility in allocating expenses | S | Expenses may be listed by rows, causal factors by column and the software can select operations for specific row/column combinations. |
| | (3) Calculate factor rates | S | Arithmetic manipulation of aggregated expense and resource data can be done using Plan80. |
| | (4) Use historical data in local situations | A | Data must be entered manually. Once entered, the data can be manipulated by Plan80 programming capability. |
| | (5) Determine shift requirement relationships | S | Since the Plan80 programming language provides conditional branching and looping as well as table arithmetic, relatively sophisticated models may be developed. Lacks regression/statistical package. |

TABLE 4-4 (continued)

PRODUCT APPLICATION FOR EXPENSE ESTIMATION

| Product Name | Desirable Information Processing Capability | Product Match* | Application Discussion |
|---|---|---|---|
| 4. Plan80 | (6) Define work rule/ assignment relationships | L | A given set of driver assignments could be analyzed for certain work rule changes. Recutting schedule is probably beyond Plan80. |
| | Model Application | | |
| | (1) Modify budget line items | S | Plan80 can be used to generate new budget documents based on modifications to any item. Consolidation of Multi-department or modal budgets may be handled with Plan80 programming language. |
| | (2) Predict line items | S | Factor and expense allocation models can be applied. Sensitivity analyses can be performed through continuous iteration. |
| | (3) Forecast changes over time and calculate life cycle costs | S | Calibrated expense equations and inflation factors can be entered on the worksheet to project expenses by month or year. Present value calculations are built in. Logical branching on conditions is available. Graphical output is available for analysis of time series data. |
| | (4) Determine incremental cost of service changes | S | Previously calibrated models can be entered on the worksheet. Models using arithmetic operations, logical branching, looping on conditions, or direct user entries are feasible. |
| | (5) Estimate impact of work rules on work assignments | L | Plan80 row and column manipulation and branching could possibly be used to cut runs from a set of blocks as aid to manual process. |
| | Report Generation | | |
| | (1) Produce summary data for multi-year forecasts and trends analysis | S | Plan80 report generator can create reports from table data. Multiple reports can be generated from same data table. |
| | (2) Produce line item budget reports | A | If worksheet has capacity, budget reports can be printed directly from the worksheet. |
| | (3) Produce graphical output | S | Plan80 can be used to produce graphs using data in tables (worksheet). |

TABLE 4-4 (continued)

PRODUCT APPLICATION FOR EXPENSE ESTIMATION

| Product Name | Desirable Information Processing Capability | Product Match* | Application Discussion |
|---|---|---|---|
| 4. Plan80 | (4) Produce comparisons between established and actual expenses | A | Actual amounts must be entered manually from accounting or statistical data bases. Arithmetic analyses of variances can then be done on worksheet. |
| 5. DSS/F and DSS/A<br>*S = strong match<br>A = adequate match<br>L = limited match | Data Capture<br>(1) Capture expense data at appropriate level of detail | S | The user can enter any expense item categorized by different type for each row and column. Although the work area for DSS/F and DSS/A is approximately 2000 cells in the Apple II (64K), DSS/F can access up to 32,000 cells and DSS/A can access up to 50,000 cells. |
| | (2) Capture work assignment data at appropriate level of detail | A | It may be possible to create a series of databases each for a single transit line using vehicle block and driver assignment data. DSS/F does have a feature which allows two or more files to be linked together. |
| | (3) Link to other data bases | L | DSS/F and DSS/A can read PASCAL text files so machine readable data could be created. |
| | Model Calibration<br>(1) Tabulate expenses and resources | S | Budget line item expense and resource data can be entered and easily modified throughout the approval process. Limitations (either rows, columns or memory) may occur if extensive departmental or modal disaggregations are used or if monthly entries are required. |
| | (2) Provide flexibility in allocating expenses | S | Expense items can be listed by rows, causal factors by column. Commands exist to limit operations to specific row and column sequences. |
| | (3) Calculate factor rates | S | Arithmetic manipulation of aggregated expense and resource data can be done using DSS/F and A. |
| | (4) Use historical data in local situations | A | Data must be entered manually. Once entered the data can be manipulated with DSS programming capabilities. |
| | (5) Determine shift requirement relationships | S | DSS/F and A provide capability (iterations, conditional branching, statistical analysis) to estimate relationships. |

TABLE 4-4 (continued)

PRODUCT APPLICATION FOR EXPENSE ESTIMATION

| Product Name | Desirable Information Processing Capability | Product Match* | Application Discussion |
|---|---|---|---|
| 5. DSS/F and DSS/A | (6) Determine work rule/ assignment relationships | L | Work assignment analysis requires manipulation of schedule data bases. DSS/F and A programming capability may be used to analyze small data sets. |
| | Model Application | | |
| | (1) Modify budget line items | S | DSS/F can be used to generate new budget documents based on modifications to any item. May encounter limits on multi-department budgets. Some worksheet consolidation capability. |
| | (2) Predict line items | S | Factor and expense allocation models can be applied. Sensitivity analyses can be performed through continuous iteration. |
| | (3) Forecast changes over time and calculate life cycle costs | S | Calibrated expense equations and inflation factors can be used to project expenses by month or year. Present value calculations are built in. Logical branching on conditions is possible. Graphics and statistical packages are available for analysis of time series data. |
| | (4) Determine incremental cost of service changes | S | Previously calibrated models can be entered on the worksheet. Models using arithmetic operations, logical branching, iteration or direct user entries are feasible. |
| | (5) Estimate impact of work rules on work assignments | L | Programs which manipulate small data sets could possibly be used to cut runs from a set of blocks as aid to manual process. |
| | Report Generation | | |
| | (1) Produce summary data for multiyear forecasts and trend analysis | S | Multiple reports can be programmed based on resident data sets. |
| | (2) Produce line item budget reports | S | If data sets are within capacity limits budget reports can be printed. |
| | (3) Produce grahical output | S | DSS/F and A can be used to produce graphs using resident data sets. |
| | (4) Produce comparisons between estimated and actual | A | Actual amounts must be entered manually for comparisons with accounting or statistical data bases. Arithmetic analyses of variances can then be done. |

* S = strong match between desirable information processing capability and product characteristics
A = adequate match L = limited match

# 5. PRODUCT APPLICATION SUMMMARY

This section summarizes the match between the characteristics of each product and the desirable transit financial planning information processing requirements discussed in Section 4. The intent of this section is to provide the reader with a quick reference to the best transit financial planning applications of each product. While specific products are discussed, the reader should keep in mind that many other similar products are available, including those listed in Appendix C and D. To assist readers who might be considering other applications, this section summarizes the characteristics of each product and the relevant transit applications which were derived from the process used in this report. Appendix A contains descriptions of each product, the hardware required and program limits. The material in this section, in Tables 4-1 through 4-4 and in Appendix A were submitted to the vendors of each product for review and adjusted accordingly.

## 5.1 VisiCalc™, VisiTrend™/VisiPlot™, VisiFile™

The "Visi" family (32) of tools (Visicalc, Visifile, Visitrend/Visiplot) are ideal for establishing and manipulating the relationships between data items for financial forecasting, budgeting and analysis. Since these tools are not designed to either process and store transaction data or perform logically complex operations with large or multidimensional data sets, most of the financial and operational data must be acquired from other "data systems" (i.e. the financial reporting system) and entered manually. It is possible to "download" other data from a large data base to the Visi programs in DIF format but this involves custom programming and, of course, a knowledge of the data base structure. Ridership trends can be analyzed, models (by whatever disaggregation is available) can be developed, and entered on the worksheet to examine fare implications. Annual revenue and expense data can be manipulated by a variety of categories to estimate marginal cost and disaggregated models. Estimates of driver requirements and costs based on the current assignments can be useful in negotiations. Models of tax revenue and cash flows could be developed. Budgeting can be simplified by using worksheets for each department and then estimating impact of policy, service level, or economic condition variables on specific budget line items.

The important product characteristics of the "Visi" family for the transit financial planning applications discussed in Section 4 are summarized below: (Typical applications are listed in parantheses)

1. Easy to learn; simple commands or menus eliminate the need for programming experience. (Expense estimation)

2. Extensive data manipulation capability and file transferability between programs within the "Visi" family. (Ridership, expense and tax models)

3. Good report writing and graphical output with VisiPlot/Trend/File. (all applications)

4. Built-in financial functions and control of positional relationships make worksheet modifications easy. (Model building for revenue and expense estimation)

5. VisiFile allows data format modifications and sorting of data files. (Ridership and fare revenue estimation)

6. VisiTrend provides time series and regression modeling capability. (Ridership, expense and tax revenue estimation)

7. Manual data entry (without a customized data transfer program) and limited (1 diskette) amount of data storage, although it can be used with the hard disk on the IBM.PC.XT. (Ridership estimation and detailed expense models)

8. Limited logical processing of data (branching, iteration), and inability to handle multidimensional arrays or manipulate matrices. (Sorting and selecting for tax model calibration)

9. Lack of data file merging for various budgets etc. (Detailed expense modeling). VisiCalc Advanced Version has this capability.

10. Limited size of records (24 fields) and limit of one diskette for VisiFile. (Ridership data processing)

11. VisiCalc lacks report writing flexibility. (Detailed and summary budgets)

12. VisiCalc lacks protection against entering wrong type of data or writing over any cell on worksheet. (Applications with multiple users). VisiCalc Advanced Version has this capability.

VisiCalc has been reviewed in Byte magazine (Vol 5, No. 11, November 1980). VisiCalc Advanced Version has been reviewed in Infoworld (Vol. 5, No. 12, March 21, 1983).

## 5.2 Calcstar™ and Datastar™

Calcstar (33), using a row and column "electronic spreadsheet" format, is designed to be used as a financial report writing tool. The software supports both text and numeric data entry. Transit financial applications which are particularly well suited to Calcstar include income and balance statements, budgeting applications, and tax revenue estimation. Calcstar lacks certain financial functions (e.g., NPV, various depreciation schedules, lookup Tables) which are important for capital budgeting applications, and cash management.

Datastar (33) is a very flexible and powerful microcomputer data entry and file management tool. The software provides very useful search and

retrieval routines for individual records. In addition, the user can scan a set of records. Data collection forms can be designed with great flexibility. The end result of the FORMGEN program in Datastar is a powerful screen formatter to facilitate easy and accurate data entry.

The important product characteristics of Calcstar and Datastar for the transit financial planning applications discussed in Section 4 are summarized below: (Typical transit financial planning applications are listed in parantheses)

1. Easy to learn; simple commands or menus eliminate the need for programming experience. (Expense estimation)

2. Good report writing capabilities (e.g. variable column width, table merge and extract). (Detailed and summary reports from expense, ridership and tax models)

3. Screen formatter interface (DataStar) which provides error checking. (Cash management and ridership estimation)

4. Text editor interface (Wordstar). (All applications)

5. Interface with higher level languages such as Basic. (All model building applications)

6. Limited modeling capability and lack of important financial functions, statistical packages, and regression with more than one variable. (Expense, fare and tax revenue modeling)

7. Limited logical processing of data (branching, iteration), and inability to handle multidimensional arrays or manipulate matrices. (Ridership estimation and tax modeling)

8. No graphics (All applications)

9. Limited to relatively small data sets and the data must be entered manually at least once. (Ridership, cash management and tax revenue applications)

## 5.3 Microplan™

Microplan (34) uses a row and column format to develop models and report financial results. The add-on Consolidation Module allows the user to combine data in two tables stored on the diskette and fetch row or column information from external files. The software, applied to transit financial forecasting and planning, is probably best suited for budget preparation, financial reporting, cash management planning( but not cash management transaction support), capital budgeting and tax revenue model implementation. Extensions to other applications would depend upon how successful the user is in structuring his problem in a worksheet format.

The important product characteristics of Microplan for the transit financial planning applications discussed in Section 4 are summarized below: (Typical transit financial planning applications are listed in parantheses)

1. Can perform arithmetic operations using multiple tables. (Expense estimation)

2. Built-in financial functions. (Expense, fare and tax revenue estimation)

3. User can "program" sequences of operations to include data input and manipulation. (All model building applications)

4. Error protection. (Multiple user, such as departments, applications for expense or cash management)

5. Inability to handle higher dimensional arrays (i.e., > 2). (Ridership and fare revenue estimation)

6. Lack of statistical estimation routines for modeling. (Ridership and expense estimation)

7. Data manipulation limited to 1000 cells although tables can be combined and data extracted from a larger set. (Detailed expense estimates and cash flow analysis)

8. Limited capability to extract data from external files using the Link command in the Consolidation Module. (Ridership estimation and cash management)

9. No graphics. (All applications)

Microplan was reviewed in Infoworld, Volume 4, Number 3, January 25, 1982. It received an "excellent" rating for performance and "good" ratings for documentation, ease of use and error handling.

## 5.4 Plan80™

Plan80 (35) is well suited to developing income and balance statements, cash flow analysis, capital budgeting, tax revenue model implementation, and budget preparation. Extensions to other transit financial forecasting/ planning applications would depend upon how successful the user is in structuring his problem in a worksheet format.

The important product characteristics of Plan80 for the transit financial planning applications discussed in Section 4 are summarized below: (Typical transit financial planning applications are listed in parantheses)

1. Contains a modeling language with logic and branching to subroutines which can be called by other application programs. (Ridership and fare revenue estimation, expense estimation, tax revenue modeling)

2. Can interface with external word processing text editors. (All applications)

3. Separate viewing of commands and data. (All model building applications)

4. Supports and integrates graphics into reports. (All applications)

5. Relatively easy to learn modeling language (harder than VisiCalc, easier than Pascal). (Ridership, expense, and tax revenue models)

6. Inability to handle higher dimensional arrays (i.e., > 2). (Ridership and fare revenue estimation, tax revenue modeling)

7. Lack of a statistical estimation routine. (Expense estimation)

8. Limited to relatively small data sets. (Ridership estimation, departmental expenses). A new version available in September 1983 will support models of up to 8,000 cells in memory.

Plan80 was reviewed in Infoworld, Volume 3, Number 20, October 5, 1981. The reviewer gave Plan80 "excellent" ratings in usefulness, documentation, ease of use and error handling.

## 5.5 DSS/F™ AND DSS/A™

Both DSS/F and DSS/A (36) are powerful end-user tools. DSS/F possesses a number of important financial modelling functions and is well suited for building complex financial models. The report generation and graphical routines of each are excellent. The two software tools should be considered as a joint package for transit financial forecasting and planning applications since DSS/A possesses important database query, statistical analysis, and additional modelling routines that DSS/F lacks. Furthermore, each was designed to communicate with the other. Transit financial applications which are particularly well suited to DSS/A and DSS/F include income and balance statements, capital budgeting, cash budget/flow analysis, tax revenue estimation, and transit cost models.

The important product characteristics of DSS/F and DSS/A for the transit financial planning applications discussed in Section 4 are summarized below: (Typical transit financial planning applications are listed in parantheses)

1. Extensive modeling capabilites to include statistical analysis and regression, built-in financial functions, and ability to solve simultaneous equations. (Ridership and fare revenue estimation, expense model calibration and application, tax revenue analysis)

2. Separate modeling and computation steps which can be used for user prompts, subroutine development and higher level language interface. (Model building applications)

3. Data base management capability (DSS/A). (Ridership estimation, cash management)

4. Integration of graphics and text. (All applications)

5. Error checking. (Multi-user applications such as expense models)

6. Report writing capability to generate multiple reports from single matrix. (All applications)

7. Inability to handle higher dimensional arrays (i.e., >2). (Ridership and tax revenues)

8. Some limitation in the ability to support user defined models that a high level programming language does not impose (i.e., general algorithmic implementations; implementation of optimization models). (Expense model calibration)

9. User work area limited to 1919 cells in Apple II (64K) version, more with larger machines. User can access up to 32,000 cells on disk with DSS/F and up to 50,000 cells with DSS/A.

10. Lack of a software and data file interface except that data values within rows and columns in a user defined database can be passed to or from DSS/A and DSS/F. (Ridership estimation and cash management)

11. DSS/F and DSS/A separate logic, data, and reporting into separate steps. Novice computer users will experience a learning curve, while those familiar with modeling will find it similar to mainframe modeling software.

DSS/F was reviewed in Infoworld, Volume 4, Number 19, May 17, 1982. The reviewer gave DSS/F "excellent" ratings for documentation and error handling and "good" ratings for performance and ease of use.

## 5.6 Conclusion

This report contains the results of a detailed analysis of each of the software products with respect to the information processing requirements needed for transit financial planning in the areas of ridership and fare revenue estimation, tax revenue yield and incidence analysis, cash management and expense estimation. Based on these analyses it was concluded that:

a. Both the "worksheet" and modelling language software are most suitable for adhoc analysis, querying of a small high quality data set, and quick report and graphics generation.

b. Specific financial applications most suitable for implementation include ridership and revenue analysis and forecasting, budget preparation, tax revenue estimation, and expense estimation.

c. None of the software packages is suitable for work requiring transaction processing.

d. A major limitation in each of the software packages is its ability to communicate with other software; thus, integration with in-place financial information systems at transit properties may not be an easily resolved problem.

Test and evaluation of commercially available, microcomputer financial software on transit properties' datasets solving "real-world" problems, and documentation of successful case studies of implementing microcomputer financial software at transit agencies remain as the next steps.

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33. MicroPro International Corp, Users Manual Calcstar and Datastar, 1299 4th Street,San Rafael, CA.

34. Chang Labs, Users Manual MicroPlan, 10228 N. Stelling Road, Cupertino, CA.

35. Business Planning Systems, Users Manual Plan80, 2 North State Street Dover, DL.

36. Addison Wesley Publishing Co., Users Manual DSS/F and DSS/A, Reading, MA.

# APPENDIX A

## SOFTWARE DESCRIPTIONS, CONFIGURATION REQUIREMENTS AND LIMITATIONS

### A.1 VISICALC™, VISITREND/VISIPLOT™, VISIFILE™ SOFTWARE DESCRIPTIONS

Three VisiCorp, Inc. (32) products will be discussed. These are VisiCalc, an electronic worksheet program, VisiTrend/VisiPlot, a time series analysis and graphics program and VisiFile, a file management program. The user of all three programs uses a TV monitor and typewriter-like keyboard attached to the microcomputer to enter and manipulate data. Printed reports and charts are obtained from a printer or plotting device also attached to the microcomputer. The programs are stored on floppy diskettes. Programs are entered into the microcomputer's memory from the diskette and all data is stored on the diskettes.

The user of VisiCalc works with a matrix of 63 columns and 254 rows. The intersecting lines of the columns and rows define thousands of entry positions. At each position, an alphabetic title, a number or a formula to be calculated can be entered. Formulas relate the values stored in one or more other cells to the cell where the formula is stored. The user controls the entry and manipulation of the data by moving a cursor to the desired cell on the screen and either entering data or executing a command. Commands assist the user in manipulating the data. The program remembers all data and formulas. When numbers on the sheet are changed, all relevant formulas are recalculated. When formulas are moved on the screen, e.g., by inserting a row or copying a formula to another location, the program readjusts all positional information. Special functions are provided to assist in summations, financial, logical, and arithmetic calculations. Rectangles of data can be stored in a format (called DIF) which can be read by the VisiTrend/VisiPlot and VisiFile programs.

The VisiTrend/VisiPlot program assists the user in analyzing time or other series of data. both of these programs are menu driven, that is the user tells the computer what to do by selecting (using the monitor and cursor) a command from a list. The program keeps track of all the logic and checks to make sure the user hasn't made a mistake. The VisiTrend program operates on a series of data points. The major functions of VisiTrend include:

1. statistical analysis of a data series
2. estimation of the relationship between one series of data and up to five others using multiple linear regression
3. creating new data series from old series by averaging or smoothing
4. creating new data series from old by arithmetic or logical operations.

The VisiTrend program also has extensive commands for editing and managing the data series used in the analysis. Once the data has been

analyzed, VisiPlot can be used to display the data. VisiPlot helps the user create more meaningful reports by creating line, bar, area, pie, hi-lo, scatter charts and various combinations thereof. VisiPlot can generate charts in six colors or use shadings and symbols to display multiple points. Extensive titling features are provided, including moveable labeling and automatic or user defined scaling.

VisiFile is a file handling program. A file is a group of records with similar formats. A record is a set of information about a particular item of interest, such as inventory items, personnel information or passenger count cards. Each record has the same field structure as the other records in the file. The VisFile program menu guides the user through the steps in defining records. The program also provides the capability to add or delete fields and change their size and transfer the old data to the new file without re-entering the information. The program allows the user up to 24 indexes to a file which enable one to sort the file on different values. Sorting can be done in ascending a descending numeric or alphabetic order. The program has a report generator which enables one to label the report and select the fields to be printed. The user can enter data from the keyboard or read a previously created DIF file. The user can compute the value of a field from other fields. For example a field called "on board" could be computed from on/off ridership values.

The hardware configuration requirements and program limits for the "Visi" family of products are listed in Table A.1.

## A.2 CALCSTAR™ AND DATASTAR™ SOFTWARE DESCRIPTIONS

Calcstar (33) uses a row and column format on a visually oriented screen display for the development of financial reports. The user can enter text or numeric data into any cell of the matrix. The screen display is divided into three parts. The first part summarizes the menu of commands including cursor movement controls. The middle section is a window showing a subsection of the user-defined Table. The user can move the window to any portion of the Table. The bottom section shows the user where the cursor is, the contents of the current location of the cursor, what type of input (i.e., text or numeric), the order sequence for the evaluation of rows and columns, and what the user is currently typing. The system prompts the user for various inputs. Should the user not specify a particular input, the system will invoke a default value. The contents of any cell can be text (e.g., row and column labels), numeric data entered directly (e.g., 12345), or a formula which references the contents of other cells in the array (e.g., 1.1*A1 + B5). All cells will automatically be adjusted using the RECALC command. New rows and columns can be inserted at any time using the INSERT command.

Datastar (33) is a data entry, retrieval and update system for microcomputer systems. It can be used as the data entry portion of other programs, including Calcstar. Flexible designs for data entry forms are supported. The software provides for field verification (e.g., checking a list of data inputs against another list) and for edit masking (e.g., allowing

TABLE A.1

"VISI" HARDWARE CONFIGURATION REQUIREMENTS AND PROGRAM LIMITS

VisiCalc™

Vendor: Visicorp
2895 Zanker Road
San Jose, CA. 95134
(408) 942-6000

Price: Approximately $250 (price subject to change)

Hardware: Apple II, II Plus or III, 16-sector diskette, 48k, single disk drive
Atari 800, 32k, single disk drive
Commodore PET 2001, 8032, 32k, single disk drive
IBM PC, 64k, single disk drive
Machine Compatible Monitor and Printer

Limits: Maximum limit is 63 columns by 254 rows
Practical limit set by internal capacity of machine, VisiCalc program uses 30K characters, each cell uses 1 character per column width; e.g. if column width is 10, 3000 cells use 30K characters

VisiTrend/Plot™

Vendor: see above

Price: Approximately $300 (price subject to change)

Hardware: Apple II or II Plus, 48k, Applesoft Basic, two disk drives, 16-sector compatible diskette
IBM PC, 128K
Machine Compatible Monitor and Printer

Limits: 645 points total or 16 series for trends
6 series and 150 points per series for plots
5 independent variables for regressions
80 character formulas for models
5 line titles for reports

TABLE A.1 (continued)

VisiFile™

| | |
|---|---|
| Vendor: | see above |
| Price: | Approximately $250 (price subject to change) |
| Hardware: | Apple II or II Plus, Apple IIe, Applesoft Basic, 48k memory, two 16-sector drives<br>IBM PC, 64K<br>Machine Compatible Monitor and Printer |
| Limits: | 232 characters per record<br>38 characters per field<br>10 field sort<br>all files on a single diskette<br>24 fields per record |

VisiCalc Advanced Version™

| | |
|---|---|
| Vendor: | see above |
| Price: | Approximately $400 (price subject to change) |
| Hardware: | Apple III, SOS, 128K RAM, one 5 1/4 inch floppy disk drive plus one additional drive |
| Limits: | Subject to machine RAM but gives user 45K of work space on 128K machine |
| Sources: | a. The Facts on How to Work Smarter Not Harder, Personal Software, Inc. October 1981<br>b. Reference (32) |

only numeric data in a field, etc.). Records can be searched and retrieved for subsequent editing. Datastar can also be used to construct data files which are compatible with most CP/M programming languages including BASIC, FORTRAN, and COBOL.

The Datastar software consists of two main program elements: DATASTAR and FORMGEN. Each program has a distinct purpose and function and may be operated individually as required. FORMGEN is used to prepare the data entry form. FORMGEN generates the "form" to be filled out on the screen. The user can design the data collection form in any way he wishes. Some of the specification features that the user may use include:

1. maximum length of data fields

2. automatic decimal point alignment

3. automatic generation of leading/trailing pad characters (e.g., asterisks * used in check protection)

4. "must enter" fields or characters. This specification requires a data entry operator to make an entry in a "must enter" datafield before going to other fields, e.g., one might require entering a vehicle ID and bus run number before any farebox receipts for the vehicle and bus run could be entered.

5. interfield arithmetic and/or character string operations

The Datastar program handles the data entry and verification process according to the form requirements defined by FORMGEN. With the Datastar program, the user can add records (data entry), select records by key (retrieval), scan in index order (review file contents), scan in data file order (review file contents) etc.

Table A.2 lists the vendor address, price, hardware configuration requirements, and program limits for Calcstar and Datastar.

## A.3 MICROPLAN™ SOFTWARE DESCRIPTION

Microplan (34) is a combination electronic worksheet and financial modeling program. It operates as an electronic worksheet using rows and columns in a table format representation on a video screen. It uses a series of menu driven lists of commands to enter data, to create models and programs, to compute results, and to format and print reports. Programs and models are developed from a list of commands which are keyed to a list of numbers. The user keys the appropriate number corresponding to the instruction he wishes to implement.

Microplan operates under two modes: (1) a normal mode; and (2) a program mode. Under the normal mode, commands operate directly on rows and columns, and are stored there. In the program mode, an instruction set of commands, subject to a maximum size limit of 100 steps, is stored in memory and executed only upon command.

TABLE A.2

"STAR" FAMILY HARDWARE CONFIGURATION REQUIREMENTS AND PROGRAM LIMITS

Calcstar™

Vendor: MicroPro International Corp.
1299 4th Street
San Rafael, CA. 94901
(415) 457 - 8990

Price: Approximately $200 (price subject to change)

Hardware: 8-bit machine running CP/M 2.0
48K but 64K recommended
Two disk drives, 80 column screen

16-bit machine running CP/M-86, MS DOS, PC DOS
160K RAM
Two disk drives, 80 column screen

DataStar™

Vendor: same as above

Price: Approximately $300 (price subject to change)

Hardware: same as above

Limits: Maximum 120 characters per field
Maximum 255 fields per record
Maximum 65535 records

Source: Reference (33)

Microplan has released an add-on (extra cost) consolidation module which provides additional commands to add, subtract, multiply, divide row-or column elements from multiple tables. This package also contains a LINK command to extract row or column values from external files.

Table A.3 lists the vendor address, price, hardware configuration requirements, and program limits of Microplan.

## A.4 PLAN80™ SOFTWARE DESCRIPTION

Plan80 (35) is a financial management program which uses a row and column Table format to construct models and financial reports. The user sets up a model in a text file by first entering the report title, then row and column titles, initial data entry values, and an instruction set of rules for computing row and column values. Report options, e.g., column width, line spacing, the number of decimal positions etc., would follow the rules section.

Plan80 also supports interactive data entry, and will recompute data values within the Table based upon the rules section. Financial reports or parts of reports and graphical output may be viewed on the screen or printed using the display command and print command respectively.

Table A.4 lists the vendor address, price, hardware configuration requirements, and program limits of Plan80.

## A.5 DSS/F™ AND DSS/A™ SOFTWARE DESCRIPTIONS

DSS/F (36) uses a row and column table format to construct models and financial reports. It uses a series of files to build financial models usingthe DSS/F text editor. By convention, the files carry a common root name (generally indicative of the application) and various suffixes to indicate their content. For example, the user would develop the instruction set of commands for a financial model in a file called MODEL.LOG, enter the data into a file MODEL.DATA and then specify the reporting formats in a file MODEL.REP. To simplify data entry, the software can create a worksheet corresponding to the data required to use the model that the user has developed.

DSS/F supports a text editor to insert, delete, or change items in any file which is created. Changes to the model logic, however, require that the model be recompiled using the compile command. In addition to creating a data file, the user does have the option of keying data values interactively from the keyboard during a model run. All files that are created can be saved and retrieved for later applications, or used in a DSS/F graphic analysis routine. The software is designed to provide a menu list of commands for user applications, any of which the user may invoke at the terminal. DSS/F supports a number of built-in financial functions including depreciation, internal rate of return, net present value, amortization, break-even analysis, tax lookup tables, and a tax loss carry forward routine.

TABLE A.3

MICROPLAN™ HARDWARE CONFIGURATION REQUIREMENTS AND PROGRAM LIMITS

Vendor: Chang Labs
10228 N. Stelling Road
Cupertino, CA. 95014
(408) 725 - 8088

Price: Approximately $495 (price subject to change)
Consolidation Module $295

Hardware: CP/M or CP/M compatible, Version 2.0 or later, can also operate under MP/M and CP/M 86.
One floppy disk; two drives preferred, 8" or 5 1/4"
48K minimum, 64K preferred
Machine compatible printer
Monitor display that has a 'cursor addressing' and 'clear screen' features; optimal configuration for terminal would include 'cursor keys', 'function keys', and a numeric keypad

Limits: Maximum of 500 rows and 99 columns for each Table, but no more than 1000 data values per table on 64K machine
140K of storage capacity is required for Microplan's system files. Additional capacity required for user's table and programs.
Maximum row description 40 characters
Maximum column description width of 2 lines of 20 characters each

Source: Reference (34)

TABLE A.4

PLAN80™ HARDWARE CONFIGURATION REQUIREMENTS AND PROGRAM LIMITS

Vendor: Business Planning Systems
2 North State Street
Dover, Delaware 19901
(302) 674 - 5500

Price: Approximately $295 (price subject to change)

Hardware: CP/M, CP/M-86 or MSDOS
56K RAM if 8 bit, 128K if 16 bit machine
Two disk drives (one for the operating system, the other for Plan80 software);
Monitor with cursor addressing, and the clear screen function; text editor; printer

Limits: With 64K memory limited to approximately 2000-4000 cells in Table
183 rows and 500 columns
Maximum number of rows or columns will be reduced if program includes INCLUDE and REPEAT commands

Source: Reference (35)

DSS/A (36) software provides an analysis capability, also using a table matrix format. The user defines his data structure to include planning units (e.g., transit routes) as rows of the Table, and variables (e.g., ridership, operating cost, revenues) as columns.

There are several modes of operation. In the PREP mode, the user can define new variables, determine the status of existing variables, display data on his screen, select certain rows or columns, consolidate or group rows or columns, and label and format variables. The REPORT mode allows the user to specify reports and their formats and either display them on the screen, or print them. In the STATISTICS mode, the user can invoke a number of statistical routines. These include developing descriptive statistics (e.g., max, min, range, median, mean, variance, etc.) for variables, one-way analysis of variance, crosstabulations, regression analysis, correlations, and frequency distributions. In the GRAPHICS mode, the user may create bar, line, or scatter graphs with user defined labels for each axis. The last mode of operation is DBADMIN which allows the user to create and edit his database. In the DBADMIN mode, the user may also create a worksheet with labeled rows and columns for easy data entry.

Table A.5 lists the vendor address, prices, hardware configuration requirements, and program limits for DSS/F and DSS/A.

TABLE A.5

DSS/F AND DSS/A HARDWARE CONFIGURATION REQUIREMENTS AND PROGRAM LIMITS

DSS/F™

Vendor: Addison Wesley Publishing Co.
Reading, Mass. 01867
(617) 944 - 3700

Price: Approximately $995 for IBM and Compaq, $795 for Apple II (price subject to change)

Hardware: Apple II plus with 64K, Apple III (256K), TRS-80 Model II, IBM PC and COMPAQ (128K)
UCSD Pascal operating system
3 Disk drives suggested; 2 minimum
Color or Black and White Monitor
132 column suggested, 80 column minimum, printer

Limits: Maximum of 32,000 cells in Tables, 800 blocks on IBM
Editor file can contain a maximum of 510 lines or 7680 characters
A single diskette holds 274 blocks of 512 characters organized into as many as 77 files; which is enough to store 18 result files (15 blocks each), 16 graphic images (16 blocks each) or 30 average report specification files

DSS/A™

Vendor: Same as above

Price: Approximately $495 (price subject to change)

Hardware: Same as above

Limits: Maximum of 500 rows (values) and 100 columns (variables) on a single DSS/A data diskette for IBM and 100 columns
Maximum of 200 rows per database on Apple
Can use variables for only one database at a time
Commands apply only to active file which has a maximum size of 20 variables

Source: Reference (36)

APPENDIX B

OPERATIONS AND PLANNING SUPPORT REVIEW PANEL
PARTICIPANTS IN JUNE 15-17, 1982 REVIEW OF OPS PROJECT*

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*Panel members listed with agencies they were working for at the time of the review panel meeting.

APPENDIX C

VENDORS RESPONDING TO CBD* ANNOUNCEMENT
AND THEIR PRODUCTS

| Vendor | Product Developer | Product |
|---|---|---|
| M/A COM-Atlanthus Data, Inc.<br>7927 Jones Branch Dr.<br>McLean, VA 22102 | Microsoft, Inc. | Multiplan™<br>(spreadsheet) |
| Radio Shack<br>1911 N. Ft. Meyer Dr.<br>Suite #22-1<br>Rosslyn, VA 22209 | Microsoft, Inc. | Multiplan™<br>(spreadsheet) |
| NCR Corporation<br>1140 19th St., N.W.<br>Washington, DC 20036 | Microsoft, Inc. | Multiplan™<br>(spreadsheet) |
| Lupfer and Long, Inc.<br>8200 Greensboro Drive<br>McLean, VA 22102 | Lupfer and Long | SPREAD™<br>(financial modeling language) |
| Cornerstone computer<br>3929 University Drive<br>Fairfax, VA 22030 | Ferox Microsystems, Inc. | ENCORE!™<br>(financial modeling language) |
| General Systems Corp.<br>8306D Old Courthouse Rd.<br>Vienna, VA 22180 | General Systems Corp. | OMNIPLAN™<br>(financial modeling language) |

*Commerce Business Daily (CBD) Issue Number PSA-8373, dated 11 July, 1983, page 29.

APPENDIX D

SPREADSHEET/FINANCIAL MODELING LANGUAGE PRODUCTS
REVIEWED IN AUGUST 1983, SOFTWARE NEWS*

| Product | Vendor |
|---|---|
| Desktop/Plan-II | VisiCorp<br>2895 Zanker Road<br>San Jose, CA 94901 |
| Execuplan II | Vector Graphic<br>500 N. Ventu Park Road<br>Thousand Oaks, CA 91320 |
| FPL | Ashton-Tate<br>10150 W. Jefferson Blvd.<br>Culver City, CA 90230 |
| LogiCalc | Software Products Int'l.<br>10343 Roselle St., Suite A<br>San Diego, CA 92121 |
| MasterPlan | Phase One Systems, Inc.<br>7700 Edgewater Dr. #830<br>Oakland, CA 94621 |
| Multiplan | Microsoft<br>10700 Northrup Way<br>Bellvue, WA 98004 |
| PeachCalc | Peachtree Software<br>3445 Peachtree Rd., N.E.<br>Atlanta, GA 30326 |
| PlanMaster | Cromemco<br>280 Bernardo Avenue<br>Mountain View, CA 94043 |
| Planner Plus | Ohio Scientific<br>1333 S. Chillicothe<br>Aurora, OH 44202 |
| ProCalc | Software Products Int'l.<br>10343 Roselle St., Suite A<br>San Diego, CA 92121 |

APPENDIX D (cont.)

SPREADSHEET/FINANCIAL MODELING LANGUAGE PRODUCTS
REVIEWED IN AUGUST 1983, SOFTWARE NEWS*

| Product | Vendor |
|---|---|
| ProfitPlan | Chang Labs<br>10228 N. Sterling Road<br>Cupertino, CA 95014 |
| ScratchPad | SuperSoft Associates<br>P.O. Box 1628<br>Champaign, IL 61820 |
| SuperCalc | Sorcim<br>2310 Lundy Avenue<br>San Jose, CA 95131 |
| TARGET Financial Modeling | Comshare Target<br>1935 Cliff Valley Way #200<br>Atlanta, GA 30329 |
| TARGET PlannerCalc | Comshare Target<br>1935 Cliff Valley Way #200<br>Atlanta, GA 30329 |
| Universal Business Machine | Spectrum Software<br>142 Carlow<br>P.O. Box 2084<br>Sunnyvale, CA 94087 |
| ZenCalc | The Software Toolworks<br>15223 Ventura Blvd. #1118<br>Sherman Oaks, CA 91403 |
| 1-2-3 | Lotus Development Corp.<br>55 Wheeler Court<br>Cambridge, MA 02138 |

*The five products discussed in this report were also included in the Software News review.

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