Microcomputer Applications in Transit Agencies

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To say that microcomputers have and will continue to affect the way that transit systems are operated and managed is to state the obvious. Within the last few years microcomputers have been used by transit systems to perform a variety of tasks, ranging from common business applications such as payroll and parts inventory to more sophisticated algorithmic applications particular to transit management, such as run-cutting and scheduling and transit service performance monitoring. A discussion of what has been learned from the experience of several transit agencies with microcomputers is presented in this paper and some direction for future microcomputer activities in transit agencies is proposed. Topics addressed in this paper are (a) how microcomputers are being used in transit operations, (b) problems and possible solutions in their deployment, and (c) some ideas on how to help ensure that microcomputers are used appropriately within transit agencies in the future.

Several microcomputer projects are ongoing at several transit operating agencies, federal agencies, universities, and consulting firms. Microcomputers in Transportation Information Source Book (1) provides a good synthesis of these activities. In addition, several ad hoc projects in microcomputer introductions are being conducted, usually through the efforts of individuals who have a high level of interest in this technology. As part of the transit industry microcomputer users' group project, a survey of microcomputer users who have some transit interest was undertaken. Results are incomplete at this time; however, some generalizations can be made from this survey. First, most users are employing generalized packaged software for analytic purposes. Few agencies use microcomputers for business functions such as payroll or financial management. This is probably because smaller transit operating organizations tend to be departments within general purpose local government agencies that maintain transit financial records as part of their overall accounting system. In addition, many are using word processing software.

The prepackaged software used includes file management system and spread-sheet analysis programs. Microcomputer use has been primarily in financial planning (particularly in budgeting and cash forecasting). Other applications have included analyses of ride-check data and vehicle requirement forecasting.

Little actual development of computer programs was observed in this survey. Some of the more formal projects of general interest to the transit community include the following.

Financial forecasting model--The Tri-County Metropolitan Transit District in Portland, Oregon, (Tri-Met) has contracted with a consulting organization to develop a multiyear financial planning and forecasting model. Once developed, this model will be field tested at three or four transit agencies in the country before public distribution.

Management information system--The transit agency in Isabella County, Michigan, will soon be using a distributed microcomputer system for financial management, vehicle scheduling, maintenance management, inventory, and word processing. This is likely to be a suitable model for other small transit properties to emulate.

Route demand forecasting model--Through a University Research and Training grant, staff from Cornell University have developed a route-level analysis model that assesses the impacts of headway and changes in fare levels on ridership, revenues, and passenger waiting and in-vehicle times. Field testing will be conducted in the future.

Transit data management system--A consulting firm, under contract to UMTA, is developing a data management system for processing transit field data from sources such as ride checks, load checks, and schedule-adherence checks. This work complements some work in statistical sampling for transit performance monitoring recently developed by the consultant.

In addition, considerable ongoing microcomputer work is being conducted in driver pick assignments (Seattle), run cutting and scheduling (San Diego), transit service performance monitoring (Albany), and timetable building (Chapel Hill). A number of transit agencies have used commercial spread-sheet accounting packages for analysis work within their organizations. These have focused on financial planning (particularly budgeting and cash forecasting); however, other applications include analysis of ride-check data and vehicle requirement forecasting.

Significant microcomputer activity relevant to transit operations is ongoing at the Transportation Systems Center. These activities include reviews of commercial data base management systems, financial planning practices, and applicable software. The major program of this organization over the next several years of interest to the transit community will be the development of an Operational Planning System (OPS). Most small- to medium-size transit properties do not currently use computers in their operation. OPS is intended to conduct a number of research and review activities to help foster the use of microcomputers in these agencies. The major elements of OPS include the following:

1. Studies of the transit industry, including the development of syntheses of operating practices and recommendations for solutions to common problems;
2. Research into new methods and development of techniques for analysis and planning in several transit functions, including service design, financial planning and management, and maintenance planning methods;
3. Technology reviews of commercial software and hardware for application to transit agencies;
4. Software development and demonstration, including development of some application and utility software to be tested at transit properties before distribution; and
5. Dissemination of results through regional seminars and workshops, newsletters, and software distribution channels.

Another project of interest to the transit community is the development of a national transit computer software directory being undertaken as part of the National Cooperative Transit Research and Development Program (NCTRP) of TRB. The contractor assigned to this project will develop a software directory on magnetic media for distribution. This directory will be updated periodically and will catalogue programs suitable for mainframe computers, minicomputers, and microcomputers.

ISSUES IN THE DEPLOYMENT OF MICROCOMPUTERS IN TRANSIT AGENCIES

Despite the diversity and complexity of applications to which microcomputers are applied in transit agencies, there are limitations to what they can perform. Further, the press may have inadvertently spawned a number of myths concerning microcomputers. Some think that a system that can perform all business and operations applications can be acquired for only a few thousand dollars. In addition to acquisition cost, however, there are costs of training even for the simplest commercial software, costs of documenting the programs, costs of procedures introduced, and costs of ongoing maintenance and operation. When all of these costs are considered, the cost of a microcomputer installation increases dramatically.

The ease with which individuals not skilled in data processing can use computers has been overstated. Small programs can be developed without considerable difficulty. More complex programs, however, often have to take into account memory and disk storage limitations, problems encountered infrequently in larger computers. Commercial software is available for most common business and analysis applications; therefore, transit agencies should not use their own staffs to develop software.

In the short run, the largest barrier to more widespread use of microcomputers will be transit staff training, particularly in small- to medium-size transit agencies where data processing and analyses are secondary staff skills. Unquestionably, the need exists for training at several levels. Most training, however, need not be transit- or transportation-specific to be useful to transit managers. UMTA staff are currently conducting several one-day workshops across the country on an introduction to microcomputers. These workshops introduce hardware selection concepts, commercial software availability, and some transit applications. By the end of these workshops attendees should be able to decide the place of microcomputers within their operations.

After an introductory session, additional training areas fall into four categories.

1. Business applications--demonstrations of how common business functions such as payroll, accounts payable, accounts receivable, ledger, and inventory can be performed by using microcomputers;
2. Analytic tools--training in general-purpose commercial software such as spread-sheet accounting, file and data base management systems, statistical packages, and graphics;
3. Programming languages--training in specific computer languages and operating systems; and
4. Transit operations applications--a series of demonstrations of software in the public domain useful in transit line and staff functions.

Of these four, the first three should be available through universities, computer stores, adult education programs, or local users' groups. Training in programming languages probably has limited usefulness to transit agencies, given the availability of commercial software for some applications and UMTA focus on software development in several other areas.

The most appropriate public training role is in disseminating information on transit operations applications. Such training could be a logical extension of the Bus Transit Operations Planning training course recently developed by UMTA through a contractor. Such short courses should be targeted to their intended audiences rather than introduce all aspects of microcomputer applications. For example, one course in service design and analysis; another in financial forecasting, budgeting, and analysis; and one in maintenance analysis would be appropriate. Interestingly enough, microcomputer and video technology can play a useful role in training. Either videotape training modules or new interactive video-training products can be used for this type of training.

The second barrier that could impede introduction of microcomputers is information on hardware and software capabilities not only for prospective purchasers but also for those who own particular systems. Information needs include the following:

1. Independent software and hardware reviews,
2. Assessment of suitability of commercial software for proposed applications,
3. Information on software development and use of commercial software at the transit agencies, and
4. Development of sample specifications and guidelines for specification development.

The first function is being performed by popular microcomputing journals. At least 60 product reviews of hardware and software that could be used by transit agencies have appeared in popular journals within the last 2 years (2). In addition, Datapro (3) provides a detailed review service. Local user groups fill the second information need.

The third barrier, namely sparce information on projects in transit agencies, can be overcome by establishing an industry users' group. In June 1982 the Capital District Transportation Authority (CDTA) was awarded a grant to initiate such a user group. A few months later CDTA, in turn, awarded a contract to Rensselaer Polytechnic Institute (RPI) in Troy, New York, to perform the technical support function for the group. The RPI staff has three major functions: publication of a quarterly newsletter on microcomputer use in transit systems, operation of a telephone inquiry service to field questions, and operation of a software exchange. The first newsletter, published in October 1982, was distributed to 1,200 persons and included a questionnaire, the results of which indicate a high degree of interest in the subject. The newsletter focused on some items of general interest to neophyte users and announced the availability of software in the public domain for distribution. The telephone inquiry service has fielded several calls on software suitability and how to obtain more information on microcomputers. Where practical, callers are referred to persons in other transit agencies who are working in similar application areas.

Over time, the most beneficial function of the user support center will be the operation of a software exchange. The support center staff has already distributed programs useful in budget calculations, cash-flow analysis, and service performance monitoring. Transit agency personnel are expected to contribute software so that a pool of programs can be made available. Further, support center staff, in conjunction with the staff of the Transportation Systems Center, are expected to convert software from formats in one computer or operating system to those in another.

Thus far, software contributions have been limited. For the most part claims are made that the software is not sufficiently documented for external distribution. This suggests that it may not be documented sufficiently for internal use either. This can present a problem if staff members who develop software leave the agency at which the programs were developed. Non-data-processing personnel should be trained in at least rudimentary documentation con-

cepts to ensure that the software that is developed is usable by persons other than the original author.

Finally, the lack of good, understandable information concerning specification development is currently causing considerable confusion and delay in the purchase of microcomputer systems by transit operators. This problem has two parts. First, most managers are unclear as to what should be included in a set of specifications. Also, they have difficulty determining the reasonable range of options available for any particular feature. Information on specification preparation is currently being disseminated informally among transit properties. UMTA should consider adding an overview of specification preparation to its training courses.

Although substantial benefits can be achieved by implementing microcomputer systems in a transit agency, policy and personnel issues that surround the integration of the computer into the operation must be considered and addressed. To date, most transit systems that have purchased microcomputers have initially limited the computer's use to a few functions and individuals and have only gradually expanded the use and availability of the machine. The impacts on the organization, therefore, have been less dramatic and more easily dealt with as they occur. Transit properties, however, are beginning to recognize the benefits of a comprehensive approach to computerization. At this level, the implementation of a computer system can affect the transit operation substantially.

Policy questions surrounding the implementation of a computer system are similar to those related to implementation of any major organizational change. Examples of these include allocations of scarce resources among departments or even within a department; assignment of responsibility for equipment and tasks; evaluation of the schedule for implementation; and consideration of issues involving the security of the equipment and information. In evaluating these questions, realize that the computer system represents an unfamiliar technology. As such, people have preconceived ideas and attitudes that can affect the implementation of the system. Therefore, the personnel issues related to the implementation of a microcomputer system should receive greater attention.

A computer system is only as accurate as the people who operate it. Errors caused by poor data collection, handling, or analysis procedures are only compounded by computer processing. The result is inaccurate data that have the appearance of accuracy. At least three personnel-related issues need to be addressed. First, the cost of a computer system is frequently justified by projecting the number of people the machine can replace. From a personnel standpoint this can be a poor approach. It can create serious morale problems and can give rise to a general resistance to the system as a whole. In addition, although computers frequently change the nature and scope of the work required, the complete elimination of a position in the organization is rarely reasonable. Data must be collected, checked, entered, and interpreted. The initial benefit of a computer system is the speed and accuracy with which the information is produced. Improvements in the quality of decision making will take time to achieve. With the introduction of computer systems new information that was too expensive to process by hand could be collected. If over the long run a staff reduction is possible, it is handled better by attrition than by staff reduction.

A second personnel problem resulting from implementation of a microcomputer system is possible resistance based on fear of the computer itself. Microcomputers represent a technology that is unfamiliar to most adults. Many articles and portions of books discuss computer anxiety. These anxieties do exist, and they can affect the success of the implementation. Easing computer anxiety can be as simple as allowing adequate time and money for training. Another approach is to consider innovative or unorthodox methods for easing the initial contact, for example, the use of computer games or educational software. This approach will have the most impact if the employee is allowed to choose the program. A third method for easing computer anxiety is to demonstrate the direct benefit of the system to the employees. Introduction of the system by implementing a program that is easy to use and well documented and that shows direct and immediate benefits to the workers can accomplish this goal. This approach usually involves preprogrammed software applied to some simple but particularly time-consuming or onerous task.

The last common personnel problem is the need to allow time for the employees to learn the system and make the transition from manual to computerized processing. Even with the simplest preprogrammed software people need time to learn the basics of the machine and the software. Also, the computerized system may not replace a manual system immediately. For more critical applications, such as financial records or maintenance inventories, good managerial practice is to run the manual and the computerized systems in parallel. This allows for a check on the computerized system. This approach requires considerably more time on the part of the employees responsible for the tasks. Not only should this time be built into the implementation schedule for the computer system, but it may also be necessary to adjust deadlines for submission of standard reports.

A LOOK FORWARD

The rapid development of new products and services over the past years in information processing makes any prognostication of the future use of microcomputers in transit quite difficult. Some generalizations can be made, however.

An exciting new development is a class of integrated software systems for microcomputers that combines modeling and statistical analysis with graphics and word processing. In addition, these systems are designed to be easier to use than previous single-purpose systems such as the electronic spread-sheet programs. These systems also permit accessing external and internal data bases for analyses. Such systems should greatly increase the ability of microcomputers to be useful analytic tools for conducting special studies such as budget analysis and maintenance work order analysis.

Another area that should benefit transit operators is the development of new peripheral devices, particularly those related to data input and output. Several of the application areas in transit are highly data intensive, for example, passenger counts and vehicle maintenance.

Further, many transit data are collected in a hostile environment, such as on-board buses, in service buildings, and in repair shops. Already, we are seeing some creative uses of nonconventional data collection methods such as bar code readers (used by the Greater Cleveland Regional Transit Authority for parts inventory) and hand-held data recorders and computers (used by several transit systems for passenger load studies). Although the data collected in these two examples are not processed by microcomputers, no technical barriers exist to doing so.

In two application areas improvements in software and hardware can make a significant impact on how

transit systems operate. These areas are maintenance management and service design, scheduling, and passenger information.

For several years many transit systems have computerized their run cutting and scheduling, the task of assigning buses to scheduled service, and the task of assigning bus operators to scheduled buses. In some instances the data base for internal (personnel and vehicle) scheduling has been used to produce printed public timetables. Many other opportunities are available to use these data to improve passenger information. Among these are visual displays of transit schedules at major generators, printed custom-tailored timetables to be posted at bus stops, video terminals for persons who answer public inquiries on scheduled, voice synthesized automated schedule information, and, in the long run, the ability of persons who have home computers to access the transit system schedule data base. Such improvements in the distribution of schedule information are likely to increase the level of transit use, particularly by nonpeak riders, a market that transit systems should attempt to penetrate better.

Service monitoring, service design, and passenger information can be viewed as a continuous process of using common data bases rather than as a set of disjointed tasks. The data that transit operators collect, including boarding counts and schedule adherence checks, are necessary to make decisions about service design. A useful analytic tool would be a system that reduces the raw data to information useful to make decisions on service headway and scheduled time between terminals. A transit analyst could then design the service and perform the run cutting and scheduling. This could be done as an iterative process in which the scheduled service reflects both passenger demands and operating constraints on schedule making.

With automation of the mechanical tasks of scheduling, transit staff can devote more time to the policy analysis functions of transit operations that, to a large degree, are currently underfunded.

The other area in which substantial innovation can be anticipated is in-fleet maintenance and servicing management, a function that typically accounts for nearly a third of transit system costs. For several transit systems microcomputers can perform the housekeeping tasks of vehicle repair records. The real benefit of maintenance management information systems may not be in their ability to display the service history of individual buses or components in order to make instantaneous decisions on individual vehicle repairs but in the more strategic planning areas of personnel planning and deployment, fleet replacement, servicing policies, life-cycle costing, and fleet specifications. A number of first generation maintenance management information systems exist, some of which operate on microcomputers. Once data on individual bus work orders are assembled into sizable data bases, a maintenance decision support system would be a useful enhancement. Some elements of such a system could include programs to design and monitor controlled experiments on inspection and service intervals and to perform assignment models for scheduling mechanics and service bays to anticipated work loads.

In conclusion, the use of microcomputers by transit agencies is a natural complement to other activities intended to improve the productivity of transit systems. The major benefit of microcomputers is to allow transit managers and analysts to devote more time to the tasks of data interpretation and policy development rather than to data assembly and tabulation. This should enable transit agencies to be better prepared to face the challenges of the next few years.

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