Microcomputers and Transportation Team Up: What's Ahead?

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The Transportation Research Board recently established a Task Force on Microcomputers aimed at promoting the use of the microcomputer in all areas of transportation and comprised of a diverse group of transportation professionals who represent all modes and many disciplines—government, industry, academia, and related interests. The Task Force will

- encourage other TRB committees to develop microcomputer-oriented papers by identifying appropriate topics and potential authors and offering to provide reviewing assistance
- stimulate broad-based, microcomputer-oriented research by identifying research needs that are multimodal and interdisciplinary in nature; inviting papers on selected themes for presentation at the TRB Annual Meeting and midyear meetings and workshops, if any; and arranging for an "informal working papers" series to provide for rapid dissemination of special-topic bibliographies, papers, programs, product reviews, and other informal documents
- plan for and conduct special-interest activities outside the TRB January Annual Meeting
- assist in coordinating the activities of the various special-purpose user groups in the transportation community (groups that are concerned with microcomputer applications and that provide information about user program libraries, documents, meetings, and similar activities)
- assess the needs for rapid information dissemination, analyze alternative strategies for responding to these needs, and implement any selected strategies
- promote standards in programming and documentation that will lead to the progressive improvement of transportation software
- promote existing educational activities, especially those of a tutorial or training nature
- assist TRB staff to develop effective uses of microcomputers in staff and possibly committee activities
- promote microcomputer access to TRB's Transportation Research Information Services (TRIS) data base and, if appropriate, other transportation-related information services
- develop a bibliography to guide transportation organizations that are in the process of making microcomputer hardware or software acquisition decisions

MICROCOMPUTER WORKSHOP

The first official activity organized by the Task Force was the Workshop on Microcomputers held immediately preceding the regularly scheduled TRB 1983 Annual Meeting in January. The workshop was attended by 275 persons. The workshop began with a talk by Ronald T. Fisher of the Office of Methods and Support, Urban Mass Transportation Administration (UMTA), who provided an introduction for new users. This talk is part of the one-day introductory microcomputer course, which is a joint effort of UMTA and the Office of Highway Planning, Federal Highway Administration. Following his remarks, five state-of-the art presentations were made: Transportation Planning by Earl R. Reuiter of Cambridge Systematics and Mike Waller of

Feature

Little Rock's Metro Plan (1), Transit Operations by Jack Reilly of Albany's Capital District Transportation Authority and Janette Dignozio of the Greater Roanoke Transit Company (2), Traffic Engineering by Kenneth Courage of the University of Florida and Christopher Claterbous, a traffic engineering consultant (3), Railroad Engineering by Carl D. Martland of the Massachusetts Institute of Technology (4), and Civil Engineering by Gary W. Davies of Garmen Associates (5).

TRANSPORTATION PLANNING

As with all areas of transportation activity, transportation planning has undergone major changes over the past 10 years as computer technology has evolved. In the early 1970s mainframe computers, able to manipulate substantial amounts of data, led to the development of areawide transportation planning models. However, most, if not all, of the input data still had to be developed by time-consuming manual methods.

In the late 1970s two publications on sketch planning methods and quick-response techniques (6, 7) included procedures that were ideally suited for the size and speed of the early microcomputers. In fact, out of 55 surveyed microcomputer programs in transportation planning, 31 percent use sketch planning, quick-response, and/or innovative analysis methods to predict some aspect of urban transportation patterns.

The second most common group of programs (16 percent) applies one or more of the traditional urban transportation planning steps that until now had been feasible only on mainframes. While the microcomputer versions insist on more stringent problem size limits, a higher degree of analyst interaction and simplified process or job control are two important benefits.

About 13 percent of the programs were designed to assist transportation service providers such as ridesharing pro-

At opening session of microcomputer workshop, Ronald T. Fisher of UMTA makes a point. His presentation served as an introduction to the vast field of microcomputers and their uses.

moters and paratransit operators. The survey found that the remaining planning application areas—impact forecasting and programming/budgeting—are well addressed by commercially available microcomputer software such as spread sheet programs and data base management systems. Interestingly enough, these applications have not always been successfully treated by larger computers.

Other planning applications include programs that interface with mainframes, digitizers, and graphics devices; travel surveying aids (e.g., license plate matching); statistical and data-processing programs; and utility software. A microcomputers in transportation planning user group has been established (8).

TRANSIT

Microcomputers have and will dramatically affect the way that transit systems are operated and managed. Within the last few years, microcomputers have been used at 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, scheduling, and transit service performance monitoring (9).

A survey conducted by the Transit Industry Microcomputer Users Group Project found that most users are employing generalized packaged software, especially file management systems and spread sheet analysis programs. While their use has been primarily in financial planning (budgeting and cash forecasting), other applications have included analyses of ride check data and vehicle requirement forecasting.

Programs have also been written for transit-specific needs: route demand forecasting; processing transit field data from sources such as ride checks, load checks, and schedule adherence checks; driver pick assignments; run cutting and scheduling; transit service performance monitoring; and timetable building.

There is significant microcomputer activity relevant to transit operations ongoing at the U.S. Department of Transportation's Transportation Systems Center (TSC), Cambridge, Massachusetts, including a review of commercial data base management systems and financial planning practices and applicable software. TSC is also developing an operational planning system to help foster the use of microcomputers in small- to medium-sized transit properties.

The Transit Industry User Support Center has been established to provide support for the users group. It has three major functions: publication of a quarterly letter on microcomputer use in transit systems, operation of a telephone inquiring service to field questions, and operation of a software exchange (10).

The new generation of integrated software systems appearing on the market that combine modeling, statistical analysis, graphics, and word processing will greatly increase the ability of microcomputers to be useful analytical 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 for data input and output such as bar code readers and hand-held data recorders.

TRAFFIC ENGINEERING

Most of the available traffic engineering design programs involve traffic signal operation in some way (9, 11, 12). Programs have been written following the methodology of Transportation Research Board Circular 212 (Interim Materials on Highway Capacity) to determine critical lane volumes, intersection capacity, and level of service. Several programs deal with optimizing intersection design and evaluation. More complex programs are available for the design and evaluation of arterial signal progression; variables to be optimized include cycle length, phasing, splits, and offsets. However, the microcomputer is not yet powerful enough for most network design and evaluation applications. While some programs exist that provide accessibility and interactive data entry, their main disadvantage is the speed of computation.

Microcomputers are being used by traffic engineers for data base management and graphic displays. For example, combined with a 10-megabyte hard disk, a microcomputer can provide a very cost-effective accident records system for a small- to medium-sized county. Two advanced graphics developments are a time-space representation that permits a 20-intersection system to be displayed on a screen and a depiction of traffic density at all points in time and distance.

The microcomputer has vastly expanded the capabilities of remote terminals that communicate with larger computers. "Intelligent" terminals offer the ability to transfer and

Implications for the Future

In each era of evolution of computer technology, we have evolved a style of transportation practice (planning, management, analysis) consistent with the available technology. The microcomputer era is a period of truly personal computational support for the professional—the era of "the professional's personal computer". We will see a great explosion of power to support personal styles of use. Although hardware innovation has come first, the software developments will be the stimulus to truly innovative support of human problem-solving capabilities. These capabilities, provided initially in microcomputer-based environments will change our professional work styles in fundamental ways.

Thus, a key feature of the microcomputer revolution is the impact on the capacity and readiness of transportation professionals to be more exploratory, more responsive, and less firmly entrenched behind a single set of numbers. This is very much a consequence of the types of software being used, such as the spread sheets, as well as of the hardware.

Micros will be used in many ways: the office micro for a single user, professional, or staff; the multi-user office micro; the micro at home, for night and weekend use, and general familiarization and support; the portable micro for use in the field and while traveling, which is supported by the mini or mainframe. All of these are candidate elements of a transportation organization's processing support.

In general, a number of these units, probably of different types, will be interconnected. These interconnections may be permanent, as when a microcomputer is wired as a terminal to a mainframe or mini, or may be intermittent. The micro may be used sometimes as a stand-alone work station and sometimes connected with a telephone or other link to a multiuser micro, to other micros, or to a mini or a mainframe. In such "distributed-processing" systems, individual users access the system through micros or terminals and draw on various levels of computer resources throughout the system when needed. We can expect substantial evolution toward this kind of multifaceted, multisite, multistation, multiuser system over the next few years.

Thus, the micro as hardware is not an issue. The micro will become simply a means for delivering desk-top access to the resources of the networks of services. The microcomputer is, from a hardware perspective, a way-station on the road toward an evolutionary distributed processing system.

The really important issues lie in the domain of software. Traditional computer applications were based around pre-packaged programs; programs that were pre-specified for particular applications (e.g., UTPS, cost models). A second type of software is typified by spread sheet programs, graphics packages, word processors, and others termed "pre-packaged application-generating" environments or "bounded" environments. Within such software, a user generates his or her own particular program or model of a problem; in that sense the user has great freedom. However, the domain of possible programs or models, while rich from some perspectives, is in fact quite bounded in that the style of what can be modeled and how is relatively constrained or bounded. "Evolutionary environments" are a third type; these would provide multiple styles of representation and of reasoning. The ideal form of evolutionary-environment software is not yet available. In such an environment a user should be capable of building up complex processes out of elementary ones, of experimenting with alternative processes and evolving them, and of structuring new procedures after experimenting with many alternatives.

Manheim and Simkowitz visualize three major phases of evolution of the use of personal, professional microcomputers in transportation.

In the first phase, tasks now being done through other means are being transferred to the microcomputer environment. These include tasks that were previously done on mainframes or minis. These tasks are transferred to the micros largely to increase an individual's accessibility to the capabilities or to reduce costs (obviously, many large-scale processing tasks cannot be transferred). This also includes tasks that were previously done with manual procedures: budget preparation, drafting of memos or reports, hand calculations, use of tables or nomographs to do complex calculations, etc. The key point is that the tasks were being done prior to their transfer to the micro environment, but now they may be done more quickly, more responsively, more elaborately, with many more iterations and adjustments, etc.

In the second phase, innovative approaches are taken to tasks that existed in an organization previously, but were not supported by computer capabilities or even in many cases by analyses of any sort.

In the third phase, innovations occur in the organization itself—in its selection of tasks to be performed as well as how they are to be accomplished, in how it is organized to accomplish these tasks, and in its very definition of its appropriate mission. In this phase, the availability of powerful, personal, professional problem-solving tools, through micros and other components of distributed-processing systems, allow, stimulate, and encourage significant changes in how individuals in the organization view what they should do and how they can get it done. In this context, the hardware and software become means, very subordinate means, to much higher ends: substantial increases in the efficiency and effectiveness with which the organization performs its missions.

Microcomputer applications in transportation are, and should continue to be, particularly interesting and exciting. The technology itself is exciting; but its implications for the practice of transportation as a profession should be even more exciting. Significant evolution can be expected in hardware and in distributed-processing strategies, in the types of software available, and in the very definitions of the roles and missions of transportation organizations.

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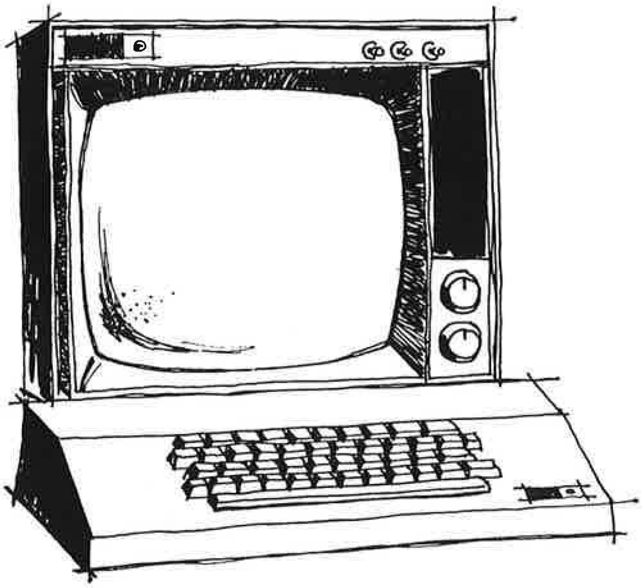


store large blocks of data, to perform computations on these data, and to display the results in numerical or graphic form. Applications include monitoring the operation of a computerized system and generating status reports interactively, transmitting signal operating parameters to local or submaster controllers in the field, interactive data entry for mainframe signal optimization programs, and graphic displays of the results of these programs.

Finally, the microcomputer can be used for real-time process control. A general purpose microcomputer system can be used as the master controller for real time operation of a group of intersections. In the signal maintenance shop, the microcomputer can be used to automatically collect, analyze, and display all types of survey data such as volumes, turning movements, travel times, and signal warrants.

RAILROAD OPERATIONS

Microcomputer and microcomputer applications are becoming increasingly common within the U.S. rail industry. Applications range from simple word processing and filing to complex operations planning models.

Several examples of the use of microcomputers for modeling exist. The MIT Service Planning Model (SPM) (13), which originally required 800-K core storage in a mainframe FORTRAN version, was revised and reprogrammed to run on a microcomputer. While slower, this version was actually more powerful and much more flexible than the FORTRAN version. The seven railroads that use the microcomputer version of the model were able to avoid the inevitable delays and costs that would have ensued in modifying it to run on their mainframe computers.

The Soo Line has developed a simulation model for estimating freight train fuel consumption, and Missouri Pacific has developed a model for unit train costing. Canadian National has used microcomputers in real-time control in its maintenance shops; in some instances, it built its own microcomputers to serve the exact requirements of a particular situation.

While individual railroads have not as yet made any special commitment to the development of models for use on microcomputers, at the industry level the story is considerably different. The Association of American Railroads (AAR) proposed preparing microcomputer versions of various models of track/train dynamics that have been developed during the course of a multiyear research program. As was the case with the SPM, the microcomputer offers smoother transfer and greater use of models developed for the industry with support from the AAR.

Despite the rapidly growing number of microcomputers in use and the wide variety of applications, it is still unclear to what extent, how soon, and under what conditions the microcomputer will be accepted by the rail industry. At least two railroads, the Boston and Maine and the Canadian National have welcomed the use of microcomputers, and people in many departments are using them for most of the types of applications described above.

One problem of using microcomputers effectively is how to bridge from the centrally controlled mainframe computer to a flexible network of computers, jointly controlled by management information system (MIS) departments and individual users. Current concerns about the proliferation of microcomputers will not likely withstand the dual impact of continuing technological improvements and declining prices of microcomputers. People who want to use microcomputers will simply buy them, whatever the attitude of senior management.

The rail industry is unlikely to use a great number of stand-alone microcomputers. Instead, railroads will acquire networks, either of microcomputers or of intelligent computer terminals. As microcomputers become more and more powerful, the distinction will become less important. Microcomputers will continue to provide an impetus to railroads to improve their computing capabilities and to make flexible, powerful software available to those who need it.

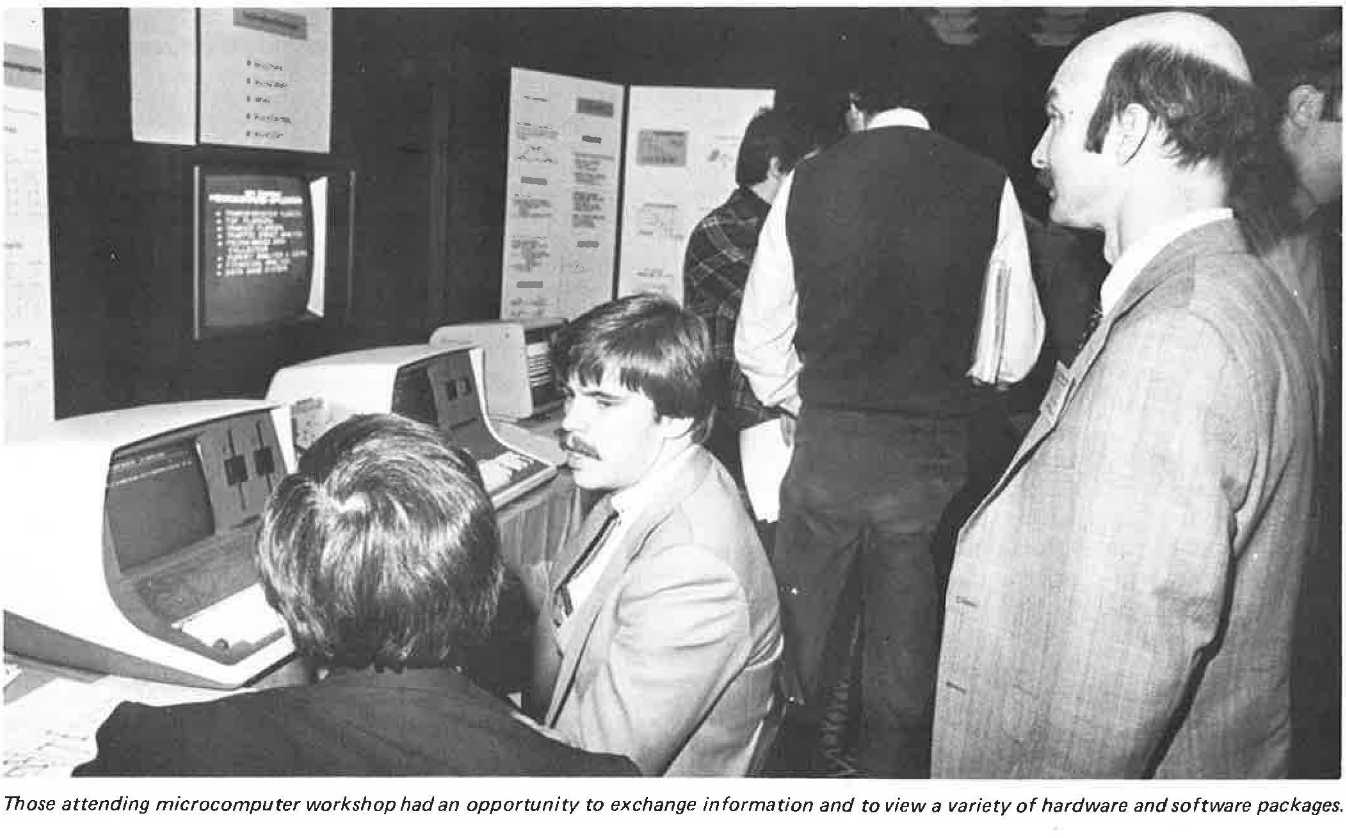
CIVIL ENGINEERING

The microcomputer has begun to change the engineer's approach to problem solving in general. The speed and capacity of microcomputers, when coupled with their portability and inexpensiveness, make microcomputers very attractive to the engineer.

Microcomputers have the greatest potential for civil engineering projects being undertaken by individuals and small firms and for projects of a more modest size. In these situations mainframe processing has not been feasible because of costs and inconvenient access methods. Even for large engineering firms and large projects microcomputers can be useful because they can support cheaper and more efficient communications and can provide graphics, spread sheets, and other utilities that are not available in the mainframe environment.

Virtually every area of civil engineering can profit from the use of the microcomputer. In addition to the standard utility programs already mentioned, a number of applications packages are becoming available to support specific civil engineering activities. Computer-aided design (CAD) systems have

Microcomputer workshop introduced participants to a variety of applications for transportation operations and planning.



Those attending microcomputer workshop had an opportunity to exchange information and to view a variety of hardware and software packages.

been developed that offer high-quality, two-dimensional drawings and design capabilities. Several critical path method network scheduling systems are available. For in-house control of design projects a number of utilities exist, including a system of software tools that allows a manager to model his or her project/resource environment and to track, analyze, and simulate it. Both tabular and graphic output is provided.

Some examples of application specific software include various coordinate geometry systems to support roadway and site layout, earthwork programs that circulate cut and fill and slope stability, structural design such as simple beam design and member selection, plane frame and grillage analysis, and two-dimensional stress analysis and truss analysis.

A number of hydraulics analysis and design systems are also available such as a storm-water detention design program. In the area of pavement design there are a number of concrete and bituminous mix design programs as well as systems for evaluating existing pavement conditions and assisting in prioritization of maintenance measures.

END NOTES

1. Earl R. Reuiter and Mike Waller. Microcomputer Software for Transportation Planning. Presented at Workshop on Microcomputers in Transportation, TRB, Washington, DC, January 16, 1983.
2. Jack Reilly and Janette Dignozio. Microcomputer Applications in Transit Agencies. Presented at Workshop on Microcomputers in Transportation, TRB, Washington, DC, January 16, 1983.
3. Kenneth Courage and Christopher Claterbous. Microcomputer Applications in Traffic Engineering. Presented at Workshop on Microcomputers in Transportation, TRB, Washington, DC, January 16, 1983.
4. Carl D. Martland. Microcomputer Applications in Railroad Operations. Presented at Workshop on Microcomputers in Transportation, TRB, Washington, DC, January 16, 1983.
5. Gary W. Davies. Microcomputers in Civil Engineering. Presented at Workshop on Microcomputers in Transportation, TRB, Washington, DC, January 16, 1983.
6. Sketch Planning Methods for Short-Range Transportation and Air Quality Planning, Volumes 1 and 2. EPA and UMTA, 1979; (NTIS) PB 80-158 702-A13 and PB 80 158 710-A15.
7. Quick-Response Urban Travel Estimation Techniques and Transferable Parameters (User's Guide). NCHRP Report 187, Transportation Research Board, 1978.
8. The address for the planning users group is Microcomputers in Transportation Planning Support Center, DOT/Transportation Systems Center, DTS-62, Kendall Square, Cambridge, MA 02142, telephone 617-494-2247.
9. Microcomputers in Transportation: Information Source Book. Urban Mass Transportation Administration (URT-41) and Federal Highway Administration (HHP-22), 1983.
10. The address for the Transit Industry User Support Center is TIME Support Center, Rensselaer Polytechnic, Civil Engineering Department, Troy, NY 12181, telephone 518-270-6227.
11. Microcomputer Applications in Transportation Engineering: Seminar Notebook and Software Directory. Institute of Transportation Engineers, 1982.
12. Microcomputer Applications in Transportation Agencies. Federal Highway Administration (publication pending).
13. For information on the SPM Users Group, contact L.A. Thomas, Freight Car Management Program, Association of American Railroads, 1920 L Street, N.W., Washington, DC 20036, telephone 202-835-9212.

Organizational Change and Initiation of Policy Studies Highlight TRB Activities

In the last issue of ***TRNews,*** readers were promised additional details about some organizational and directional movements within the Transportation Research Board. This article outlines two of these movements.

ORGANIZATIONAL STRUCTURE

As a result of a major reorganization of the National Research Council (NRC), TRB was designated one of eight major units reporting directly to the NRC Governing Board. This action not only raised TRB to a new and significant level of importance and stature within the NRC, but also placed on it increased responsibility and internal accountability for its activities.

In conjunction with this structural realignment, the TRB Executive Committee at its June 1982 meeting approved a number of changes designed to

- increase the involvement of the NRC Governing Board and members of the National Academy of Sciences (NAS), the National Academy of Engineering (NAE), and the Institute of Medicine (IOM) in the oversight of TRB, as a substitute for the oversight formerly provided by the now defunct Commission on Sociotechnical Systems
- ensure that the procedures related to committee and panel appointments and report review are in accordance with general NRC practices
- provide staff support for the Office of the TRB Executive Director comparable with that of other NRC units

Thus, three additional members were named to the TRB Executive Committee, who are also members of NAS, NAE, or IOM. They are Milton Pikarsky (NAE), Director of Research, IIT Research Institute and a former TRB Executive Committee chairman; John R. Borchert (NAS), Professor of Geography, University of Minnesota; and Fujio Matsuda (NAE), former Director of Transportation of Hawaii and now President of the University of Hawaii.

To serve as liaison between TRB and the NRC Governing Board, the Committee for NRC Oversight (CNO) was estab-