Microcomputer Software for Transportation Planning

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A survey was conducted of a number of U.S. metropolitan planning organizations and private-sector software providers. The results indicate that many types of microcomputer software useful to transportation planners are available and are being used by planners, especially in smaller- and medium-sized regions, to plan more effectively and efficiently. The largest group of microcomputer programs implement sketch-planning transportation analysis methods that do not require detailed network coding and processing. Other common areas of application are traditional urban planning methods, aids for providing transportation services such as shared-ride matching, means of predicting transportation-related impacts, and project programming and budgeting aids. A number of programs are also available that broaden the support base for using microcomputers and developing application programs for use in transportation planning. This group of programs includes interfaces with other computing hardware, travel surveying aids, statistical and data processing programs, and system development programming aids. Based on the survey of available transportation planning software, a number of observations and recommendations are made concerning the ideal future development of the area. The broad range of microcomputer systems needs to be recognized—from home-style personal computers to multiuser supermicrocomputers. Also, all program developers should adopt the goal of developing portable software, both among different computers and among different planning agencies. Finally, strong emphasis should be placed on developing ways to use microcomputers effectively as smart terminals that can access the wealth of transportation software available on larger computers.

Many metropolitan planning organizations (MPOs), especially those in smaller- and medium-sized regions, have about 10 years of transportation planning experience. In the typical case the responsibility for a metropolitan area transportation study and planning process was transferred to the newly organized MPO. In general, the MPO staff was immediately charged with the responsibility for updating the land use and traffic forecasts of the latest transportation plan for the area. This assignment involved the review of several thousand numbers that describe land use and transportation system characteristics. In most urban areas this task was difficult to accomplish.

In a typical urban area, with a population of 500,000, the local MPO had no computer-processing capacity, only one or two desk-top-style calculators, and a staff of three or four planners, none of whom had been involved in the completion of the transportation plan under review. Even simple comparisons of alternative data sets involved the summarization, by hand methods, of these thousands of numbers. In the eyes of the average citizen and elected official, the credibility of many MPOs never had a chance to become established.

About 8 years ago many of these MPOs began a major review that was to include a somewhat comprehensive evaluation of alternative transportation plans. This process required the development of at least one 20-year forecast of land use, which would provide the basis for comparison among the alternatives. Again, the size of the data sets involved was substantial and, although the actual synthesis of these numbers into highway and transit assignments was accomplished on large computers, most if not all input data were developed by manual methods.

These were difficult days for most transportation planners. A typical day involved the counting of houses from aerial photographs, the measuring of land use acreages by counting the dots on a sheet of acetate, the summing of several thousand numbers, the converting of the number to ratios, and the coloring of a map to display the results of the day's work. About 5:00 p.m. someone would review this work and suggest that a basic factor should be changed and the entire day's effort should be repeated.

The modern microcomputer has not solved all the data-handling problems of the average transportation planner; however, it provides a significant part of the solution. Two publications stand out as the seeds that ultimately led to the growing use of microcomputers in transportation planning organizations:

1. A two-volume compilation of sketch-planning methods for short-range transportation and air quality planning prepared for the U.S. Environmental Protection Agency (EPA) and UMTA (1) and
2. The quick-response travel estimation techniques prepared for the NCHRP (2).

A number of the air quality sketch-planning procedures compiled in the first report were designed to be used with a small programmable calculator. Microcomputers such as the ones in use today were not readily available in 1978, although a few small ones, such as the early Apples, Ohio Scientifics, and the TRS (Radio Shack) models did exist. These machines generally operated with only 4 to 16K of random access memory (RAM); only infrequently was a disk drive available. A transportation planner with the Association of Central Oklahoma Governments wrote one of the first microcomputer-based transportation planning programs to apply an air quality sketch-planning procedure included in the first report. This program aided in successfully completing the Section 175 of the Clean Air Act of 1964, as amended, planning requirements in several metropolitan areas.

The NCHRP report provides a readily implemented foundation for sketch-planning programs on microcomputers. A number of programs written by using its factors and procedures have been implemented; they are likely to be used by many urban areas to reduce the cost and aggravation of long-range transportation analysis. These procedures also offer techniques that can be used to evaluate the impact of alternative future land use possibilities economically and quickly.

At about the same time as these early efforts were beginning in planning agencies, university research at such places as Cornell and Massachusetts Institute of Technology (MIT), as well as private-sector system development, also began to produce useful microcomputer transportation planning programs. Much progress has been made in just 4 years. The current state of the art of microcomputer programs for transportation planning and, in the light of the existing situation, the major issues that will face program developers and users for the next few years are summarized and discussed in this paper. These issues lead to a recommendation for some of the characteristics of the ideal transportation planning microcomputer program of the future. The conclusion of the paper contains a brief listing of the 55 programs and systems identified in a survey.

MICROCOMPUTERS TODAY

A telephone survey combined with the compilation of existing published information provided background information. Selected MPOs and other microcomputer software developers were contacted. The results of this survey are summarized in Figures 1 to 6. A total of 55 programs were identified, many from previous listings in catalog publications prepared by ITE (3) and UMTA (4). This list is not all-inclusive; however, it does provide a general overview of the range of current capabilities, organized by application area. As Figure 1 indicates, these programs provide a wide span of capabilities. The most common program is one that uses sketch planning, quick response, and innovative analysis methods to predict some aspect of urban transportation patterns. None of these programs is dependent on coded networks. Most are limited to transit or mode-choice analysis, but six--travel budget and quick-response analysis programs--provide procedures designed to address the full range of significant aspects of urban travel in a unified prediction process.

The second-most-common group of programs apply one or more of the traditional urban transportation planning steps (land use and demographic forecasting, trip generation, trip distribution, mode choice, and assignment) similar to the way in which these steps are usually applied with large computers. The only significant differences are more stringent problem size limits, a higher degree of analyst interaction, and simplified process or job control. Some of these program packages are now being developed for supermicrocomputers, which does much to relax the problem size limits of the smaller personal computers.

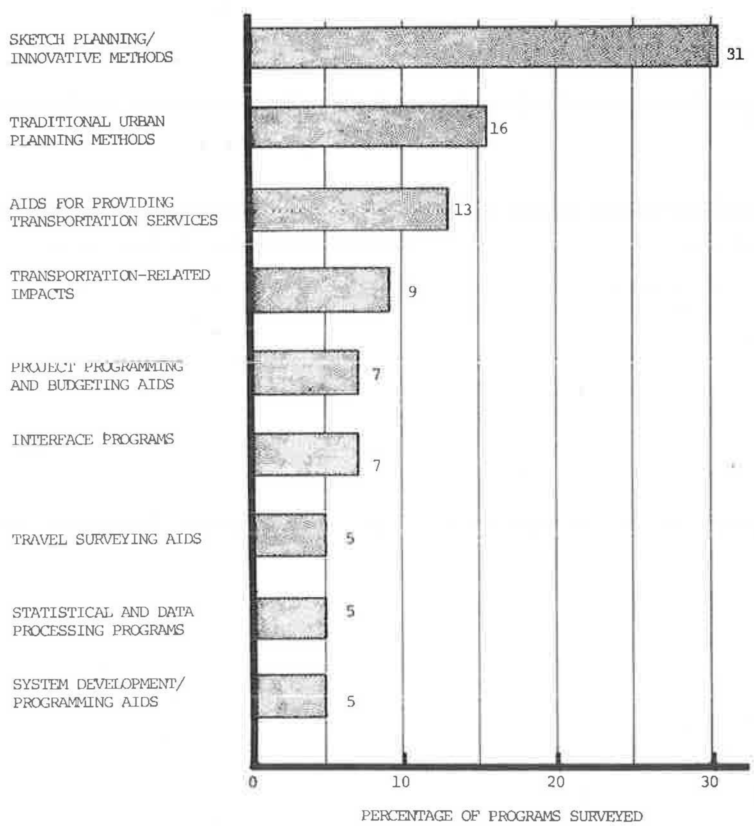
A significant emphasis in microcomputer program development has been the provision of aids for transportation service providers such as ridesharing promoters and paratransit operators, the third-highest grouping shown in Figure 1. The ease of using microcomputers in interactive and real-time environments, plus the increase in the need for carpool-matching and similar programs at the same time that microcomputers are becoming more common are two causes for this emphasis.

The remaining planning application areas, impact forecasting and programming and budgeting, are examples of areas not well addressed by commonly available software for nonmicrocomputer planning. Planners are likely to look for readily developed and easily applied computer tools to aid them in addressing these issues. They now find that microcomputers are available more frequently and are used more easily without the extensive involvement of more-computer-oriented professionals. In some cases generally available software such as spread-sheet programs and data base systems are ideally suited to these new problem areas. In other cases simple programs developed in high-level languages such as Pascal and Basic are appropriate. Applications of these types can be expected to be areas of significant continued growth in microcomputer capabilities in the future.

The four remaining application areas represent a different, but equally important, trend in the development of microcomputer programs. Interface programs, travel surveying aids, statistical and data processing programs, and system development programming aids each represent a broadening of the support base for planning analysis and microcomputer program development. They also represent the involvement of the more-computer-oriented analyst who is able to generalize the needs in a particular application into sets of capabilities that can be used in many applications. These efforts also provide a start toward the development of the more portable planning software advocated in the following sections.

Figure 2 indicates the variety of programming languages that have been used to develop existing programs. Basic is the most common language used;

Figure 1. Application areas.



however, no one language dominates. The entire range of languages, from assembly language to VISICALC, which is not strictly a language but has many of the same characteristics, has been used.

Although 54 percent of the programs surveyed are proprietary, this figure undoubtedly represents a surveying bias. The larger number of potential developers of public domain programs is more difficult to survey completely; this group is less likely to spend the extra effort required to provide fully documented transferable programs that others can implement in their own microcomputing environment. Also, proprietary system developers must advertise in order to sell.

The costs of obtaining microcomputer programs vary widely, which is a reflection of whether or not the programs were developed with public funds, whether or not source material is provided, and the wide range of sizes and scopes represented. The smaller programs tend to be sold for a one-time price in the $150 to $300 range, with no continuing support provided. Licensing arrangements, with an annual fee for maintenance and updates, tend to apply to the larger, more complex packages. These have initial costs in the $5,000 to $12,500 range. In addition, turnkey packages, including both hardware and software, are options available for some of the larger systems.

Apple brand microcomputers remain the predominant computers for which transportation planning software has been developed (see Figure 3). The IBM Personal

Figure 2. Programming languages.

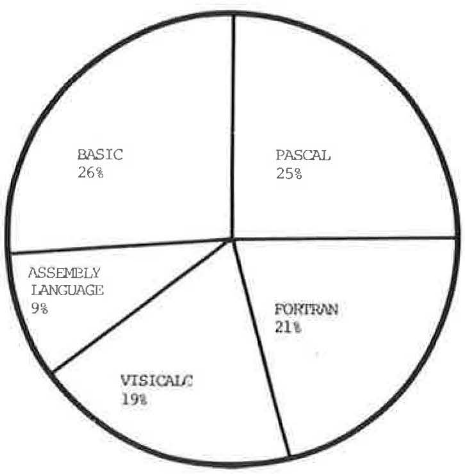


Figure 3. Microprocessors supported.

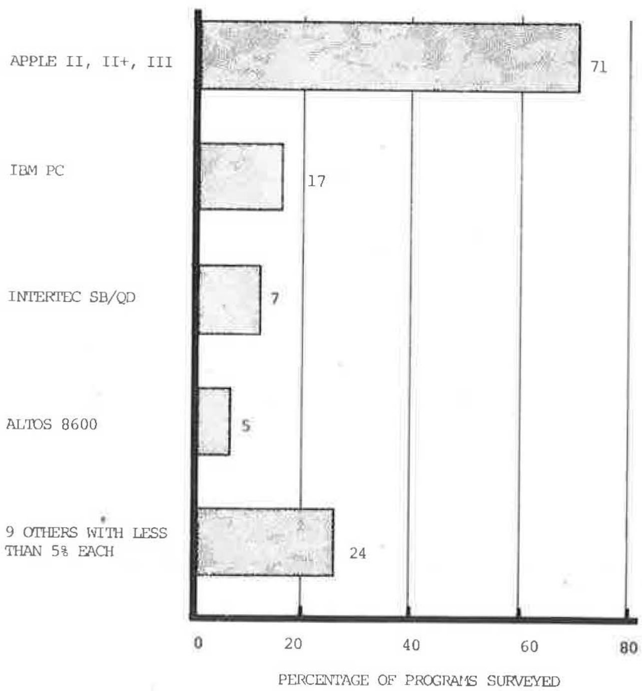


Figure 4. Operating systems.

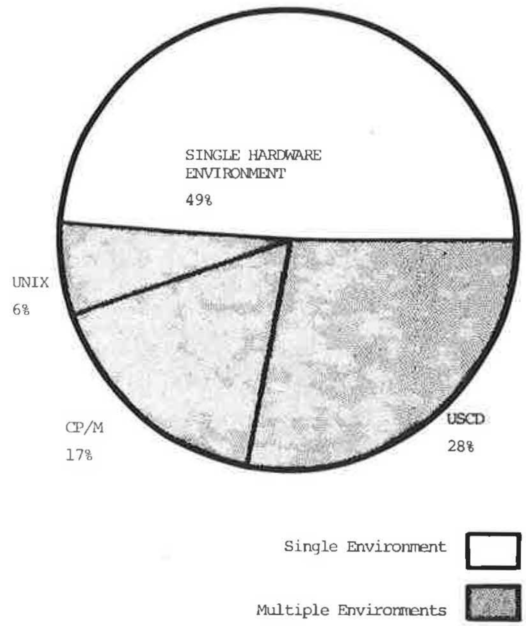


Figure 5. Memory requirements.

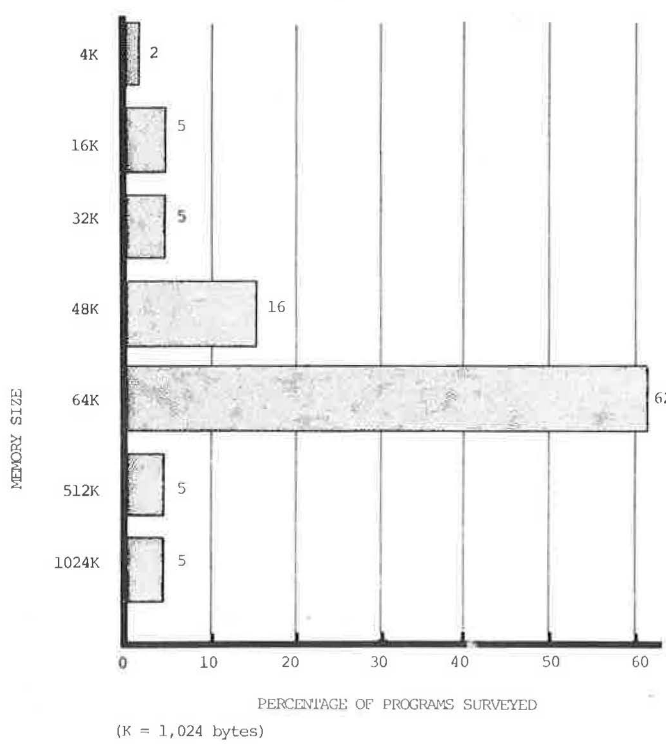
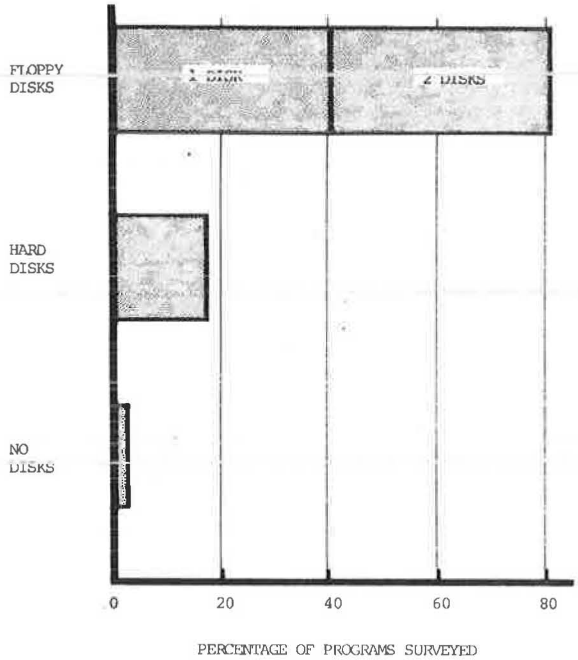


Figure 6. Disks required.



Computer is becoming increasingly popular; it has already overtaken the TRS-80 models for second place. The range of computers represented is very large--from inexpensive TIs and TRS-80s to multiuser supermicrocomputers (Pixel, Momentum, and Altos). This shows how increasingly difficult it is to view microcomputer hardware and software in an undifferentiated way.

Figure 4 shows a commendable trend toward the use of operating systems available in a number of hardware environments. The lack of a predominant multiple-environment system remains a fact of life, however. Only by adapting their programs to two of the multiple-environment operating systems can developers of operating system-dependent software hope to span more than a third of the potential market.

The hardware requirements of the surveyed programs are summarized in Figures 5 and 6. The most common configuration is 64K bytes (K = 1,024) of memory and one or two floppy disks. This configuration, with two disks, can probably be taken as a hardware standard minimum requirement for new transportation planning systems and programs. Increasingly, however, larger machines that have hard disks and much higher data storage capacity are being used as the basis for developing new capabilities oriented to the use and maintenance of large data bases, such as census data processing, carpool-matching programs, and transportation network processing.

MICROCOMPUTERS IN THE FUTURE

The use of microcomputers in transportation planning will undoubtedly be one of the major impacts on the field throughout the 1980s. This new technology has the same potential for revolutionizing the profession as machines like the IBM 704s and 709s did in the late 1950s, when these machines provided the means for origin-destination surveys to evolve rapidly into the computer-assisted urban planning process we now think of as the conventional four-step approach.

Much thought and analysis must go into the process of developing new urban transportation planning strategies for current and future needs. To be more appropriate and effective, strategies must be developed that reflect the changes that continue to occur in energy costs and availability, concern for the environment, and the role of the federal government in urban transport, as well as in computing capabilities such as microprocessors. Although most of these areas are beyond the scope of this paper, comments on how microcomputer software should be developed to support the effective evolution of transportation planning practice throughout the 1980s are in order.

First, the broad range of microprocessor capabilities reflected in Figures 5 and 6 must be recognized explicitly. The separation into at least two categories of systems is desirable; for want of better labels these might be termed personal computer systems and supermicrocomputer systems. The former systems are typified by the standard minimum requirement identified previously: a single-user system with 64K bytes of memory and two floppy disk drives, typically also having an impact printer and both an operating system and programming language that are available on a number of other machines. Such systems, in addition to having the capabilities required for many existing transportation programs, also provide much of the computing needs of the transportation planner in the form of widely available packages such as spread-sheet analysis, word processing, and personal data base management.

An example of a supermicrocomputer system would be a multiuser computer that has 512K (or more) of memory and a hard disk. These supermicrocomputer systems can be thought of as much less expensive replacements for minicomputers and (in many applications) mainframes rather than as larger personal computers. Past experience indicates that further price reductions will occur. The supermicrocomputer will soon be just as available and inexpensive as the personal computers.

Until these changes occur steps must be taken to clarify the differences between the two types of computers to prevent the planning community from confusing their distinctive capabilities and current costs. By providing this clarification, the TRB Task Force on Microcomputers in Transportation can continue to assist planners in understanding the innovations that microcomputers make possible in computer use by individuals, professionals, and organizations as well as how the technology is rapidly changing.

A major concern with respect to both types of systems is to minimize redundant software development. Software developed for use in transportation planning should provide the maximum possible level of portability, both to other agencies and to other machines. The potential magnitude of redundancy is great if we consider the number of transportation planners who will face similar planning problems.

Unfortunately, the provision of portability to other agencies will often require significant costs to provide the required level of generality. In most cases individual agencies have no incentives for incurring these costs in connection with the programs its staff have developed. As a result, only federally funded public-domain systems and proprietary systems are likely to provide sufficient levels of interagency portability. The people who support proprietary and federally funded systems, however, are somewhat opposed to the whole idea of the personal ad hoc approach that has made microcomputers so popular. A balance must be struck between these opposing pressures if microcomputers are to be used cost effectively.

Table 1. Summary of surveyed microcomputer programs.

Application	Computer	Memory	Disks	Operating System	Distribution Conditions[a]	Developer
Sketch Planning and Innovative Methods						
EXTRA: Express bus corridors	IBM	64K	1	DOS	Proprietary	W.G. Barker and Associates
Transit systems analysis (DODOTRANS II subsystem)	Apple	64K	—[b]	UCSD	Public	MIT
PVT: Impacts of service changes on transit line	Apple	64K	1	UCSD	Public	MIT
FARE PROG: Transit fare policies	Apple	64K	1	DOS	Public	Berkshire Company Planning
Transit fare policies	Commodore	32K	2	DOS	Public	Old Colony Planning
Transit service analysis	Apple	—[b]	—[b]	USCD	Public	Dartmouth University
UMOT: Travel budget analysis (4 programs)	Apple	64K	1	DOS	Licensed	Mobility Systems, Inc.
AGGREGTN: Pivot-point mode choice	Apple	64K	1	USCD	Public	MIT
Pivot-point mode choice	Ohio Scientific	4K	0	—[b]	Public	Little Rock Metroplan
PIVOT: Pivot-point mode choice	Apple	64K	2	UCSD	Proprietary	Schimpeler-Corradino
Paratransit planning	Apple	—[b]	—[b]	UCSD	Public	Dartmouth University
SAMPLENUM: Sample enumeration mode choice analysis	Apple	48K	2	UCSD	Licensed	Cambridge Systematics, Inc.
Quick-response methods	Apple, IBM	64K	2	UCSD	Public[c]	COMSIS
IMPAX: Quick-response prediction and evaluation	Apple, IBM, Intertec, TRS-80	64K	2	CP/M	Sold	PRC Voorhees
Traditional Urban Planning Methods						
MicroTRIPS	Apple, IBM, Intertec, TRS-80	64K	2	CP/M	Sold	PRC Voorhees
TMODEL	Apple, IBM	—[b]	—[b]	CP/M	Proprietary	Professional Solutions, Inc.
POP ITER, RTZ POP	Apple	64K	1	DOS	Public	Berkshire Company Planning
MINUTP	Molecular, IBM	—[b]	—[b]	CP/M	Sold	COMSIS
TRIPGEN	Apple	64K	2	UCSD	Sold	Garmen Associates
ASSIGN	Apple	48K	1	DOS	Proprietary	CH 2M Hill
EMME	Pixel	—[b]	—[b]	UNIX	Licensed	University of Montreal
TRANPLAN	Momentum	512K	20M	UNIX	Licensed	Vista Systems
Aids for Providing Transportation Services						
Carpool matching	TI99	16K	1	Ext. Basic	Public	Little Rock Metroplan
Carpool matching	Altos	1024K	Hard	Xenix	Proprietary	K. Roberts and Associates
MicroCRIS: Ridesharing support	Molecular	64K	Hard	CP/M	Proprietary	COMSIS
Ridesharing matching	TRS-80	—[b]	Hard	—[b]	Public	University of Tennessee
COMPOOL: Carpool and vanpool matching	Altos	512K	Hard	UNIX	Licensed	Crain and Associates
Dial-a-ride: elderly and handicapped service support	Altos	1024K	Hard	Xenix	Proprietary	K. Roberts and Associates
PSP: Paratransit scheduling	Northstar	64K	2	—[b]	Proprietary	W.G. Barker and Associates
Transportation-Related Impacts						
AQ ROADWAYS and AQ INTERS: Air quality impacts	Apple	64K	1	DOS	Public	Berkshire Company Planning
URBEMIS: Air quality impacts	Apple	—[b]	—[b]	—[b]	Public	California Air Resources Board
PROLEV: Energy requirements	Apple	48K	1	—[b]	Public	New York State Department of Transportation
PROLEV.HICOND: Energy related to highway conditions	Apple	48K	1	—[b]	Public	New York State Department of Transportation
Programming and Budgeting Aids						
MPS: Multimodal Priority System (DODOTRANS II subsystem)	Apple	64K	2	UCSD	Public	MIT
Priority ordering of street segment improvements	Apple	64K	2	DOS	Public	District of Columbia Department of Transportation
Local alloctions of federal aid	Apple	64K	2	DOS	Public	District of Columbia Department of Transportation
REKEN: National transit budgeting	Apple	48K	2	CP/M	Licensed	Cambridge Systematics, Inc.
Interface Programs						
TTY: Micro-mainframe communications	Apple, IBM, Intertec, TRS-80	64K	2	CP/M	Sale	PRC Voorhees
ACCESS: Micro-UTPS interface	Apple	—[b]	—[b]	UCSD	Proprietary	Garmen Associates
Digitizer interface	TI99	16K	1	Ext. Basic	Public	Little Rock Metroplan
Graphics system	Apple	48K	2	—[b]	Public	North Central Florida Planning
Travel Surveying Aids						
COMPARK: License plate survey matching	TRS-80	48K	2	DOS	Sold	ADA Computer Services
LMAT: License plate matching	Apple	64K	2	UCSD	Proprietary	Schimpeler–Corradino
VISTA: Data collection via video recorders	Apple	—[b]	—[b]	—[b]	Proprietary	Wootton, Jeffreys and Partners, England
Statistical and Data Processing System						
MicroSURVEY: Editing, tabulating, regression	Apple, IBM, Intertec, TRS-80	64K	2	CP/M	Sold	PRC Voorhees
MDA: Statistics, regression, logit estimation	IBM, Apple, Data General, TRS-80, Northstar, Osborne	64K	2	MP/OS, CP/M, various DOSs	Licensed	Cambridge Systematics, Inc.
OCTAGON: Census data processing	Apple	—[b]	Hard	CP/M	Proprietary	Vistar Enterprises
System Development and Programming Aids						
DODOTRANS II: Analysis environment system	Apple	64K	2	UCSD	Public	MIT
Utility programs	(PASCAL)	—[b]	—[b]	—[b]	Sold	Garmen Associates
Function graphing utilities	Apple	64K	2	UCSD	Public	MIT

[a] Proprietary denotes a program that must be paid for, but the arrangements (license or sale) are either unknown or unspecified. Public denotes a program that is not proprietary but may require a payment to cover transmittal costs.
[b] Information not determined.
[c] UMTA.

Portability among machines can probably be achieved more readily than among agencies, but this objective calls for careful planning and cooperation by both program developers and those who decide on hardware configurations. As multiple-environment operating systems, programming languages, and analysis environment subsystems oriented to transportation planning become available for a wider range of processors, they should be used rather than the single-environment systems now so commonly used.

For maximum portability, however, planners must go even further. Ideally, they should agree on the use of just one operating system. UMTA has taken the lead in specifying its preference for the UCSD p-system and Pascal. Unfortunately, CP/M operating systems are currently more generally available.

The same issue faces all professions and companies that have made substantial investments in data processing. Several approaches to the solution of this dilemma have been suggested, and clearly a consensus is needed. The most likely approaches are

1. Specify a standard operating system and language combination,
2. Establish user groups to promote and support the exchange of whatever software emerges from the use of microcomputers, and
3. Encourage the use of microcomputers as intelligent terminals that communicate with Urban Transportation Planning System (UTPS) and other programs that operate in the mainframe environment.

The most apparent problem with the specification of a standard system is that most agencies now own systems that probably would not meet the standard requirements and therefore can no longer be used as effectively. The selection of this approach also may preclude taking advantage of future developments in microcomputer technology because of a lack of compatability. Simply stated, this approach could result in the same situation in which we already find ourselves, with UTPS-type software running in an environment many agencies cannot or would prefer not to use.

The second approach has appeal, perhaps because of the freedom and creativity it can foster. The previously mentioned problem of redundant effort is still not completely avoided.

Microcomputers have proven to be excellent terminals for use with conventional timesharing computer systems on which a wealth of software for transportation planning exists. Examples include land use models, UTPS, statistical packages such as statistical analysis system (SAS) and statistical packages for the social sciences (SPSS), and travel model estimation tools such as logit programs. In the area of transportation planning, however, this use of microcomputers has been minimal. Although a few success stories can be told, most state and local government mainframe computer installations remain closed to access by microcomputers. Instead planners must place the required data in the proper formats and then submit their desired run to a data processing department for eventual processing. Planners usually consider this process unsatisfactory. This is frequently cited as justification for the purchase of a microcomputer, even when the bulk of the required computer work can be done within the UTPS system. Under these conditions access to mainframes via microcomputers is highly desirable.

This access is particularly difficult to arrange when it is requested from outside the agency that owns the mainframe computer. Many have been faced with established mainframe data processing departments that oppose efforts to incorporate use of the microcomputer into agency work. However, use of the microcomputers as intelligent terminals for access to conventional U.S. Department of Transportation software, as well as for running stand-alone microcomputer programs, can be a feasible compromise that takes maximum advantage of the available equipment and software.

The task force must consider these factors, make its own decisions on the values of each development direction, and then work with the U.S. Department of Transportation to promote the acceptance of a common strategy for using microcomputers with portable software. By helping to resolve the technical details of how to provide software portability, the task force can make a major contribution to the advancement of transportation planning practice in the 1980s. If these issues are not resolved the significant segment of the planning profession represented on this task force will find it harder to address the larger questions of what to plan for and how to plan most effectively.

LISTING OF PROGRAMS

The 55 microcomputer programs that were surveyed are summarized in Table 1. Only limited information is provided. Two catalogs (3,4) provide one- to two-page descriptions of microcomputer software packages. Programs appear under the headings and in the order used in Figure 1. To reduce the chances for errors (at the expense of specificity), computers and operating systems are identified in Table 1 only by their more generic names, not by model names or numbers or release numbers.

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