occurs most frequently with the state's larger transit operators, those in the New York City area. Improved performance of these operators could have the biggest payoff due to their size and offer the greatest potential for easing the need for public subsidy.

Several alternative approaches are possible as a means of addressing this particular problem. One alternative calls for comparing the larger New York City operators to operators in other large urban areas in the United States and perhaps the world. Although the age of equipment and operating conditions vary drastically from city to city, this comparison should still help describe New York's relative performance on selected indicators. Now that data from Section 15 of the Urban Mass Transportation Act of 1964 have become available, this approach will be studied further. A second alternative is to focus on the time-series analysis of individual operators described earlier. Even if an operator cannot be compared with other similar operators, a review of the operator's performance from year to year should indicate whether performance is improving or declining.

The review of public and private bus operators revealed that there were differences in performance, as suspected. Admittedly, the private operators often operate with fewer bureaucratic constraints, but the usually more cost-effective performance of the private operators provides a target for performance improvement of public operators.

A major drawback of a strictly quantitative performance-evaluation program like the peer comparison described above is that the measures in no way reflect the quality of service being provided as perceived by the rider. This problem is particularly true in the New York City area where traditional efficiency and effectiveness measures do not capture the drastic deterioration in service reliability, quality, and safety seen in the last few years. To address this problem, NYSDOT is developing a set of service-quality measures to monitor for each of the major transit operators in New York State. These service-quality measures, coupled with the traditional efficiency and effectiveness measures, should provide a more comprehensive picture of the level of performance and quality of transit service throughout the state.

FUTURE RESEARCH EFFORTS

Future research in the field of transit-performance evaluation should concentrate on integrating the quantitative performance evaluation presented in this paper with the evaluation of transit service quality. It is clear that only by combining several approaches--time series, group comparison, and service quality--can an accurate and comprehensive picture of transit service be presented.

Additional work should focus on further analysis of performance measures to develop indicators that best identify services that would benefit from in-depth study, determination of the transferability of the performance measures developed in New York State to other areas, more in-depth study of the factors that can be used to group operators for analysis, and more in-depth study of methods to determine acceptable levels of performance.

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Potential Role of Decision Support Systems in Transit Management

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The potential of microcomputer-based decision support systems in transit management is explored. Although computers are now used quite widely in the transit industry, their role tends to be predominantly in highly structured activities such as financial management and record keeping. These functions are provided on main frame computers requiring expensive technical support. Microcomputers, however, have the potential to be used directly by the transit manager to assist in decisionmaking. It is suggested that microcomputer-based decision support systems should be the focus of future computer use in the transit industry. Significant potential exists for the development of transferable software to support a wide range of transit management functions. A case study of the Cairo Transport Authority is presented to show how a decision support system can be based on the ideas advanced in this paper.

For many years, computers have been widely used in the management of organizations in many different industries. To date, however, these computers have been used principally in the more structured management tasks where large amounts of data must be processed (e.g., personnel records and payroll). In the last few years, the introduction of microcomputers has revolutionized data processing and is beginning to affect day-to-day management activities. The current political and fiscal environment of the U.S. transit industry suggests that, in future years, transit managers will be under significant pressure to improve the efficiency of their operations (1).

The hypothesis that microcomputers can be valuable in improving transit management is explored. To test this hypothesis, three underlying propositions are investigated in this paper:

Proposition 1: the U.S. industry does not currently make effective use of computers. (This proposition will be tested empirically.)

Proposition 2: decision support systems (DSS) have significant potential for improving transit management. By DSS, we mean the use of computer-based technology to support managers' decisionmaking activities. The potential of DSS in transit agencies will be based on the results of an in-depth case study that illustrates both the process and the approach of DSS.

Proposition 3: microcomputers and end-user languages provide substantial technological capabilities for DSS.

Before these propositions are explored, two major characteristics of DSS merit special attention: (a) such systems provide support for managers in their decisionmaking processes and (b) they should result in more effective and efficient decisionmaking. Thus, one must be concerned not only with the technological capability of DSS, but also with the type of decisionmaking structure that is best suited for DSS application and the needs of the ultimate users of the system, in our case, transit managers. Although management information systems (MIS), as one type of DSS, have been used to some extent in the transit industry, they have played only a special and limited role, as will be seen from the following discussion.

CURRENT USE OF COMPUTERS IN TRANSIT INDUSTRY

The role of computers in transit management is large and growing. A recent survey by the American Public Transit Association (APTA) indicated that a large percentage of transit organizations (79 percent of those responding) now make some use of computers. This survey provides a good basis for exploring current computer applications in the industry and so can be used to address the first proposition.

Table 1 summarizes the current use of computers in the transit industry in the United States as determined by the survey. The table indicates the different applications within each functional area, ordered by decreasing use of computers. In interpreting these survey results, care should be taken with the reported transferability figure. Although the transferability issue is very important, it is often difficult to assess transferability in light of technical compatibility of software and hardware, cost, transfer time, and adaptability to different specifications and needs.

There are several conclusions that can be made about current practice based on the data from Table 1. First, there is little use of computer-based systems in most activities in the transit industry. For example, there are only four activities--payroll, general ledger, accounts payable, and fleet vehicle maintenance--for which computers are used by more than 50 percent of transit agencies. Second, the level of computer use in other activities varies widely, although in several areas (such as planning) in which one might expect significant utilization of computers, there is currently very limited use. Finally, there is a heavier concentration of computer use for activities that do not require managerial judgment. These tend to be structured activities in which the computer system serves strictly the MIS role.

Based on the results of the APTA survey, Proposition 1 seems well founded, i.e., that the current use of computers in the transit industry is limited to a small number of highly structured management functions. Before the next two propositions are addressed, it is necessary to consider transit management at a more general level.

FRAMEWORK FOR TRANSIT MANAGEMENT

One of the first tasks in determining the appropriate role of any computer-aided management tool is to identify the decisionmaking structure in an organization. As noted by Keen and Morton, "a descriptive framework provides the basis for prescriptive design; that is, to 'improve' a decision process, one must first define and analyze it" (2). The analysis of decisionmaking must consider and integrate several dimensions, including the organization's characteristics, management's needs and capacities, specific activities and tasks, and the technology and techniques used to accomplish these activities. This multilevel approach has been lacking in most prior studies of transit management and decisionmaking that have focused on the formal structure found in organizational charts (3,4).

For purposes of this research, transit management activities will be viewed as consisting of a series of tasks that are undertaken in functional areas (see Table 2). The functional areas include service planning and operations, maintenance, finance, and marketing; the key tasks include the following (5):

1. Strategic planning: the process of identifying future directions for the organization, determining the resources needed to achieve specific goals, and establishing policies to assure goal achievement;
2. Management control: the process by which managers assure that resources are used effectively and efficiently in the achievement of organizational objectives; and
3. Operational control: the process of assuring that specific tasks are carried out.

Central to this perspective of management activities is another dimension describing the degree of structure of these problem-solving activities, i.e., whether the activities are structured, semistructured, or unstructured. These characteristics are defined as follows:

1. Structured activities: those that do not involve a manager, situations where the decisions are well enough understood to be given to clerks or to be automated, for example, standard operating procedures;
2. Semistructured decisions: those in which managerial judgment alone will not be adequate, perhaps because of the size of the problem or the computational complexity and precision needed to solve it; on the other hand, the model and data alone are also inadequate because the solution involves some judgment or subjective analysis; and
3. Unstructured decisions: those that either are

Table 1. Current use of computers in U.S. transit industry.

Function	No. Using Computers	Percentage of Operators Using Computers	Percentage of Computer Systems Transferable
Financial management			
Payroll, salaried	59	87	67
General ledger	54	80	64
Accounts payable	47	69	71
Labor distribution/job project costing	31	46	82
Budget and financial responsibility reporting	31	46	57
Fixed assets and property management	25	37	56
Accounts receivable	22	32	76
Fare and revenue collection	16	23	56
Payroll, operating and non-operating	16	23	78
Financial forecasting and simulation	8	12	67
Maintenance and materials management			
Fleet vehicle maintenance	42	62	67
Materials management and inventory control	32	47	62
Purchasing	17	25	67
Facilities and/or plant management	8	12	62
Operational management			
Schedules	33	48	73
Operator selection/assignment	28	41	75
Productivity/performance measurement	18	26	28
Safety	10	15	50
Claims	9	13	56
Ridership complaints/incident reporting	7	10	71
Marketing and telephone information	7	10	71
Labor relations	1	1	100
Planning			
Ridership statistics	27	40	74
Route statistics and information	17	25	80
Passenger counting and statistics	16	23	78
Revenue planning and statistics	5	7	60
Financial planning	1	1	100
Administration			
Personnel management	8	12	100
Equal Opportunity Office reporting	2	3	50
Benefits and medical	1	1	100
Engineering and construction management			
Capital project control and information	7	10	57
Reliability reporting and quality control	5	7	100
Construction management and contract control	5	7	60
Design and construction estimate and control	5	7	60
Engineering drawings and specifications control	2	3	100

not able to be structured or that have not yet been examined in depth and so appear to the organization as unstructured.

As shown in Table 2, specific activities can fit into both these functional areas and the level of management task. This should be viewed as one classification of these activities, with others also being possible. The relationships shown in the table will be used as the basis for the development of DSS within transit agencies. Later we will incorporate the dimension of the degree of structure of the activity.

DSS PERSPECTIVE

The analysis framework focused on specific managerial activities, whereas the DSS perspective asks how the manager can best be supported in carrying out these activities. The focus of the DSS is on improving management decisionmaking, so care must be taken to understand the existing management process, specifically, the key decisions and tasks, the data on which decisions are based, and the technology and techniques appropriate for mapping the data base into these decisions. Thus, DSS combines two perspectives, description (i.e., how decisions are made) and prescription (i.e., where computers can be introduced to improve decisionmaking).

The important characteristics of the DSS include the following:

1. The impact is on decisions in which there is sufficient structure for computer and analytic aids to be of value but where managers' judgment is essential;
2. The payoff is in extending the range and capability of managers' decision processes to help them improve their effectiveness; and
3. The relevance for managers is the creation of a supportive tool under their own control, which does not attempt to automate the decision process, predefine objectives, or impose solutions.

This should be clearly distinguished from the field of MIS in which the important characteristics are as follows:

1. The main impact is on structured tasks for which standard operating procedures, decision rules, and information flows can be predefined;
2. The main impact has been in improving efficiency by reducing costs and turnaround time and by replacing clerical personnel;
3. The impact on managers' decisionmaking has mainly been indirect, for example, by providing reports and access to data.

Thus, DSS represents a natural evolution in the field of computer-aided management tools from MIS, which concentrated mainly on the product (the package or system provided), to where the emphasis is on both the product and the process used to incorporate the system into the organizational decisionmaking process. The importance of the change process to ensure the diffusion of the product and its adoption (institutionalization) by the user cannot be underestimated (6).

Previous experience with DSS indicates that there are several significant characteristics of the systems (the product), and of the process used in their implementation, that are important in understanding the role they can play in decisionmaking. These include the following:

1. Adaptive design: user learning and participation is an essential component in successful DSS development.
2. Support to improve effectiveness and efficiency of decisionmaking: information support is useful only when the information is directly relevant to the decisionmaker's needs, aims, decisionmaking style, and education.
3. Incremental development based on interaction between user of system, builder of system, and system itself: DSS should be compatible with the way managers approach problems and be flexible enough to evolve to meet changing needs.
4. Most appropriate technology to support decisionmaking activities: the availability of low-cost microcomputers, which can be viewed as on-the-shelf depreciable products with low investment risk, enhances the potential of the DSS approach. In fact, the microcomputer is as much an economic advance as a technical advance; it has brought down

Table 2. Summary of basic transit management activities.

Functional Area	Strategic Planning	Management Control	Operations Control
Service planning and operations	Type of service (local express, paratransit, etc.) Demand analysis Facility planning and network design Surveys R&D	Network-planning improvements Productivity/performance, reporting	Vehicle allocation Dispatching Scheduling Productivity/performance, reporting Operation monitoring and inspection data collection
Finance	Financial planning and capital investment plans	Budget and financial responsibility Reporting Financial and/or bond management Cash management Revenue planning and statistics	General ledger Accounts payable Payroll, salaried Payroll, operating and nonoperating Labor distribution/job-projection costing Fare and revenue collection
Marketing	Market research/information Market segmentation Classes of people Geographical area Economic changes	Customer services Schedules Type of services Special services: ride and handicapped	Contracting
Maintenance	Facility planning Failure cost estimation Life-cycle cost estimation Long-term resource planning Training R&D	Status tracking/reporting Vehicle availability Vehicle fleet inventory Backlog status Management reporting Summary reporting Special reporting Failure monitoring Reliability analysis Inventory management Spare-parts estimation policy Planning Short-term equipment planning Short-term labor planning Short-term policies Availability Repair and maintenance	Preventive maintenance Consumable and mileage monitoring Vehicle-component - labor scheduling Work-order processing Repair history Cost reporting Labor reporting Failure monitoring Road call processing Inventory Inventory transactions Use reporting

the entry cost of using the computer and the cost of computerizing itself.

5. End-user languages that are used with interactive technology: in this way, small-scale models and techniques can be made operational and delivered to managers in days or weeks as opposed to the months or even years that many managers have experienced using traditional computer systems. These end-user systems request from the user what outputs are required or what functions need to be performed and then work out the sequence of instructions involved. Such systems were inefficient or infeasible until the cost of computer power for data manipulation was dramatically reduced by the development of microcomputers. DSS stresses man-to-machine interaction as opposed to reliance on written reports.

Given these characteristics of DSS, there are two potential development levels for such systems:

1. Macro development (industrywide development) focuses on activities that are similar among transit agencies and makes use of software that can be readily used by managers in different agencies; we call these portable systems;
2. Micro development (agency-specific) focuses on those activities that are distinctive to an organization, so that local development of DSS is needed; this can be thought of as a complementary development process.

In the next section a case study of the Cairo Transport Authority (CTA) will be presented to demonstrate the application of DSS at the micro level. The following section will then highlight the issues of development at the industrywide level.

CTA: A CASE STUDY

This section is intended to show the general approach to developing a DSS in a transit organization, the level of technology needed for the development of DSS, and the potential role of microcomputer-based DSS. The DSS approach was applied in CTA, the major provider of public transportation for the approximately 9 million inhabitants of Cairo. The management of such a large organization is of course an extremely difficult problem. Routines and procedures have developed over time as part of a rigid hierarchical structure with overemphasis on information processing, which is often redundant and unproductive. Analysis of such an organization requires a clear differentiation between management's need for information and the means by which this information can be provided, given a limited data base. These means include the techniques, the technology, and the resources that are currently used and those that should be used in the future.

One of the first tasks in this study was to identify which areas were the best candidates for initial DSS development. High-level management identified three principal functional sectors of the organization that should receive attention: the service-planning sector, the maintenance sector, and the financial sector. Applying the approach outlined earlier in this paper, the study was structured in the following stages:

Stage 1: An analysis of the Cairo Transport Authority was conducted examining three different aspects: (a) organization structure, (b) activities and decisions, and (c) information needs, uses, and sources. The first step necessary in developing a DSS was the identification of the decisions made in specific sectors and the type of information collected to support decisionmaking. The results of this analysis are shown in Table 3. Based on this analysis, a more detailed examination of the service-planning sector and its data needs was undertaken to develop the necessary tools that could then be transferred to other sectors. In this regard,

Table 3. Classification of existing and prescribed functional activities at CTA.

Level of Activity	Strategic Planning	Management Control	Operational Control
Existing Activities			
Structured		Counting	Scheduling Payroll
Semi-structured		Bus allocation Network planning System control Statistical analysis/routines	Inventory control
Unstructured		Fare alteration Setting performance standards for vehicles and labor Capital allocation	Preventive maintenance
Prescribed Activities			
Structured	Facility planning	Bus allocation model Budget analysis	Scheduling Counting Preventive maintenance Fuel and oil consumption Inventory control Incentive routines Payroll Revenue reporting cost recording
Semi-structured	Training Capital investment and life-cycle cost analysis	Performance indicators Network planning Fare determination Labor/parts use Labor/parts distribution Vehicle availability Repair and maintenance policy	Auditing Cash management
Unstructured	R&D Sparing policy (due to uncontrollable factors)	Hiring managers or personnel	

from a strategic point of view, it was important to show some improvement in CTA operations to maintain a good working relationship with CTA officials.

Stage 2: The process of describing the existing decisionmaking structure in CTA was useful in immediately suggesting problem areas. Meetings were held with high-level CTA officials to reclassify existing functional activities to improve effectiveness and efficiency. The results of these discussions are also shown in Table 3, which suggests a reasonable set of service-planning activities for the future. This framework was very important in guiding the development of the DSS for CTA, especially in deciding where the initial effort should be made.

Stage 3: A major task was a detailed analysis of the forms and procedures used in the service-planning sector. This analysis resulted in (a) identification of the basic items required to support the sector's activities and (b) work-simplification recommendations that reduced the number of forms used within the sector from 83 (before the study) to 31 (after the study).

Stage 4: A new data-collection program was proposed based on a special characteristic of CTA: the use of two-man crews with conductors issuing tickets. By making minor changes to the ticketing procedure, a solid data base would be available at almost no additional cost. The resulting data base forms a current, reliable, and effective base on which to build most of the decisionmaking activities in this sector. Microcomputers were recommended as the technology for simple processing of the raw data.

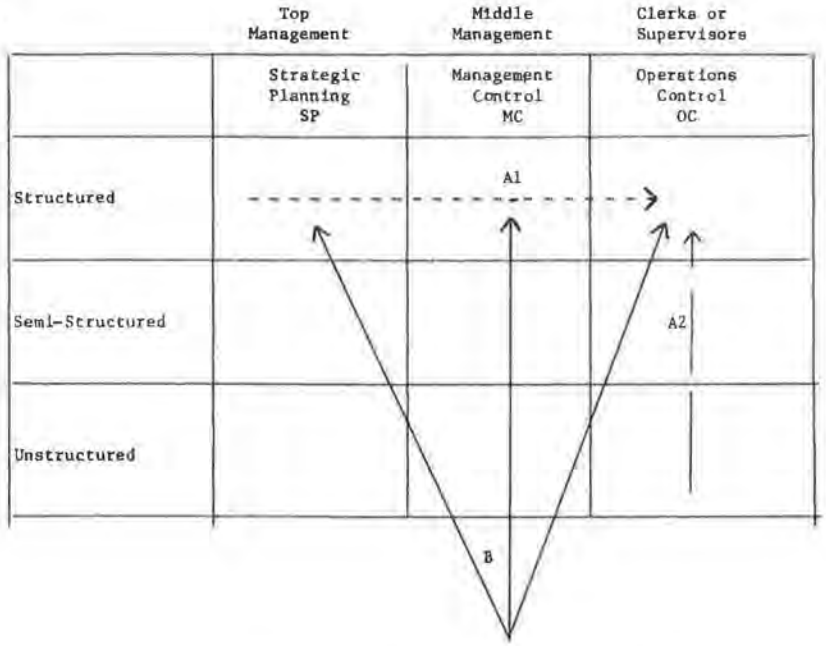
Stage 5: A similar approach is now being used to analyze both the maintenance and financial sectors. The initial analysis of CTA and top management needs showed that the priority activities in the maintenance sector were inventory management, preventive maintenance, and vehicle availability. In the financial sector the focus will be on providing tools for financial planning and control.

Stage 6: A prototype microcomputer-based DSS is currently being developed, which will be the basis for the evolution of the DSS for CTA.

The development of the DSS for CTA, carried out incrementally and interactively, included two phases in the development process: the predesign cycle and the design cycle. The predesign cycle involved the definition of the organizational structure, authority, and power; the degree of commitment; and priorities for development. A clear statement of CTA goals and objectives, resources available, and existing constraints was developed. In addition, each decision process was analyzed to determine type of decision, decisionmaker, the controllable and uncontrollable variables, and the relationship with other decisions. The DSS development process is illustrated in Figure 1, which shows two types of changes occurring. Type A, shifting or reclassifying existing functions, includes A1, transferring existing functions from the management-control level to the operations-control level, thus improving the efficiency of top and middle management through time savings at higher management levels; and A2, making existing unstructured or semistructured functions structured to improve efficiency (for example, preventive maintenance). Type-B changes involve introducing new management functions. Examination of Table 3 shows a lack of strategic-planning functions among the existing activities, as well as other essential management-control and operations-control functions, for example, sampling programs at the latter level. On the strategic-planning level, functional activities including capital investment analysis, life-cycle cost analysis, and facility planning should be introduced. In other words, new functions are introduced at both the semistructured and structured levels and existing functions are reclassified at the strategic-planning, management-control, and operations-control levels.

This process leads to a set of potential changes in CTA management activities (they will be referred to as projects), which can then be evaluated and ranked according to a defined priority scheme.

Figure 1. DSS development map.



After specific projects have been selected, the next step is to make operational the design objectives by defining the data base, the data management software, and the hardware for each area. In the case of CTA, microcomputer technology was selected for implementation of the DSS for the following reasons:

1. Low cost: large computers require a large investment for an organization. In Egypt, this problem is more severe due to the lack of foreign exchange. Microcomputers significantly reduce the cost of using computers.
2. Quick delivery: the lead time to acquire hardware and implement software is usually weeks as opposed to months or even years in the case of the large-computer/MIS approach.
3. Skills: less reliance on the highly technical skills required for large-computer installations, since the microcomputer is designed to be used by managers within each functional area. The ease of use, simplicity, and response to the user needs are the key benefits for use.
4. Learning: Microcomputer-based DSS provide a learning medium in which professionals learn about new techniques and tools that can improve their activities. In addition, they can learn more about their own evolving needs.

The development strategy adopted was based on an initial prototype system, to which the user can react and from which the user can learn to participate effectively in the development of the functional systems. The idea here is to start quickly and to modify the system according to the user's requirements and needs rather than to try to give the user everything at once. With this development strategy, stress must be placed on the user-machine learning process and the facilities of dialogue (in this case in Arabic) between the user and the machine. Here, one should recognize the difference in training required for a DSS compared with that for an MIS; in DSS, the initial user training should be of the order of hours for a high school graduate compared with days or weeks for MIS training.

ASSESSMENT OF DSS IN TRANSIT AGENCIES: INDUSTRY PERSPECTIVE

In previous sections, we have shown (a) the current lack of computer support for transit-management decisionmaking (Proposition 1) and (b) the potential for DSS in transit agencies as illustrated by the CTA case study (Proposition 2). In order to assess the feasibility of DSS for industrywide applications, it now may be useful to consider the technological dimension. This complements the management view of Proposition 1 and expands on the experience gained from the CTA case to the industrywide level.

The current use of computers in transit, as reported in the APTA survey, is shown in Table 4 (7). This summary shows the type of computer used by operators of different size: small, medium, large, and very large. Computers are classified according to whether they belong to a service bureau or are in house. In addition, in-house computers are classified as microcomputers, minicomputers, or large computers.

Table 4 shows the following situations:

1. Only 25 percent of small operators have an in-house computer;
2. About 33 percent of small operators rely on outside services;
3. The dependence on outside computer services is inversely proportional to the size of the operator;
4. The availability of in-house computers is programmed to the size of operator, and large operators often have more than one computer; and
5. Microcomputers are used by only 3 percent of the operators in the industry, and large computers represent 67 percent of all computers used in the industry.

These survey results suggest the following conclusions on current use of computers in the industry:

1. Computers are still used mainly by larger agencies--those that can afford their high cost and risk.
2. Transit officials seem to feel that computer systems require large capital investments, rely on scarce and expensive technical specialists, require long development time for information systems that are mostly "number crunching" (recall that more than 50 percent of the transit operator's use of computers centered around four activities--payroll,

Table 4. Computer use by transit operators.

	Size of Operator									
	Small (N = 24)		Medium (N = 22)		Large (N = 17)		Very Large (N = 19)		Total (N = 82)	
Type of Use	Percent	No.	Percent	No.	Percent	No.	Percent	No.	Percent	No.
Service bureau	33	8	23	5	18	3	5	1	21	17
In house	25	6	86	19	76	13	100	29	82	67
Microcomputer		-		1		-		1	3	2
Minicomputer		4		13		1		2	30	20
Large computer		2		5		12		26	67	45

Note: Some operators have more than one computer, whereas others make use of service bureaus as well as in-house computers.

accounts payable, ledger, and fleet preventive maintenance).

3. There seems to have been an overemphasis on technical issues, which results in systems that are hard to use, unrealistic, or inflexible.

Examining the recent technological developments, however, we find that technology is changing fast and there is dramatic price-performance improvement in computer technology.

Recent developments now make it possible to solve the problems identified by the APTA survey. Small-scale desk-top computers in the \$300-\$9000 range (U.S. prices, mid-1981) provide more than enough computer power, speed, and capacity to meet most of the needs of decisionmakers. End-user languages allow flexible systems to be developed very quickly and without relying on technical staff. DSS provide proved methods for developing simple, useful, responsive, and flexible interactive computer aids that meet the needs of decisionmakers, leverage their skills, and mesh with the way they think.

Together, these tools add up to a cost-effective, low-risk strategy at both the transit-agency and industry levels. Thus, the third proposition with which we began, that microcomputers and end-user languages have reached a level of technological development that provides for their economic use in DSS, is shown to hold. The microcomputer technology provided highly suitable application at the CTA and would seem to offer low-cost/low-risk application in DSS in U.S. transit agencies.

SUMMARY AND CONCLUSIONS

The potential development of microcomputer-based DSS in U.S. transit agencies has been examined. A framework for transit management was presented to identify the key activities in the main functional areas in a transit agency (service and operations planning, maintenance, finance, and marketing) and classify each activity as strategic planning, management control, or operational control and also according to its degree of structure.

Based on this framework for transit management, the DSS approach was introduced as distinct from other traditional computer applications. This approach has a high potential in the industry, especially combined with the use of the microbased technology. This statement is supported by the survey of computer use in the U.S. transit industry by APTA in 1980 and a case study of the Metropolitan Transport Authority in Cairo, Egypt. This development is possible at two levels, macrodevelopment (industrywide development) and microdevelopment (agency-specific), which are complementary to each other.

The survey of current use of computers has shown that transit agencies still rely on traditional use of both computer technology, i.e., large computers or minicomputers, and application areas, i.e., structured tasks, such as payroll and general ledger. It shows that there is little use of computers in the semistructured activities where managerial interaction and judgment are key, such as service and operational planning, financial planning, etc. This indicates that there is strong potential in the combination of microcomputers and end-user software on the one hand and DSS on the other hand to provide portable low-cost applications.

In short, we have shown an approach that can be applied to industrywide development or to transit-agency development or to both. The case study also shows that there is a potential use of this approach in developing countries. However, this paper provides only the nucleus on which further research should be conducted to identify the DSS activities that can be easily transferable and to quantify the cost effectiveness of this approach.

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