95

NATIONAL COOPERATIVE HIGHWAY RESEARCH PROGRAM
SYNTHESIS OF HIGHWAY PRACTICE

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STATEWIDE TRANSPORTATION PLANNING

TRANSPORTATION RESEARCH BOARD
NATIONAL RESEARCH COUNCIL

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STATEWIDE TRANSPORTATION PLANNING

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TRANSPORTATION RESEARCH BOARD
NATIONAL RESEARCH COUNCIL
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NATIONAL COOPERATIVE HIGHWAY RESEARCH PROGRAM

Systematic, well-designed research provides the most effective approach to the solution of many problems facing highway administrators and engineers. Often, highway problems are of local interest and can best be studied by highway departments individually or in cooperation with their state universities and others. However, the accelerating growth of highway transportation develops increasingly complex problems of wide interest to highway authorities. These problems are best studied through a coordinated program of cooperative research.

In recognition of these needs, the highway administrators of the American Association of State Highway and Transportation Officials initiated in 1962 an objective national highway research program employing modern scientific techniques. This program is supported on a continuing basis by funds from participating member states of the Association and it receives the full cooperation and support of the Federal Highway Administration, United States Department of Transportation.

The Transportation Research Board of the National Research Council was requested by the Association to administer the research program because of the Board's recognized objectivity and understanding of modern research practices. The Board is uniquely suited for this purpose as: it maintains an extensive committee structure from which authorities on any highway transportation subject may be drawn; it possesses avenues of communications and cooperation with federal, state, and local governmental agencies, universities, and industry; its relationship to its parent organization, the National Academy of Sciences, a private, nonprofit institution, is an insurance of objectivity; it maintains a full-time research correlation staff of specialists in highway transportation matters to bring the findings of research directly to those who are in a position to use them.

The program is developed on the basis of research needs identified by chief administrators of the highway and transportation departments and by committees of AASHTO. Each year, specific areas of research needs to be included in the program are proposed to the Academy and the Board by the American Association of State Highway and Transportation Officials. Research projects to fulfill these needs are defined by the Board, and qualified research agencies are selected from those that have submitted proposals. Administration and surveillance of research contracts are the responsibilities of the Academy and its Transportation Research Board.

The needs for highway research are many, and the National Cooperative Highway Research Program can make significant contributions to the solution of highway transportation problems of mutual concern to many responsible groups. The program, however, is intended to complement rather than to substitute for or duplicate other highway research programs.

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PREFACE

A vast storehouse of information exists on nearly every subject of concern to highway administrators and engineers. Much of this information has resulted from both research and the successful application of solutions to the problems faced by practitioners in their daily work. Because previously there has been no systematic means for compiling such useful information and making it available to the entire highway community, the American Association of State Highway and Transportation Officials has, through the mechanism ot the National Cooperative Highway Research Program, authorized the Transportation Research Board to undertake a continuing project to search out and synthesize useful knowledge from all available sources and to prepare documented reports on current practices in the subject areas of concern.

This synthesis series reports on various practices, making specific recommendations where appropriate but without the detailed directions usually found in handbooks or design manuals. Nonetheless, these documents can serve similar purposes, for each is a compendium of the best knowledge available on those measures found to be the most successful in resolving specific problems. The extent to which these reports are useful will be tempered by the user's knowledge and experience in the particular problem area.

FOREWORD

By Staff
Transportation
Research Board

This synthesis will be of special interest to transportation planners and others concerned with the rapidly changing nature of the planning process. Detailed discussion is included on various practices in the management and execution of the transportation planning function.

Administrators, engineers, and researchers are continually faced with highway problems on which much information exists, either in the form of reports or in terms of undocumented experience and practice. Unfortunately, this information often is scattered and unevaluated, and, as a consequence, in seeking solutions, full information on what has been learned about a problem frequently is not assembled. Costly research findings may go unused, valuable experience may be overlooked, and full consideration may not be given to available practices for solving or alleviating the problem. In an effort to correct this situation, a continuing NCHRP project, carried out by the Transportation Research Board as the research agency, has the objective of reporting on common highway problems and synthesizing available information. The synthesis reports from this endeavor constitute an NCHRP publication series in which various forms of relevant information are assembled into single, concise documents pertaining to specific highway problems or sets of closely related problems.

The relatively new technology of statewide transportation planning continues to change rapidly in response to new problems, new solutions, and new tools for data management and computation. This report of the Transportation Research Board contains information on the current state of practice and includes examples of good procedures in the planning process and its management.

To develop this synthesis in a comprehensive manner and to ensure inclusion of significant knowledge, the Board analyzed available information assembled from numerous sources, including a large number of state highway and transportation departments. A topic panel of experts in the subject area was established to guide the researcher in organizing and evaluating the collected data, and to review the final synthesis report.

This synthesis is an immediately useful document that records practices that were acceptable within the limitations of the knowledge available at the time of its preparation. As the processes of advancement continue, new knowledge can be expected to be added to that now at hand.

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Special appreciation is expressed to Roger Creighton, Roger Creighton Associates, Inc., who was responsible for the collection of the data and the preparation of the report.

Valuable assistance in the preparation of this synthesis was provided by the Topic Panel, consisting of Ann Barkley, Chief, Transportation Planning Division, California Department of Transportation; Arne L. Gausmann, Director, Bureau of System Planning, Wisconsin Department of Transportation; Robert C. Kirk, State Transportation Planning Engineer, Georgia Department of Transportation; Isaac Shafran, Manager, Plan Development, Maryland Department of Transportation; Thomas Weeks, Community Planner, Office of Highway Planning, Federal Highway Administration; and Phillip L. Wilson, State Planning Engineer—Transportation, Texas State Department of Highways and Public Transportation.

James A. Scott, Transportation Planner, Transportation Research Board, assisted the NCHRP Project 20-5 Staff and the Topic Panel.

Information on current practice was provided by many highway and transportation agencies. Their cooperation and assistance were most helpful.

STATEWIDE TRANSPORTATION PLANNING

SUMMARY

Multimodal statewide transportation planning dates mainly from the mid-1960's, when the first state departments of transportation were formed. Today there is rapid change taking place as the DOT's face 10 basic issues: (a) a lower level of financial resources, (b) completion of the Interstate system, (c) decreased growth of vehicle miles of travel, (d) changes in national transportation regulation policy, (e) increased volume of foreign trade, (f) higher energy costs, (g) minimization of total distribution costs, (h) new technology, (i) concern for quality of life, and (j) enhancement of a state's economy.

Reactions by state DOT's to these issues have caused changes in the work of their planning staffs; therefore, a new framework for managing statewide transportation planning is suggested here. The framework consists of two parts: technical (or substantive) and management. The framework recognizes that the day-to-day work of policy planning, communication, programming, and monitoring is a form of planning. The two parts are not independent—management cannot function without the technical content because the "what" and "how" of transportation affect policies and programs; technicians must be attuned to needs of decision makers and to financial realities.

There is a trend among transportation agencies toward the use of computers by which data can be accessed from terminals throughout the agency. This creates a new relationship between the analyst and the data, allowing improved estimates of financial resources, improved estimates of the roads that need rehabilitation and of the costs of alternative maintenance/rehabilitation strategies, and increased staff productivity.

The management side of statewide transportation planning is the area in which some of the greatest changes and improvements have been made in recent years. The synthesis presents examples of good practice by various agencies in strategic planning, estimating financial resources, regulation, communications, productivity, energy, and environment.

On the substantive (or technical) side, there are no strong trends or new techniques. The synthesis gives examples of good practice for planning highways, intercity and rural buses, railroads, freight, waterways and ports, aviation, and pipelines. Recent statewide transportation plans are giving more attention to financial policy, communications, and project scheduling; two examples of good statewide transportation plans are presented here.

The future of statewide transportation planning is difficult to predict; however, the following trends appear likely;

- There will be a continuing movement to increase staff productivity through standardization of procedures, use of larger-scale word processing equipment and microcomputers, and computer management and storage of basic data.

- There will be increasing storage of data in accessible computer files that will be more coordinated so that management can be aware of, for example, road conditions, plans, and construction stages.
- Methods and procedures will be devised for transportation agencies to measure both their accomplishments and the condition and performance of all transportation systems in a state.
- Publication of the statewide transportation plan will become a regular activity.

CHAPTER ONE

INTRODUCTION

Although statewide highway planning has existed for at least 50 years, the field of comprehensive, multimodal statewide transportation planning dates from the mid-1960's, when the first state departments of transportation were formed. Many changes in statewide transportation planning have taken place during the past 15 years, with the rate of change being the most rapid in the past 5 years. These changes have occurred as the result of new issues, new perceptions as to appropriate planning responses, and strong new technical and computer capabilities for the comprehension and management of data.

The changes that have taken place—and will surely continue in the next few years—strongly affect the relationship between the chief administrative officer (CAO) of a state transportation agency and the planning staff. In the past planning was, in many cases, an off-line activity devoted primarily to the development of system plans; however, information obtained during the preparation of this report indicates that the lines between planning and management are becoming blurred. Increasingly, planning staffs are becoming management staffs, engaged in those kinds of duties that directly assist the executive.

PURPOSE OF SYNTHESIS

The practice of statewide transportation planning, and perhaps the perception of its role, has changed substantially since the last synthesis report on this topic was published in 1972 (*1*) when comprehensive, multimodal planning was in its infancy. The present synthesis was undertaken in response to the need for a new report on the state of the art in this field.

After an examination of existing literature, a request was sent to 43 state transportation agencies for reports or technical papers on examples of "good practice" in the field of statewide transportation planning. Replies were received from more than 20 states. The transportation agencies of seven states (Arizona, California, Georgia, Iowa, Michigan, New York and Texas) were visited. Extensive field notes and published materials were obtained in each state and assembled for this report.

The intent of this report is to portray good practice (not theoretical possibilities) in the various subject areas. The selection of the examples of "good practice," the citation of specific reports, and the listings in the Bibliography section do not mean that there may not be other examples or reports that are equal to or superior than the ones cited.

ISSUES OF CONCERN TO STATE DOT'S

Visits to the seven states and the review of recent publications provided evidence that there are 10 basic issues facing state transportation agencies today. These issues, or problems, which are discussed below, have major impact on state transportation programs and, for that reason, on the subject matter that planning staffs will be expected to address. For additional information, see *TRB Special Report 189* (*2*); *NCHRP Report 177* (*3*, Tables A-7–A-12); *NCHRP Report 178* (*4*, Tables 3–8); and *NCHRP Report 199* (*5*).

Lower Level of Financial Resources

Three factors contribute to the lower level of financial resources available for transportation. First, inflation has eaten into the real purchasing power of the transportation dollar at rates considerably higher than the consumer price index. This factor has been highlighted in a number of published state transportation plans (*6–9*). Second, revenues available for transportation purposes have not increased at historic rates due to lower fuel consumption resulting from public response to higher fuel costs and higher vehicle purchase costs and from the increased fuel efficiency of automobiles. Third, there has been a general public reaction against increases in governmental spending, as exemplified by California's Proposition 13 and Massachusett's Proposition 2½. This has resulted in legislative caution concerning spending and increased taxes.

These factors have affected state transportation agencies, with the result that much greater attention is being paid to planning and the management of available resources.

Near-Completion of the Interstate System; Reductions in Other Major Transportation Systems

As of December 1981, only 5 percent of the basic Interstate system remained to be opened (*10*). Also, the impetus for the extension of other major highway systems (new center-line miles) has been greatly reduced by the slower growth rate of vehicle miles of travel (VMT) (except perhaps in the southern and western states). Several states (e.g., Iowa and Michigan) are considering closing some roads as an economy move, but these are primarily local, land-service roads.

The railroad system in the United States is steadily contracting. From a high of approximately 250,000 miles (402 000 km) in 1912, the rail network declined to 195,000 miles (314 000 km) in 1978 and is continuing to decline (*11*, *12*).

With the rise in fuel costs and with deregulation, the nation's commercial passenger aviation system has undergone radical changes in service levels. Fewer airports are served by major airlines and regional carriers; third-level carriers have entered the market to serve smaller cities, but their financial performance is uneven as witnessed by bankrupt-

cies or withdrawals from the market. This has been a matter of concern to many states.

There are, of course, significant differences in the rates and nature of these changes among the various regions of the United States. Generally, the most severe reductions have occurred in the northern and eastern states.

The implications of these changes for state transportation agencies and their planning programs are clear. More attention is being focused on the management of existing systems through maintenance, rehabilitation, and bridge replacement. Little attention is being given to the planning of future systems (*2*). Efforts are being expended to ease the adjustment impacts of reductions in rail and air service. Finally, with less attention being paid to the planning of new systems (or major new corridors), greater time can be devoted to improving available planning and management methodology. In some cases, this has led to sophisticated methodologies (see Examples 7–9); in other cases, the result has simply been more accurate, comprehensive and faster work.

Decreased VMT Growth Rates

The causes of slower rates of growth of vehicle miles of travel (VMT) are primarily economic. Transportation costs (fuel, vehicle purchase, repair costs, and all operating costs) have risen to a point where they are seen by the general public as a significant component of the family budget. In addition, there is the impact of a sluggish U.S. economy.

This issue is of greater concern to the northern states where, along with a constant or declining population, revenues are severely affected. In states where population is growing, VMT will continue to increase with population, although perhaps not as fast as in the past. Factors that complicate forecasting VMT rates of change include age of the population, urban versus rural growth rates, and the changing size of automobiles.

Changes in National Policy: Less Intervention or Control of Private Transportation Firms

Whether the United States has crossed permanently into a new watershed of decreased regulation of private transportation companies is not clear. However, it must be recognized that transportation deregulation has been the policy of two administrations. Deregulation has probably been necessary in order to allow technological, economic, and organizational adaptations to occur that otherwise would have been stifled, with resultant increases in transportation cost.

It is difficult to forecast the ultimate implications of deregulation for state transportation agencies. There could be less control over events; however, the real strength of the states in the past is an unknown. Certainly state transportation agencies will have to maintain a greater level of awareness of events in the private transportation sector, because these events may occur at a faster rate and because the impact of transportation changes on each state's economy (which the transportation agency must protect) may be profound. Finally, state transportation agencies will have to be inventive in their responses to changes in service levels.

Increased Volume of Foreign Trade

This country's foreign trade volumes have increased dramatically in the past decade (*13*). The result of this increased volume of freight movement is a greater need for improved ports, inland waterways, and interconnections among ports, rail systems, and highway systems. Such improvements need to be planned with careful attention to the economy of the investment as well as to the design of physical linkages and their capacity requirements.

Higher Energy Costs

Higher energy costs are a root cause of inflation, of higher transport costs paid by individuals and firms, and of reductions in automobile size. Higher energy costs have also encouraged increased fuel efficiency, which in turn has reduced state fuel tax receipts.

Given current price fluctuations, it is almost impossible to predict whether prices will continue to rise or whether they will stabilize or even decline. However, the conservative transportation planner will likely count on long-term price increases.

Additional implications of high energy costs for state transportation agencies fall into two categories: concern for energy used by the traveling public, and concern for energy used by internal operations of state transportation agencies including construction energy. Public energy consumption can be reduced through continued efforts to reduce waste in travel by means of various fine-tuning measures. Reduction of energy used by internal operations of transportation agencies is primarily a matter of careful management; however, some planning staffs are getting into this field (*14*, *15*).

Adaptation of Private/Public Enterprise Systems to Minimize Total Physical Distribution Costs

With the expansion of communications and computing capabilities, along with generally larger private firms, there is increasing concern with overall physical distribution costs (i.e., the total transportation, storage, capital, and interest costs) and with the need to minimize the total cost.

For example, the total cost of the production of grain, transportation by truck to either local or regional elevators, storage at the elevators, and subsequent transportation to ports or market by rail or barge has been studied (Example 20). The use of different sizes of storage elevators, which affects the use of unit trains with lower rates, is an important factor in total physical distribution costs, and the costs of building those elevators can be factored into the equations.

This type of concern can expand either with the increasing size of the firm, or as a result of recognition that *systems* of enterprises exist (combinations, for example, of farms, railroads, grain storage companies, and international shippers) that, in fact, work together.

State transportation agencies will probably have to extend their studies and knowledge beyond transportation into these larger systems. They will also have to collaborate more

closely with other departments of state government, such as agriculture and economic development.

New Technology

New technology in transportation is rarely the result of a major breakthrough, but rather is gradually developed as older equipment is replaced and new equipment is proven and phased into existing systems. The new technology includes adaptations of equipment (e.g., the wide-body jet), and not just the technological development itself (e.g., the fan-jet engine).

The new technology currently includes: (a) the small, light, fuel-efficient automobile; (b) the tandem trailer on the Interstate system; (c) the wide-body jet; (d) new aircraft being designed specifically for commuter airlines (*16*); (e) trailer and container systems (rail, ship, barge); and (f) communications substitutes for the transportation of people.

The implications of the new technology for states include (a) shifts in the locations of economic activity as accessibility changes for different sizes of urban areas; (b) decreased revenues from fuel sales; (c) increased wear on all highway systems caused by more and heavier trucks; and (d) changes in demand for rail transportation according to distance, commodity, and size of shipment. All these changes are slow and subtle and must be monitored with care.

Continued Concern for the Quality of Life and the Environment

Although the more frantic period of the environmental movement may have passed, there remains a solid concern for the environment that is built into a body of laws and regulations. Furthermore, it is possible to discern through census figures a decrease in growth rates for large metropolitan areas and a movement toward small communities and rural areas. In part, these changes have been hastened by the recent extraordinary rise in housing costs and rents in the largest urban areas (*personal communication*, A. Barkley, California Department of Transportation) and by other factors such as downtown congestion and perceptions of personal safety. High-speed automobile transportation, excellent telephone communications, and the reduced costs of certain services (such as computers and word-processing equipment) make it possible for more people to function effectively away from large urban cores.

At present, these forces are unlikely to have significant impacts. However, transportation agencies must become increasingly sophisticated and efficient in dealing with these concerns, and more imaginative in proposing solutions that, in details as well as in broad outline, respond to the high levels of public expectation. The current low level of major new road construction should give transportation agencies greater opportunity to improve their techniques in this area.

Enhancing the State's Economy; Understanding of Population, Geographic, and Economic Forces

A continued and extremely important background issue is the support and expansion of each state's economy. Included in this issue is the need to understand the demographic, geographic, and economic forces that are at work in each state, and how these forces relate to a state's transportation system.

In general, transportation accessibility (time, cost, convenience, reliability, and safety) affects decisions regarding the location of economic enterprises. However, the exact extent of these impacts is difficult to determine. Nontransportation factors (higher metropolitan housing costs, perceptions of personal safety, desire for the "good life," availability of labor) also profoundly affect intrastate location of demographic and economic activity.

State transportation agencies must understand and anticipate, to the extent feasible, these forces in order to maintain and possibly expand the state's economy.

IMPACT OF ISSUES ON STATE DOT PROGRAMS AND ON PLANNING STAFFS

What will be the impacts of the issues described above on state transportation agencies? How will the work load and functions of transportation agency planning staffs be affected? What new skills will have to be developed by planning, or management and planning, staffs to respond to the needs of top management?

These questions are initially addressed by the relationships diagrammed in Figure 1. The 10 basic issues described above are listed in the first column. The typical responses of state transportation agencies, which are more or less forced by events, are listed in the second column. In the third column are the responses that will be required by planning staffs in order to inform decision makers (administrative or legislative) on available options or to warn them of the severity of impending issues.

That state transportation agency planning staffs are, in fact, making the responses listed in Figure 1 can be verified by an examination of the examples of good practice that were identified during the preparation of this report. In effect, Figure 1 shows what is happening currently, although it is a summation of examples of good practice and not average practice in all states.

The expected impacts of current issues on state planning staffs can be summarized as follows:

- More attention will be given to communications with the CAO and with the public, the legislature, and local governments. These communications must be both timely and relevant to review and decision making.
- Increased staff work will be required for financial policy planning, programming, and critical examination of year-to-year performance of all modes.
- More attention will be given to business and management problems.
- Less attention will be given to system planning, at least in the "classical" 3-C approach.
- Planning will become increasingly multimodal instead of being restricted to traditional modes.
- More effective and responsive tools in most of the modal planning areas will be needed.
- Project planning will become more streamlined to deal

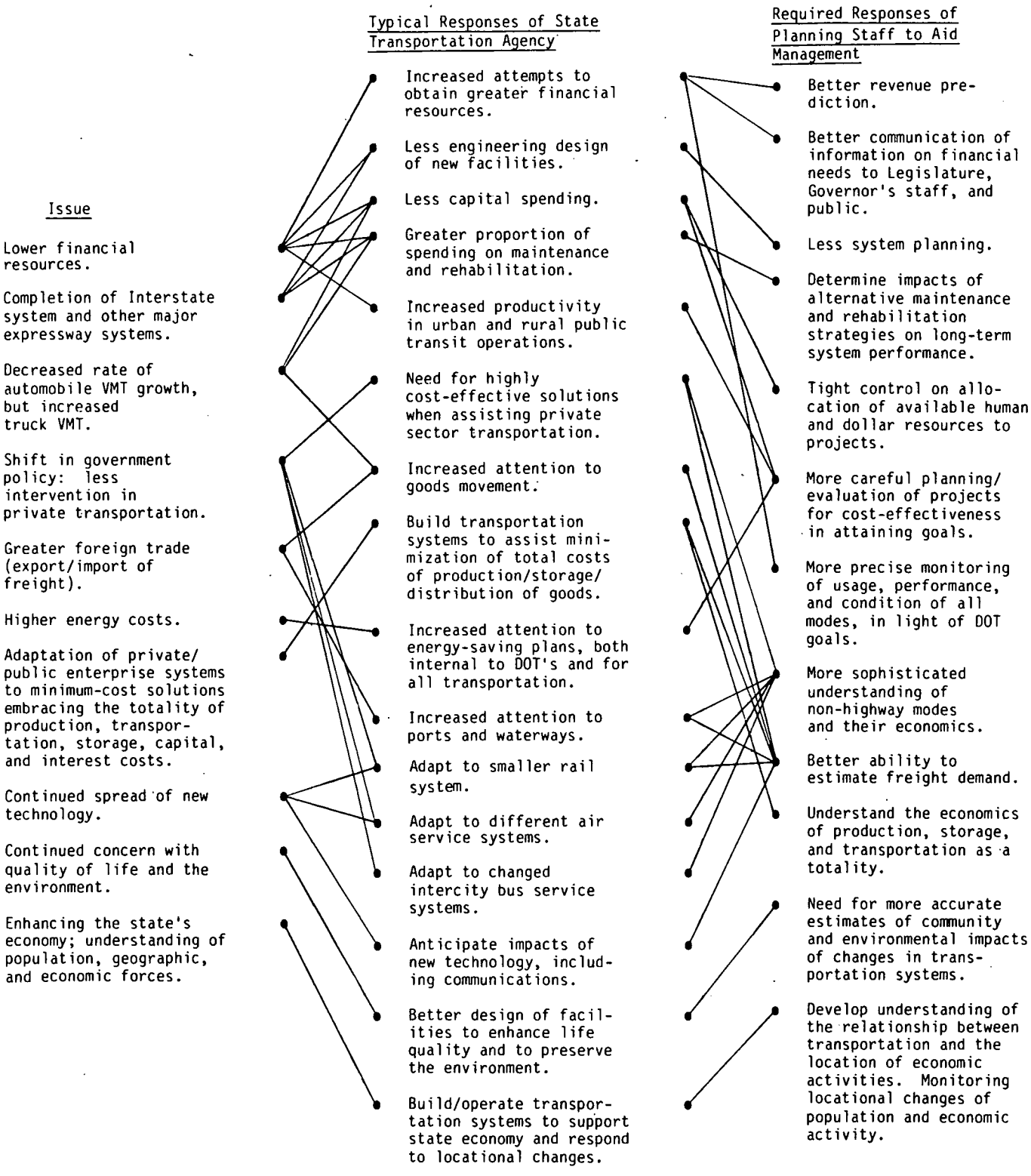


FIGURE 1 Potential impact of current issues on state DOT programs and on requirements for planning.

more effectively and quickly with environmental and community impact issues.

- Work with private transportation systems will continue, for movement of both persons and goods. This will require increased understanding of these modes and of the ways the economy of a state can be affected. Public investments will continue to be needed to cushion the impacts of changes and to improve/coordinate the operations of all systems, but these investments will have to be made with more careful attention to their economic worth. This planning will continue to be an intermodal activity, with engineering economics a major factor.
- Planning will become more sensitive to the impact of transportation (all modes) on the economy of each state.

Some of the impacts listed above are new (for example, the greater emphasis on business and management), but some are simply heightened demands for activities with which planning staffs are already familiar (for example, modal planning or communication with administrators and legislators). The pressures will fall on staffs that most likely are static or shrinking in size. Hence there is a real need for methods to increase planning productivity; fortunately this is occurring at a time when there has been a major increase in on-line computer capability.

Planning staffs will have to adapt their operations in a number of areas. Based on what is occurring in several states (including Arizona, California, Iowa, Michigan, and Texas) the following adaptations will be necessary.

- Management methods will have to be applied to planning operations.
- Data bases will have to be more accessible, and, in some cases, greatly expanded.
- Communication with decision makers will have to be both more timely and continuous.
- Wherever possible, paper work must be replaced by automated computer processes.
- Much more attention must be given to economics as a factor in decision making.
- Standardized procedures must replace individual, hand techniques.
- Increased budgets will be needed for both EDP and data-collection efforts.

FRAMEWORK FOR MANAGING STATEWIDE TRANSPORTATION PLANNING

The framework suggested here is intended to be helpful to the head of a state transportation agency and to the director of planning in a state transportation agency. The viewpoint is primarily from the top, or from outside; the purpose is to understand what planning is and what actions should be taken in the new roles created by changing circumstances. In a number of states, such as California and Iowa, planning and management have already come close together. If this is a trend, how should top management view the planning function? What responsibilities should be assigned to planning and what demands placed upon it? These questions can best be answered if there is an organized framework for looking at, and managing, the planning function.

Before discussing the framework, a basic definition of statewide transportation planning is needed. The following definition is modified from an earlier publication (*17*); it should be noted that the definition describes the overall mission of a state transportation agency and hence is not confined to planning.

Definition of Statewide Transportation Planning

Statewide transportation planning may be defined as an activity (or a series of activities) that leads to recommendations for making coordinated changes in construction, investment, management, technological improvement, pricing, subsidy, and regulation with respect to transportation facilities and services of all types, including facilities for the movement of people and goods. The recommended changes are intended to attain a series of goals or to improve performance as measured by a series of criteria, which represent the needs and desires of different groups (for example, those who use transportation facilities, shippers and receivers of goods, suppliers of transportation services) and the public at large. Statewide transportation planning is undertaken by means of an orderly, objective process that is based on measurement, closely integrated with external matters such as the economy, social and political concerns, land use, the environment, natural resources, and energy, for the geographic area of a state, several states, or a region of some other type, for a period that may vary from 10 to 30 years or more.

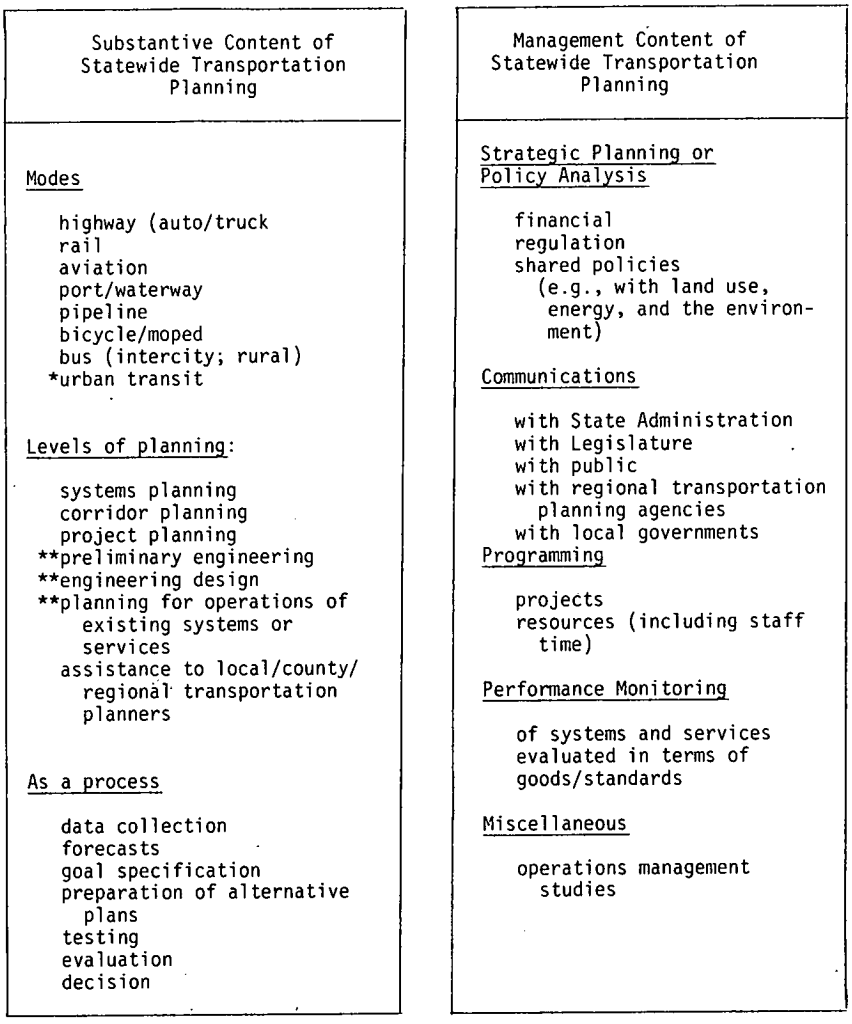
The Framework: Overview

The recommended framework for managing statewide transportation planning is shown in Figure 2. Statewide transportation planning is organized in two parts:

1. *Substantive content.* This deals with the substance of transportation planning: the different modes; their physical and service properties; the way people, vehicles, and freight move over different systems; how well they function; and how they can be improved. In addition to systems planning, corridor planning, and project planning, planning assistance to local governments may be included.
2. *Management content.* This deals with the entire spectrum of procedures for implementation, including decisions on policy and strategy, communications, detailed programming of projects, and monitoring and surveillance of system performance.

The substantive content of statewide transportation planning is a technical activity that too often in the past has proceeded in isolation from the management content. The management content, on the other hand, has highly technical aspects (such as the techniques of estimating financial resources or programming/scheduling of projects), but also demands ability in the persuasive arts. It is quintessential staff work and necessarily involves the closest possible relationship with the head of the state transportation agency who should *use* the planning staff in the development, organization, and articulation of the program.

It cannot be emphasized enough, however, that the substantive and management components of statewide trans-



* In some states, urban transit may be a function of a statewide transportation planning staff, but in most states only the funding levels are critical issues in statewide transportation planning.

** Not functions of transportation agency's planning staff, but part of the total process leading to construction or project implementation.

FIGURE 2 Framework for statewide transportation planning.

portation planning cannot proceed independently of one another. The management content—the "what" and "how" of transportation facilities, services, vehicle flows, trip lengths, and travel requirements, etc.—affects every policy, communication, and program. On the other side, the technical content must be attuned to the needs of decision makers as well as to the financial realities, or else the technicians will be proceeding in splendid but useless isolation.

This particular framework contrasts with the older "linear" concept of statewide transportation planning that prevailed between 1965 and 1977. With that concept the dominant factor was to produce a good technical plan, whether for one mode or all modes, and then to implement it. Implementation, programming, and communication often came *after* the technical work and were treated by planners as subordinate to the process.

The framework described here treats the management content of statewide transportation planning as, at the least, an equal partner. In some states this part may be dominant. It is recognized that the functions of strategic planning or policy analysis, communications, programming, and monitoring/surveillance are, in fact, a form of planning, and certainly deserve the best brains and efforts available. It is clear that some states already are acting along these lines. Their planning staffs have a close relationship with the transportation agency's chief administrative officer, and are conducting their technical/substantive work with an eye on the decisions that must be made. Thus the technical/substantive studies have relevance to the management content.

The close relationship between top management and planning staff appears to occur when both parties recognize the benefits to be obtained—when the chief administrative officer understands that the main job of that office is policy, communication, and programs and that having a good staff to

develop these functions is of paramount importance to success, and when the head planner understands that a close relationship is the best way to get plans implemented and to be informed on the critical issues.

This framework has important implications for (a) the function of the published statewide transportation plan and (b) the functions of an integrated data base that can be constructed to support both the management and the substantive content (these are discussed in Chapters 2 and 3, respectively).

Substantive Content of Statewide Transportation Planning

An adequate body of literature exists on the substantive content of statewide transportation planning. The reader is directed to Creighton (*17*) and *TRB Special Report* (*18*) for information on the modes, the levels at which planning is carried out, and the process(es) by which planning is undertaken.

It is valuable for managers of statewide transportation planning to establish, for their particular state and organization, the particular areas they will be concerned with in substantive planning programs. For example, in some states (particularly the smaller or less populous states), the planning function may be made responsible for planning at a higher level of detail, such as project planning, or for planning for small urban areas. Table 1 can be used as an aid to determine the areas for which the planning function will be responsible. This table may be used as a point of departure for identifying the concerns with the highest priority in a particular state.

Management Content of Statewide Transportation Planning

The management content of statewide transportation planning (see Figure 2) consists of four or (in some states) five components:

- Strategic planning or policy analysis
- Communications
- Programming
- Performance monitoring
- Miscellaneous studies (optional) (e.g., management studies of departmental operations)

Strategic Planning or Policy Analysis

Although the exact definitions of the terms "strategic planning" and "policy analysis" vary within different organizations, there appears to be agreement as to the basic core of the subject matter with which both deal. Different states may include additional items and may have preferences as to whether this activity should fall in the management or the substantive side. However, the term and how the function is structured is less important than an understanding of what is occurring and an appreciation of the inferences that may be drawn from the use of each term.

At the most fundamental level, both strategic planning and policy analysis are concerned with major decisions regarding (*2*):

- Allocation of resources—principally, the amount and distribution of financial resources to and within the transportation sector, but also including broad allocations of human resources (personnel time).
- Regulation—setting the "rules of the game" regarding who does what and under what conditions.
- Institutional arrangements—which government and public corporations have responsibilities for different transportation activities.
- Shared policies—policies that mutually relate transportation to other sectors of the state, such as housing, land use, energy, and the environment.

Possible distinctions between strategic planning and policy analysis may be made, although different states may define these terms in such a way as to erase any distinction. However, it is worthwhile to note the distinctions in order to point out the implications of each term.

The implication of the term "strategic plan" is that it is possible to lay out a kind of grand strategy with respect to financial resources, regulation, institutional arrangements, and policies shared with other sectors of a state that will be followed by a state transportation agency over a considerable period of time. An example of such a document is the Wisconsin State Transportation Policy Plan of January 1980 (*19*). The strategic plan may include some broad descriptions of major transportation systems, and it carries the implication that there is sufficient agreement strategy and sufficient controls that the strategy will, in fact, be carried out.

In contrast, the term "policy analysis" proceeds from a different set of assumptions and thus has a different flavor. Many administrators and planning professionals have long recognized that most policy, strictly speaking, is not planned—that policy is not worked out neatly in abstract terms, or by a series of memoranda, but is, in fact, a body of decisions. These decisions may remain static for fairly long periods or they may change. Such decisions are worked out between a state's governor, its transportation agency, its legislature, other state agencies, and various private interests, including labor unions. The forums in which these decisions are hammered out include state government, the federal government, and the operations of the marketplace (*18*). The methods of decision making include economic and political bargaining.

In both strategic planning and policy analysis, it is essential that there be sound staff work to support the CAO of the state transportation agency in negotiations with and presentations to all the other actors who are playing the decision game. Because the CAO of the state transportation agency generally presents the facts and figures to the legislature and the governor, policy staff work also supports the legislature and the governor. Such staff work may include (*2*): (a) defining a present policy(ies) (see Examples 1–3); (b) articulating goals (*19,20*); (c) proposing alternative policies; (d) estimating impacts of alternative policies; and (e) evaluating impacts.

Whether a state chooses to employ the term "strategic

TABLE 1
CONCERNS OF STATEWIDE TRANSPORTATION PLANNING

Mode	Is Concerned With:	Is Not Directly Concerned With:
Highway	System design in principle for all systems; corridor location for primary and Interstate routes; investment levels (construction and maintenance) by functional class, location and timing (both intra-urban and statewide); safety; user costs; energy usage; environmental effects.	Route location; engineering design; corridors of secondary highways; traffic engineering and control.
Bus	Systems of routes (patterns of service between cities; and inter-line coordination); service levels (headways); generalized terminal location; safety; fare levels; bus size.	Detailed terminal location; scheduling.
Air Passenger and Air Freight	Systems of air routes and airports; generalized airport location; size, and investment; environmental effects; fare levels; airspace use.	Detailed airport location; scheduling; internal operations; safety; air traffic control.
General Aviation	Systems of airports; generalized airport location, size and investment; airspace use; environmental effect.	Detailed airport location; scheduling; internal operations; safety; air traffic control.
Rail Passenger	Rail passenger systems, generalized station locations; fare levels; service levels (headways); subsidies; grade crossing elimination.	Scheduling and operations; safety.
Rail Freight	Extent and design of mainlines and branchlines; investment; terminals, especially trailer- and container-on-flat-car (TOFC/COFC); system speed and pick-up frequency; rail-truck coordination; service to agriculture and industry; grade crossing elimination.	Scheduling and operations; safety.
Truck	TOFC/COFC locations; expressway location; truck size; safety.	Operations; details of TOFC/COFC locations; safety.
Waterways	Investment and maintenance costs; systems as related to rail and highways.	Operations; recreational use.
Ports	Investment; coordination with rail, highway; interport coordination.	Design; management; operations.
Pipelines	Impact on rail, waterways, ports.	Safety; management; operations.
Transit	Levels of capital investment and operating assistance; energy utilization.	System design.

planning" with its implication of greater certainty, support, and continuity, or the term "policy analysis" with its implication of change and bargaining, probably makes little difference, as long as the implications are recognized and a strong analysis of the alternatives is undertaken. (See Chapter 2 for a more detailed discussion of policy.)

Communications

Communications from a transportation agency must extend upward to the governor and his staff and outward to the legislature and the general public. The planning staff, by reason of its constant work both in the substance of modal plans and projects and in the management aspects (e.g., policy analysis and monitoring), is in the best position to supply the materials needed for effective communication (see Example 6).

Programming

The programming or scheduling of projects (all modes) is a well-established activity that is increasingly being supported by computers. Programming may include a variety of subjects, such as: (a) estimation of financial resources; (b) policy; (c) setting priorities; (d) scheduling within constraints (financial, geographic, programmatic, etc.); and (e) reviews and decisions. For more information on this topic, see two previous NCHRP studies (*5, 21*). Also see the discussion of California's PYPSCAN project (Example 7) in Chapter 2, the discussion of two pavement management systems (Examples 14 and 15) in Chapter 3, and *NCHRP Synthesis of Highway Practice 84* (*22*) for implications for improvements in or extensions to the art of programming.

Performance Monitoring

To the extent that a state transportation agency is no longer a *construction* agency but an agency that *manages* transportation systems, its performance is measured not so much in miles of new roads that have been opened to traffic (as was the case in the 1950's through the early 1970's) as in the quality of the service that it renders to the public. The factors involved in service quality include safety, traffic levels of service, pavement condition or ride quality, freight transportation costs, and transit coverage and service levels. These apply both to automobile and truck drivers and to passengers on other modes of transportation. The quality and cost of freight transportation should also be included, because this may affect the economy of a state.

Consequently, performance monitoring of a state's transportation system should be an increasingly important activity for a state transportation agency as it demonstrates financial needs to the public and to the legislature. This type of work is being carried out by a few transportation agencies but not to the extent or with the formality that is expected to be required in the future (for further discussion see Chapter 2).

Miscellaneous Studies

The employment of a planning staff to examine how a DOT conducts certain of its operations is a logical extension of planning through the use of personnel with experience in transportation, operations research, and economics. An example of such use of the planning staff is provided in Iowa, where the transportation agency has had its planners work on the location of maintenance garages, on motor-vehicle enforcement, and on motor-vehicle licensing as an operation (*personal communication*, C. I. MacGillivray, Iowa Department of Transportation).

Use of the planning staff for operations management is not widespread and is certainly an optional activity. However, when qualified persons are on hand within a planning staff, it is common sense to have them draw on their network data, travel times, costs, and similar data and to employ their basic systems and computer skills for the benefit of transportaion agency operations. Unfortunately, no documented information was available on this topic at the time this synthesis was prepared.

Conclusion

It has been suggested here that statewide transportation planning has two interrelated sets of content: one dealing with the substantive aspects of the modes and the other dealing with management. The management content of statewide transportation planning involves the planning staff directly with the chief administrative officer of the state transportation agency; in effect, the planning staff becomes the CAO's principal staff for policy, communications, programming, and performance monitoring. The management content is, however, inseparable from the substantive content.

This organizational framework breaks away from the older, linear concept of statewide transportation planning in which implementation followed the completion of all substantive transportation planning activities and consequently tended to get lost. This framework, if followed, should prevent the isolation of planning staff from management, a phenomenon that has occurred too often in the past.

IMPACT OF CHANGING COMPUTER CAPABILITIES

Most transportation agency executives are familiar with, and many have been "burned" by, the old-style batch-processing computer systems. Those systems, with their extensive tape files, caused substantial problems for users. Data entry was an arduous process; searching for individual records might require the computer to read an entire magnetic tape or a manual search through a thick, hard-copy "bible" of all individual records; and printouts could be delayed a week or a month by the priorities of other work requests to the computer room.

Increasingly, transportation agencies are switching to computers in which the data are stored on magnetic disks or on "disk-packs" (stacks of disks) in which from 5 million to billions of bytes (digits, in effect) of data can be stored and

accessed virtually instantaneously. Access is by terminal (or multiple terminals), which can be placed strategically throughout the transportation agency, including one in the CAO's office, as, for example, is the case in Pennsylvania (*23*). The advantages of these systems are revolutionary:

- Individual records can be examined, altered, added, or deleted without revising the entire file.
- Standard summaries can be obtained whenever needed, either for visual inspection (at the terminal) or in the form of hard copy.
- Files can be interrelated provided geographic or other common identifiers (e.g., project numbering systems) have been built into the system.
- Computer speeds are increased and processing costs lowered.
- A wide range of graphic materials can be produced.

These capabilities create a new relationship between the analyst and the data and the programs. The planner or manager looks at the inputs and then calls for results, which are, basically, instantly available. The intermediate manipulations (which can be extremely time-consuming under either manual or batch-processing modes) are no longer necessary.

Improved computer capability has brought the following advances.

- *Estimate of financial resources*. See Examples 4 and 5 (both from California) in Chapter 2. Beaton et al. (*24*) provide similar examples of good practice in other states. The significance of these models is not their particular formats, but the fact that they are being used *regularly* to estimate resources as a part of policy planning.
- *Maintenance/rehabilitation of highways*. See Examples 14 (Arizona) and 15 (California). Also see Hughes (*25*) for a description of Wisconsin's "deficiency analysis" system. The essential elements of an effective maintenance/rehabilitation planning system include: (a) a complete data base (or adequate sample) for all miles, or lanes, of a highway system; (b) a periodic (biennial or annual) measurement of conditions, entered into the data base; (c) a set of criteria ("distress trigger values" or predictive equations), indicating which miles or lanes need to be rehabilitated and preferably when; and (d) equations or models to estimate costs under alternative maintenance/rehabilitation strategies.
- *Increasing staff productivity*. This activity includes five different techniques: (a) California's Person Year Project Scheduling and Analysis (PYPSCAN) (Example 7); (b) Michigan's Statewide Transportation Modeling System (STMS) (Example 8); (c) the Texas Management Information System (MIS) (Example 9); (d) New York's Centralized Local Accident Surveillance System (CLASS) (Example 10); and (e) Tennessee's Road Information Management System (TRIMS) (Example 11).

The implications of these trends in computer capability are tremendous. There will be less fumbling for information. The care, protection, and constant updating of data will become both less expensive and more important. There will be pressure to extend the record-keeping techniques now possible on state highway systems to all the streets and highways in a state, as is happening with New York DOT's CLASS. Because the data will be good, the need for much more sophisticated and accurate estimating equations (for example, in pavement management) will be greater.

Although the capabilities of the new systems are revolutionary, top management must be aware of the pitfalls. One weakness is incompatibility among computers—even those of the same manufacturer; using incompatible systems will seriously impair the ability of a state transportation agency to coordinate data sets (*26*). A second pitfall is incompatible data reference systems, particularly geographic area systems and road network identifiers. If the data reference systems are incompatible, the files cannot be used together except at great cost (*personal communication,* R. Esch, Michigan Department of Transportation). Finally, there are "turf" problems with respect to computers, programmers, and priorities. Management must be informed and strong to avoid these pitfalls.

CHAPTER TWO

EXAMPLES OF GOOD PRACTICE: THE MANAGEMENT SIDE

Some of the greatest changes and improvements in recent years have been made in the management side of statewide transportation planning.

The management side has gained momentum because the harsh realities of fiscal shortfalls have forced both management and planning staffs into more intensive work. Simultaneously, the new capabilities of interactive computation have provided the means for faster, more detailed, and more comprehensive analyses, particularly for repetitive tasks.

Some of the topics described below will be of use to both the management and the substantive (see Chapter 3) sides of statewide transportation planning [for example Michigan's STMS (Example 8)]. The subject of programming is not discussed in this chapter because it has been recently covered by two NCHRP publications (*5, 22*). Business management studies are not discussed here because sufficient materials were not available.

STRATEGIC PLANNING OR POLICY ANALYSIS (GENERAL)

In Chapter 1, the common elements and distinguishing characteristics of "strategic planning" and "policy analysis" were presented. In the discussion here, the common elements are amplified and the articulation or presentation of policy is reviewed.

Transportation policy deals with four basic areas (*18*):

1. Allocations of resources (human, material, and energy) principally through the control of money. In state government, resources are allocated to modes, programs, and projects by means of budgets, taxation, fuel rationing (in energy contingencies), and pricing of tolls or fares. (Project programming or scheduling is considered here as a support activity, not as a direct part of policy development.)
2. Arrangements of institutions (who does what). Examples include establishment or changes of public corporations, such as port authorities or regional transit agencies, and the creation of new programs, such as ride-sharing and rural public transit.
3. Regulation (establishing the "rules of the game") (*2*). Examples include deregulation as well as regulation and rights to enter or leave the market.
4. Shared policies (decisions that affect how transportation relates to other sectors of a state, including housing, land use, the economy, energy, the spatial distribution of human activities, and the environment).

Generally, transportation policy does not deal with specific physical systems or networks, or with the operations of transportation systems. However, policy must be based on an accurate understanding of the implications for systems and operations; for example, policies of nonmaintenance of highways will quickly result in poor driving conditions.

As noted in Chapter 1, policy is in fact a series of decisions; policy is what is done, not what might be done. As such, policy is set (and changed) by decision makers—the chief executive of a state transportation agency, the governor, the state legislature, the U.S. Congress, the U.S. DOT, various regulatory bodies, and the courts. Private businesses also make policy when they establish rail, air, truck, or bus fares (subject to regulatory review), or decide to ship by truck instead of rail. Clearly, the places where policy is worked out include the "corridors of power" in government and also the economic "marketplaces."

In this setting, policy analysis is the staff work that assists the state transportation agency chief executive or his agents in negotiating with the other decision makers. Such staff work includes: defining existing policies (see Examples 1 and 2); articulating goals; proposing new policies; estimating the impact of new policies (*27*); and evaluating the impacts (see Figure 8 under Example 8).

One problem in transportation is the need to articulate policy that is not only sufficiently general so that it does not become an encyclopedia, but is also sufficiently specific so that the reader can grasp its relevance to particular decisions (Example 25). At the same time, policy statements that emanate from a state department of transportation must not be seen to be so specific that they pre-empt the rights and duties of the legislature or the governor.

Three examples of good practice in the articulation of policy are presented below. Examples 1 and 2 each emanate from a regular process of review within the state transportation agency. The resultant policy documents of Iowa, specifically, and California, by implication, are cleared with their legislatures. Wisconsin's State Transportation Plan is, by contrast, a one-time statement that is intended to be written in sufficiently broad terms so that it does not have to be modified frequently.

Many other examples of policy declaration exist (also see published state plans in Chapter 3). New York's change in policy, giving greater emphasis to transit, which was set forth in its 1973 plan, is an example of policy articulation (*28*).

Example of Good Practice 1

Title: Policy Direction Statement
Organization: California Department of Transportation
Date: 1978 to date
Problem: A consistent, overview statement is needed to give broad direction to the departmental staff to plan, design, construct, operate, and maintain a statewide comprehensive, balanced transportation system.

The document must be clearly understandable as to its intentions, because its acceptance by many groups and interests is important to the selling of the department's legislative and financial program.

There is no desire on the part of Caltrans officials to incorporate such a policy statement in a published statewide transportation plan because of past difficulties in obtaining consensus on such a plan and, more important, because of the recent history of rapid change in fiscal policies and programs.

The desired policy statement is not directly based on quantitative needs or performance indexes, because quantitative needs statements do not address fiscal resources, which remain a policy decision.

The document is revised annually and incorporates the views of headquarters and district personnel.

Approach: The approach to the development of policy builds on historical antecedents, including reports and studies from 1974 and 1977 (*29*). Reviews of recent statements (*30*) show substantial consistency from year to year.

There is an annual review of the current year's document. Subsequent to legislative requests and policy revisions, the document is approved by the director. It then becomes the basis for guiding budget submissions.

The following extract from the 1983–84 Policy Direction Statement (*30*) is helpful to an understanding of the document:

> This document sets forth the major policies of the California Department of Transportation. It provides a framework for ongoing decision-making by Departmental staff; and gives direction to the Department's preparation of its annual budget and its proposed State Transportation Improvement Program.
>
> Policies at whatever level of detail are, by their nature, broad tools for decision-making. In any one instance, the application of a particular policy may be determined to be inappropriate and judgment must be used. Furthermore, concerning some issues, policies may be in conflict with one another. Again, judgment and the careful weighing of the facts under specific circumstances are keys to good decision-making.
>
> This document begins with the general setting for Caltrans' major policies. Second, it provides a description of the fiscal and organizational policies. Third, it covers program policies and is separated into highways and their users (automobiles, motorcycles, bicycles, pedestrians); freight; public transportation; and aeronautics.

Comment: The advantages of this approach are realism, clarity, and rapid response to changing circumstances. Generally, policy statements run the danger of being so bland that they lose relevance. Here, however, it is easy to discern the thrust of Caltrans' concerns. The policy statements become helpful in building legislative support. The existence of such a carefully thought-out document says, in effect, "We know where we're going." By contrast, the lack of such a document leaves a sense of uncertainty in the minds of both the public and departmental employees.

Example of Good Practice 2

Title: General Policy

Organization: Iowa Department of Transportation

Date: 1974 to date

Problem: The 1974 legislation that created the Iowa Department of Transportation also required its Transportation Commission to develop a comprehensive transportation policy and to submit that policy statement to the General Assembly for its approval. Internally, the DOT recognized that a statement of transportation policy was needed "to provide direction and specify a desired course of action that would meet the goals of the state" (*31*). Hence the development and modification of a written statement of policy became a regular task.

Approach: The first transportation policy was developed after review of materials in published plans of other states and after extensive public discussions with concerned public and private groups. After the initial draft was prepared, a public hearing was held (November 23, 1974). The final draft was approved by the Transportation Commission and subsequently by both houses of the legislature.

In subsequent years, the Iowa Transportation Policy has been modified as needs required and new issues arose. In each case, the policy has been approved by the Transportation Commission and subsequently by the legislature, thus ensuring continued scrutiny and consensus.

Comment: The Iowa Transportation Policy is a 1-page statement (see Figure 3). Nineteen points of the policy have remained essentially unchanged in 1981 from the first statement published in 1976; four points were added in 1977 and five in 1980; and only one point has been deleted. Thus there has been substantial continuity.

There are probably two ways to evaluate the value of this type of policy statement. First, to what extent does it reflect joint intent on the part of the legislature and the state administration? Second, to what extent does it actually guide the actions of a state transportation agency?

In Iowa, the fact that the published Transportation Policy has been revised from year to year after review by the Transportation Commission and legislature is a good demonstration that the policy statement is taken seriously and is subjected to careful scrutiny. This is another manifestation of the Iowa DOT's practice of constant communication with the legislature and the public.

The extent to which the policy statement actually guides day-to-day decisions cannot be demonstrated so easily. However, because the Iowa DOT is a tightly managed and cohesive organization that uses "management by objectives" principles in its day-to-day work, there is good reason to believe that the published Transportation Policy has an influence on daily actions. The document would probably not appear in major Iowa DOT publications on plans and programs if this were not the case. Hence it is fair to conclude that the Transportation Policy statement is a useful and, in fact, an integral part of the Iowa DOT's total program of upward and outward communication and internal management.

It might be helpful for states that are considering publishing policy statements to follow such statements with brief examples of how the key policies affect day-to-day decision making. (Washington has moved in this direction; see Example 25.) Alternatively, references to sections in a published plan or annual report could demonstrate how the policies are relevant. By doing this, states can avoid creating an impression that there is no connection between what appear to be very general statements and the real world of decision making.

IOWA TRANSPORTATION POLICY

January 1, 1981

GOAL The transportation goal for Iowa is to provide adequate, safe, and efficient transportation services to the public.

POLICY The Iowa Department of Transportation will:

A. General

1. Promote a transportation system to satisfy user needs and maximize economic and social benefits for Iowa citizens.
2. Provide for a participatory planning process which involves public, private, and citizen interests and which encourages complementary transportation and land development patterns.
3. Encourage and support programs to provide commodity movement and mobility for all citizens.
4. Develop and promote just and equitable policies and procedures for the registration and regulation of motor vehicles and common carriers of passengers and freight.
5. Promote financing of the transportation system through user and non-user sources in an equitable manner.

B. Plan

1. Develop a total transportation system plan, subject to annual review, which;
   - considers all transportation modes as interacting elements;
   - considers facilities and services necessary for person and commodity movement from origin to destination;
   - contributes to the development and implementation of a comprehensive state plan;
   - exerts a positive influence on social, economic, and aesthetic values;
   - provides safe, convenient travel opportunities;
   - minimizes economic, energy and environmental costs;
   - coordinates available federal, state, and local resources;
   - recommends appropriate investment and funding procedures;
   - makes the best use of land resources for permanent transportation use;
   - encourages more efficient use of energy resources;
   - fosters usage of technological advancements in transportation facilities; and
   - evaluates progress toward achievement of the goal contained in this policy.
2. Encourage and assist in the development of general aviation, airport facilities, and air-carrier services.
3. Encourage and assist in the general development, preservation and efficient use of highway transportation through improvement programs to equalize functional adequacy of roads and streets throughout Iowa.
4. Encourage and assist in the development, maintenance and improvement of public transit systems and services.
5. Encourage and assist in developing and maintaining a viable railroad system which is responsive to the needs of Iowa and the United States.
6. Encourage and assist in the development of programs which promote efficient use of river transportation.
7. Develop and participate in programs to improve the safety of all transportation modes.
8. Encourage and support development of transportation education programs.

C. Program

1. Prepare a current and long-range program of capital investment, services, and regulatory practice--each year.
2. Propose and promote legislative programs to facilitate an integrated transportation system.

FIGURE 3 Iowa transportation policy (*32*).

Example of Good Practice 3

Title: State Transportation Policy Plan
Organization: Wisconsin Department of Transportation
Date: 1978–1980

Problem: In a period of rapidly changing problems ["fuel shortages, failing railroads and transit systems, environmental concerns and straining budgets . . ." (*19*)], the Wisconsin DOT sought to find the most critical problems and issues facing transportation, and then to establish guidelines that would determine how the department would respond to these issues. The intent was to provide a "long-lasting picture of where the Department is going" and what implementation steps would be consistently taken to address each issue "over which the state has some control." In particular, the intent was to identify policy positions and implementation actions that could be taken within the existing powers of the Wisconsin DOT.

Approach: This policy document was developed over a 2-yr period, involving extensive discussions with a State Transportation Plan Advisory Committee, debate within the department, and public review at regional meetings. The initial focus was on issue identification (15 critical issues were identified).

The main part of the document consists of 14 policy statements addressing the 15 critical issues. Each policy statement is followed by a section entitled "Rationale," which gives background reasoning—what the problems are, why the policy has been adopted, and what limitations may exist on the state's ability to reduce problems. The "Rationale" is followed by "Implementation Guidelines," which indicate the steps the department intends to take to implement its policy.

The main body of the document is preceded by a Profile of Transportation in Wisconsin giving, for each mode, the salient facts on networks, service, and conditions. The department's responsibilities are also indicated. The main body (Chapter 2) is followed by a short chapter on implementation. An appendix contains an environmental analysis of the State Transportation Policy Plan (see Chapter 3 in this synthesis).

Comment: The strength of this report is in the clear linking of policy with rationale and implementation guidelines. Thus the single-sentence statements of policy (which, though precisely worded, are nevertheless general) are immediately explained as to why they have been adopted. Each explanation, furthermore, is immediately followed by a series of implementation steps, so that the relevancy of the policy is clearly established.

Like many policy statements, however, these appear to be directed more toward the department than outward to the public or to the legislature. The implementation guidelines are rules for conduct that, if followed, should ensure consistent processes or, at the least, a most carefully thought-out checklist of factors and elements to be taken into account in subsequent departmental work.

ESTIMATION OF FINANCIAL RESOURCES

The estimation of financial resources is (or should be ideally) a subset of policy analysis, but is included here as a separate topic because of its unique importance. This activity forecasts the funds that will be available to pay for all of the various programs supported by a state transportation agency; it should be a continuing activity, either on an annual or semiannual basis. This is the kind of activity that a planning staff can readily perform for top management, and it should be a regular part of the staff assistance that cements the planning-management relationship. (In some organizations, estimation of financial resources or revenues is the responsibility of the transportation agency's financial office; but even in such situations, the planning staff should provide forecasts of VMT, registrations, and fuel consumption.)

The key to successful and economical performance of this particular task is the use of the computer. Once the logic of the procedure has been established (which, because of differences in state laws and funding, is likely to be different for each state) and the programs have been written, then the rerunning of the program is merely a matter of changing input variables. The model(s) can also be used to ascertain the impact of alternative fiscal policies, such as changes in gasoline or excise taxes. The computer turns a time-consuming, error-prone task into a routine operation and greatly improves planning productivity.

Estimating financial resources is, of course, captive to the policies of both state legislatures and the U.S. Congress. Thus major components of financial programs can only be guessed at, and long-range estimates become particularly hazardous. Nevertheless, any reasonably good model will identify these assumptions, and alternative assumptions can be entered, giving an "if-then" range of estimates.

There are a number of programs available for estimating financial resources. Two examples, both from California, are given below. A number of models are available for estimating future vehicle miles of travel, which is a critical component for estimating revenues derived from gasoline and diesel-fuel taxes; readers interested in alternative technical models should consult previously published reports (*24*,*33*).

Example of Good Practice 4

Title: Estimation of Capital Outlay Cost Escalation
Organization: California Department of Transportation
Date: 1981

Problem: To estimate the varying impact of inflation on different capital activities of a state transportation agency.

Approach: Historical data were assembled from contracts awarded in 1978, 1979, and 1980 (*34*). Six major types of capital activities (excavation, structures, highway surfacing, roadside appearance and preservation, drainage and sewers, and miscellaneous) were separated into common cost elements that could be matched with forecasting indexes. The common cost elements are listed in the first column of Table 2.

Various price indexes were applied, and forecasts of those indexes were obtained from Chase Econometrics. By applying the price indexes to the components of each activity, activity cost escalation rates were developed.

Comment: This is a straightforward form of analysis and forecasting, similar to that developed by a number of states. The link between the method and a continuing national economic forecast is of particular interest.

TABLE 2
PROJECTED CAPITAL OUTLAY ESCALATION RATE FOR TOTAL PROGRAM BY COST ELEMENTS (PERCENT ANNUAL RATE) (*54*)

PROGRAM COST ELEMENT	REL. WT.	INDEX	ESCALATION RATE 80-81	81-82	82-83	83-84	84-85	85-86	86-87
TOTAL	100.0		14.6	10.2	9.6	9.0	8.7	8.4	7.9
Construction Labor	17.9	Hourly Wage Rate, Constr.	8.3	9.0	8.4.	8.0	8.0	8.3	8.4
Equipment	18.3	Composite of Autos, Trucks & Machinery	8.7	9.1	10.2	8.8	8.1	7.6	7.1
Materials and Supplies	54.9		19.2	10.8	9.5	9.2	8.9	8.5	7.9
Fuel	6.0	Gasoline (CPI)	27.4	11.9	9.4	11.1	10.0	8.6	8.3
Metals	9.7	Metals & Metal Products (PPI)	9.1	10.8	12.0	9.8	8.9	8.1	7.4
PCC Products	19.5	Ind. Commodities (PPI)	13.9	10.6	9.0	8.3	8.2	7.8	7.1
Asphalt Products	14.4	Refined Petroleum (PPI)	33.3	11.6	9.2	9.8	10.0	10.2	9.7
Paint, Plastics, Chemicals	1.7	Chemicals, Rubber, & Plastics (PPI)	12.6	8.6	7.9	8.0	7.4	6.8	6.4
Other	3.7	Implicit Price Deflator State & Local Gov't Purchases	8.5	8.3	8.0	7.6	7.3	6.9	6.7
Overhead and Profit	8.9	Composite of Rent, Utilities, Non-Constr. Labor, Profit	10.8	10.9	10.9	10.6	10.0	9.3	9.1

Example of Good Practice 5

Title: Forecasting Financial Resources for Highways
Organization: California Department of Transportation
Date: 1979

Problem: To obtain an accurate, multiyear estimation of financial resources for highways, taking into account all the factors that both contribute to resources (from taxes, fees, and miscellaneous sources) and subtract from resources (apportionments and transfers).

Approach: Estimates are prepared by use of Finplan (*35*), a highly disaggregated model with eight main modules (Figure 4). The model employs approximately 115 input variables, more than half of which deal with vehicle numbers, fuel consumption efficiencies, and VMT, all by vehicle class. VMT is estimated separately by a short-range model (*36*). Three of Finplan's modules are basically governmental accounting models dealing with the collection, apportionment, and transfer of funds to various accounts, and the summation of all revenues flowing into the State Highway Account.

Comment: There is no guarantee that greater disaggregation in a forecasting model will yield accuracy or reliability in the estimates. In fact, greater disaggregation generally requires more assumptions.

However, what is significant in an approach of this type is the benefits that come through a greater understanding of the components of the forecast, such as vehicle-fleet aging, renewal, and relationships to licensed drivers. Furthermore, the accounting functions of fuel-tax collection and distribution are hard facts, and their modeling gives administrators the ability to estimate the consequences of proposed legislated changes.

REGULATION

The United States is in a period of transition in the regulation of private-sector transportation industries. This transition has already spanned two federal administrations. There is uncertainty over how this transition will end—whether in the future there will be less regulation or whether some "re-regulation" will become necessary. During this transition time some states (such as Arizona) have taken decisive action to deregulate (*37*), but the vast majority are [such as New York (*personal communication*, B. J. Riggs, New York State DOT)] proceeding cautiously in those spheres where they have a role, until the situation has achieved some equilibrium, at least at the national level.

The deregulation movement gained momentum at a time when substantial changes were occurring in private-sector transportation. For example, railroads needed the ability to abandon many miles of branchlines and, in addition, the ability to restructure their mainline systems. Conrail, created by Congress under the Regional Rail Reorganization Act of 1973, was the forerunner of a series of private system changes achieved through mergers and as a consequence of bankruptcies. Perhaps deregulation was the only way in which inefficiencies and redundancies could be shaken out of the system (particularly the rail system), so that more efficient equipment, operations, and labor agreements could be achieved.

Issues

The following list of issues in regulation and deregulation was developed in part from an Arizona report (*27*), in part from a paper by Fuller (*38*), and in part from discussions with B. J. Riggs (New York State DOT).

- Competition: Is there enough competition to ensure fair prices and good service?
- Entry and exit: Are the rules too inflexible?
- Fraud: Is the public protected from fly-by-night operators, such as in the furniture-moving business?
- Rate making: Are regulated rates fair to the shipper and to the carrier? Is the long-distance traveler subsidizing the

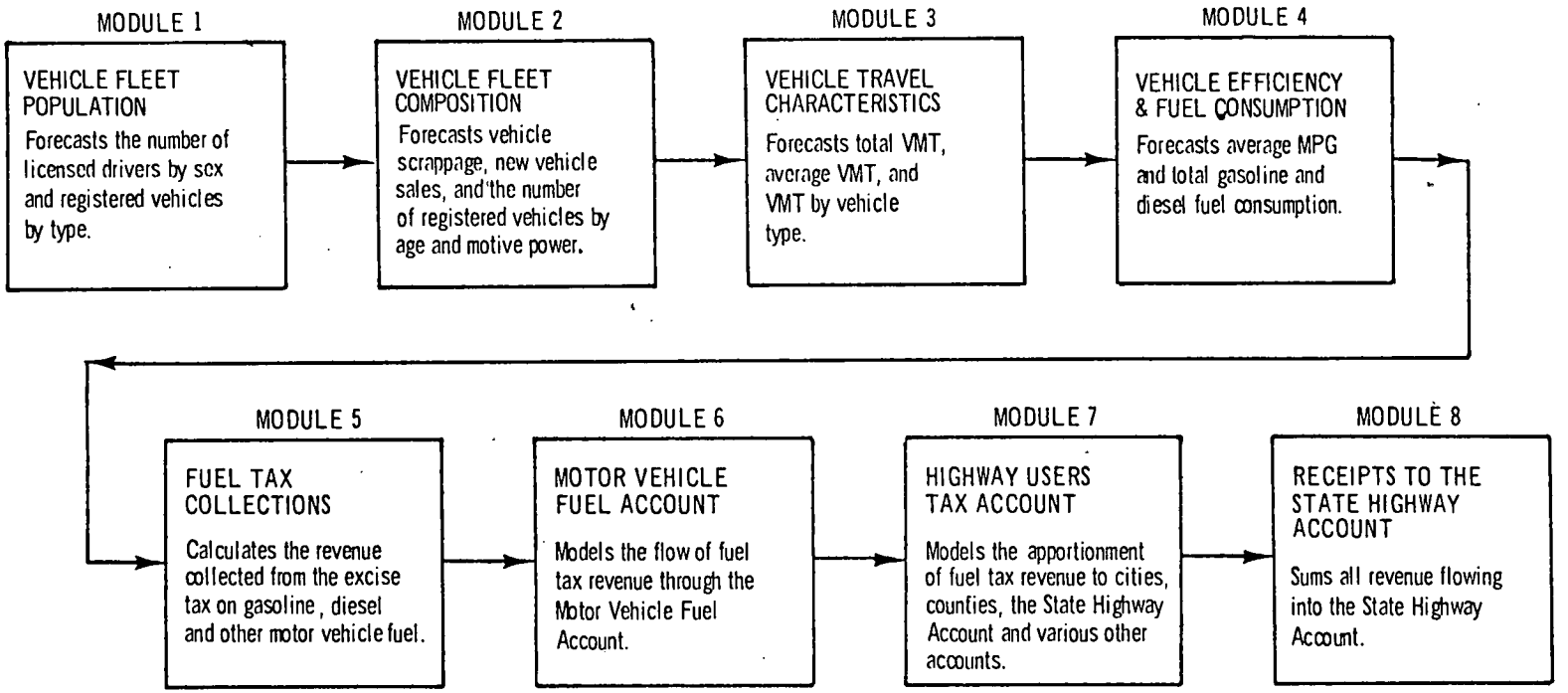


FIGURE 4 Schematic of the Finplan model (*35*).

short-haul traveler or vice versa? What are the implications of such cross subsidies?

- Safety: Are vehicles and ways safe?
- Service: Where interline or intercarrier transfers are required, can the shipper or traveler know that he will be served and at consistent, equitable rates?
- Impact on settlement patterns: Will deregulation put small urban places and short-haul travel at a consistent disadvantage?
- Impact on small shipper: Will the trend toward larger transportation companies (trucks and railroads) impose crippling hardships on the small shipper?
- Technological/organizational change: Can government regulate an industry without stifling technological progress and improved organizational patterns?

Clearly, some of these issues are of little importance to statewide transportation planning (e.g., protecting the public from fraud), and other issues (e.g., competition) are only important in individual cases. However, certain issues are of great importance because they effect the economy of the state and the operations of existing transportation systems.

Deregulation may permit private carriers to curtail or eliminate service to smaller urban areas and low density regions of the state, thus potentially adversely affecting settlement patterns and the economy of the state. Under regulation, carriers are forced to subsidize uneconomic lines or services with the profits of high-density lines. In Michigan, for example, there is a real concern that if the intercity bus industry is deregulated, the state could lose 45 to 55 percent of its regular-route bus miles (*personal communication*, J. Rudnick, Michigan DOT).

The second major issue involves the impacts of deregulation on existing transportation systems. Sweeping closings of branchlines, for example, can add truck vehicle miles to the state highway system. Individual branchline closings are rarely traumatic, but the cumulative effect of many closings, particularly when coupled with railroad policies that discourage single-car shipments, can be substantial.

It must be emphasized that the location, size, and character of a state all profoundly influence its views and needs with respect to these issues. A western or mountain state with one or two large population centers, traversed by transcontinental rail, highway, and aviation routes, and with relatively little intrastate travel demands, faces significantly different regulation problems than an eastern state with many large urban centers located short distances apart.

The Role of Statewide Transportation Planning

Only a few examples of state activities in the deregulation field were obtained during the literature search and interviews conducted for this report.

The Arizona Department of Transportation has taken a strong position, both intrastate and nationally, for the deregulation of trucking, railroads, buses, and aviation (*27*).

In New York the legislature has initiated an inquiry into air fares, noting that it routinely costs less to fly to Florida than within the state (*39*). High intrastate air fares and poor intrastate service are matters of great concern. In the long run, this situation could affect smaller, "incubator" firms located in the metropolitan and urban centers along the old "water-level route" and in the southern tier counties.

In Montana a study of grain transportation (see Example 20), although not specifically directed at regulation concerns, dealt with the impact of changes in transportation and storage systems (unit train versus single car rates; small versus large grain storage units) on the economy of the agriculture in the state. Rail and trucking costs and rates were a dominant factor.

Current practice suggests that state transportation agencies consider the following actions in the regulation field:

- Monitor all federal regulation/deregulation proposals.
- Periodically analyze the impacts that regulation and deregulation have had on business and agriculture, and on the settlement patterns of the state.
- Periodically monitor the impacts of regulation and deregulation on existing transportation systems and services, particularly aviation, intercity bus transportation, and highways.
- Develop position statements for Congressional and other hearings.
- When preparing modal or multimodal transportation plans for aviation, intercity bus systems, waterways, railroads, or highways (truck impacts, particularly), incorporate rate, cost, and service considerations in the planning process.

COMMUNICATIONS

One of the most important activities of the chief administrative officer of a state transportation agency is to communicate policies and financial needs to the governor, the legislature, and the public. Such work should be strongly supported by the planning staff. It is clear from visits with planning staffs during the preparation of this synthesis and from a review of published material that states are taking this duty seriously and are acting accordingly.

A key objective of communications is to obtain adequate funding. A recent FHWA report (*40*) states:

> The central issue examined here is the process of involving both legislators and the general public in the highway planning and programming process. This idea of involvement perhaps best describes the information transfer necessary in order to instill both a common level of knowledge and a receptivity to highway concerns within an audience.

Substitute "transportation" for "highway" and the message stands as a valid recommendation for communications goals for state transportation agencies.

There are many examples of effective communications at the state level. Minnesota's extensive work with the public through a hearing process in the development of its statewide transportation plan (*41*) is notable.

Iowa's regional transit planning (Example 17) is only one aspect of its consistent, careful presentation of plans and programs to the public. The Iowa DOT (*42*)

> holds a series of public meetings around the State to obtain citizen reaction and input toward the revised Transportation

Improvement Program. State representatives are often in attendance, asking questions as well as answering them.

In the Kansas DOT (*40*)

[s]tate personnel give guided tours of State roads and bridges for county legislators. This was done in response to the senate majority leader's request that the tours be given within the highway districts. The Secretary of Kansas Department of Transportation conducted the tours personally, and explained the critical shortage of State highway funds, the deteriorating condition of the highways and the need for the Kansas legislature to provide additional revenue. The FHWA Division Administrator lent his support by accompanying the Kansas Department of Transportation secretary to explain how Federal-aid highway funds might be used.

The example from Arizona given below is especially interesting because of the extent to which communication with the legislature and governor is the key philosophy of its planning staff. This philosophy colors the entire staff's approach to both programming and modal planning.

Example of Good Practice 6

Title: Communications
Organization: Arizona Department of Transportation
Date: 1979 to date
Problem: The problem involves the relationship between planning and decision making: It would be extremely undesirable if there were no relationship between the two; that is, if the statewide transportation planning function had no relevance to decision making. The more planning can provide support for decision making, the better it will be for state transportation programs. "The product of planning is the decision that is made" (*personal communication*, C. Anders, Arizona DOT).

If a close relationship between planning and decision making is to be obtained, then the thrust of the staff and the work of a state transportation agency's planning operation must be to those who make the major decisions. In Arizona these are the Director, the Transportation Commission, the Legislature, and the Governor's Office.

Approach: To attain a close relationship, the upper echelons of the Planning Division of the Arizona DOT spend a great deal of time working directly with the Director of the DOT, representatives from the Governor's Office, and key legislators and their staffs. A drawback to this approach is that unusual and unforeseen work items may become a burden on the Planning Division and there may be staff concern that there is too much "fire fighting." Nevertheless, this must be accepted in the interests of gaining access to, and the confidence of, key decision makers. The risks of being wrong or becoming unpopular must also be weighed and accepted.

In addition, the key decisions that will need to be made in the near term must be anticipated. Basically, four methods of anticipating needs are employed: (a) feedback from the decision makers, indicating their concerns; (b) the planner's judgment; (c) the total body of technical studies and long-range plans that have been produced to date; and (d) continuing studies that monitor the conditions prevailing in the state's transportation facilities and services (these may identify critical problems about which decisions must be made). All these methods, however, require from the staff an attitude that looks at planning not as a technical exercise, but as a means toward the end of identifying critical decision issues and supplying the information relevant to those issues.

Given the identified issues or the critically important decisions to be made, the technique of policy planning applied is a function of the type of issue being addressed. The technique may be the conduct of an *ad hoc* study reference to an existing policy (as in the case of a published plan), or a technical process (such as a regular forecast of tax receipts).

As information is supplied, an institutional relationship is strengthened between planners and decision makers. This relationship is advantageous to the implementation of projects, programs, and plans.

Comment: This is a long-term, institution-building approach calling for the utmost in diplomatic skill. This approach is not without risks; however, it is essential. The approach must be supported by a staff with the capability of producing accurate answers and evaluations on a wide variety of fronts and with unusual speed. Good public relations without excellent technical backup will eventually flounder because of the inability to produce correct and credible answers.

PRODUCTIVITY IN TRANSPORTATION PLANNING

Productivity in transportation planning includes all the means by which planning staffs can reduce the cost and time requirements of their assignments, whether these assignments are in the area of staff assistance to management or in the development of modal plans. There appears to be a continuing movement by state transportation agencies, supported by the U. S. Department of Transportation and other organizations (such as the National Cooperative Highway Research Program of the Transportation Research Board), to increase professional productivity.

One example of action in this area is the "Staffing and Organization Study" currently underway in the Colorado Department of Highways, in which the entire staffing plan and work-force levels are being reviewed to enable the department "to anticipate and respond quickly, flexibly, and responsibly to changing circumstances" (*43,44*).

In transportation planning, staff productivity may be attained by three basic means: standardization of procedures, word-processing methods, and computer methods. Other means, which are not included in this discussion, include the reassignment of work-load priorities, the dropping of low-priority tasks, or a host of minor labor- and time-saving devices such as xerographic reproduction.

Standardization of Procedures

When a particular planning task is repeated even a few times, whether by one jurisdiction or several, then the development of procedure manuals becomes desirable. This practice has been supported by the U. S. Department of Transportation and the Transportation Research Board. Most states prepare manuals, especially for directions given

to regional offices. An excellent example of a manual is Iowa's "Guidelines for FY 1983–1987 Regional Transit Development Plans" (*42*).

Word Processing

The use of word-processing equipment (the generation of equipment beyond the individual typewriter with magnetic card or diskette storage) is just beginning to penetrate the state transportation agency market. This equipment has tremendous potential for increasing office efficiency and professional productivity, particularly the more recent equipment that offers the user the ability to merge computation and word processing.

Computer Methods

State transportation agencies have steadily been increasing their use of computers over the past 25 years. In the past 5 years some startling advances have taken place (see Examples 7–11). California's PYPSCAN battery of programs is oriented to the management side of planning, and Michigan's STMS is a data base for multimodal, multiple-purpose planning. All of the models described in the following examples depend on data files that are stored on-line in disk-packs where they are continuously available to any user at any of the computer's terminals. This is the distinctive feature that greatly increases computer productivity in comparison to the older, batch-processing mode.

In addition to the gains in productivity made possible by main-frame computers, the use of microcomputers can increase planning productivity for planning staffs. It is anticipated that numerous small software packages will become available in the next decade; many of these will be written by planning staffs. There are, in addition, some excellent general-purpose table-manipulating programs that are commercially available.

Gains in productivity that have been actually experienced as the result of using the newer computer methods include the reduction of: the drafting time for preparing mapped displays of networks and graphics for reports; the programming time for producing "spread-sheet" types of calculations; the delays in producing budgets and scheduled programs of projects and in accessing data; the intercity communication of data; and the time and effort needed to complete many planning technical computations.

Example of Good Practice 7

Title: Person Year and Project Scheduling and Cost Analysis (PYPSCAN)

Organization: California Department of Transportation

Date: 1979 to date

Problem: The context in which the problem occurs needs to be understood, because it shows the solution to be economical and of extreme importance. In California, which is the nation's most populous state and has the third largest land area, the DOT performs almost all of the planning, engineering design, and construction supervision by means of its own forces. Approximately one-third of the 15,000 DOT personnel work in these areas. There are approximately 3,000 projects underway at any single time in 11 separate districts, one supplemental roadway design unit in Sacramento, and the statewide structure (bridge) design unit in Sacramento, all of which requires a carefully developed coordinating process.

A number of problems have been experienced across the entire spectrum of operations—from project inception, budget preparation, and policy review to timely completion of projects, including:

1. Overoptimism by district offices in the estimations of time needed for project planning and design.
2. Inconsistent cost estimation of projects.
3. Excessive time required to prepare capital budgets.
4. Excessive time required for scheduling of projects and allocation of manpower to projects, using either manual or combined manual and computer methods.
5. Nontimely and nonlinked (i.e., separate) management information systems.
6. Inadequate reporting and tracking procedures.
7. Inaccurate information; need for quality data on projects (all aspects).
8. Inability by top management to control events (resulting from the preceding seven problems); instead, top management has been controlled by events.
9. Need for "exception-style" reporting to prevent being buried in paper.
10. Need for the department to cope with frequent changes in program direction and composition resulting from changing executive, legislative, and administrative policies and directions.
11. Increasing numbers of small manpower-intensive projects that increase the project management work load.
12. Need for increased departmental productivity.
13. Need to have information for each step of the management cycle: planning; programming/scheduling; staffing (allocation of work load to staff); budget preparation; monitoring progress; evaluation; and feedback to planning.
14. Need to synchronize the scheduling of money needs with project delivery schedules.

The amount of paper work involved in estimations of project cost and manpower, assembly of budgets, allocations of available manpower to projects, and monitoring was so time-consuming and subject to so many potential errors that it was unmanageable. In some cases, it took up to 6 months to prepare a departmental work schedule, and hence the results were outdated before they could be used. To reiterate, the paper-work system did not permit top management to control events; instead, events controlled themselves.

Approach: The objective of the Caltrans approach was to break the barriers of time and amount of paper work by building a comprehensive, computerized, on-line (i.e., available at all times) management information system. This system came to be known as the Person Year and Project Scheduling and Cost Analysis (PYPSCAN) system (*45, 46*).

Certain policy decisions were made at or near the outset of the 3-yr period specified to build PYPSCAN. First, written backing for the entire project was obtained from Caltran's Directorate (the Director and Deputy Directors). Second, it was determined that the management of all capital-related resources would be done at headquarters. Third, it was decided not to limit the focus to budgeting, but to develop a comprehensive *management* information system that would automate the multiyear scheduling of all resources (money, time, and people).

An existing data base (Project Management Control System) was used as a beginning module. To this were added project-level modules that (a) estimate manpower requirements, (b) calculate schedules, and (c) schedule capital costs. A 4,000-project historical data base was used as the empirical basis for the cost-estimating module. PYPSCAN reports are utilized to distribute and level labor-hours within available manpower limits by district to assure an even flow of work.

PYPSCAN is multimodal (i.e., including rail and aviation projects) and project-specific. It currently deals with approximately 3,000 projects. Inquiry can be made by any district or by the main office concerning the status of any individual project. District offices can enter progress reports, but revisions in schedules, costs, or labor requirements can only be made by the main office after request by the district office.

Progress reports are prepared regularly at various levels of detail; the most detailed reports go to project managers in the districts and the least detailed (summary) report goes to the Caltrans Directorate.

The computer model accepts project definitions (type, location, extent, present conditions, etc.) from the district. It then calculates person-year labor requirements and delivery schedules (after a "begin" date is provided), using empirically-developed formulas. Budget and multiyear programming estimates are also prepared.

Comment: PYPSCAN is an excellent example of what computer power can do to assist management. By taking repetitive computation tasks away from people and by compressing paper work, the preparation of a long-range capital budget and schedule that would normally take a year to complete can now be done within hours. This permits more alternatives to be examined and greater management control to be exercised.

However, it should be noted that the development and use of a large model like PYPSCAN may require changes in organization and working habits, necessitating diligence, firmness and diplomacy. If a computer system is not used, it is worthless. If it is fed incorrect data, it can only return wrong answers. Hence the development and installation of a major system like PYPSCAN must be undertaken with careful attention to human, institutional, and procedural elements, as appears to have been accomplished in California.

Although the use of PYPSCAN as a management tool was developed on the basis of the size and work load of Caltrans, and its near-total use of in-house workers for planning, engineering design, and construction supervision, there is no logical reason why this tool cannot be used by states that let out design and construction supervision work to consultants. In fact, the PYPSCAN cost- and labor-estimating modules could well be used to check out the bids of private firms.

Example of Good Practice 8

Title: Statewide Transportation Modeling System (STMS)

Organization: Michigan State Department of Transportation

Date: Initiated 1967; staffed 1972 to date (greatest expansion in period 1976 to date, when requests for responses started to increase)

Problem: A number of problems led to the development and steady expansion of the "statewide transportation modeling system." Most of these problems are internal to the planning (and management) function, but their existence adversely affected the ability of staff to respond adequately to external problems. The fundamental problem was the lack of an adequate support system of information that was (a) readily accessible to planning and management staff, (b) accurate, and (c) useful. The internal needs included:

1. A system that would permit high-speed answers to the questions of decision-makers.
2. Equivalent data sets covering all modes and the various dimensions of a state's population, economy, infrastructure, and natural resources.
3. A common geographic reference system, and coordination among the various reference systems that customarily identify transportation links/nodes, jurisdictions, mapping systems, etc.
4. Ability to respond to any type of question, both transportation and nontransportation, through relating different data sets.
5. Avoidance of the "boom and bust" cycles common to data collection and processing by (a) maintaining/updating existing inventories; (b) keeping instead of discarding data; (c) reducing the complexity of the systems; and (d) the supply of data by other agencies, including local governments, through regular updates.
6. Avoidance of batch-processing systems, where feasible, by keeping data on-line and available; taking advantage of new, low-cost "disk-pack" storage systems.
7. Increased productivity of planning professionals.
8. Ability to use stored data to feed into simulation packages at the state, regional, or local scale.

Approach: The approach used to develop the STMS as a working information and planning tool is complex; thus only the various aspects of the present system are described here (*47–59*).

1. *Computer system.* The data and programs of the STMS are stored on seven "disk packs," each capable of storing approximately 130 million bytes for a total of nearly 1 billion bytes of data. There is some room for the temporary storage of data as the files are being worked on. As a result, most of the data are highly accessible at the terminals and printers located in the Planning Division. Digitizing units in the Planning Division can be used to enter geographic data into storage. The CRT terminals available to planners are large (some are 27-in. diagonal), high-resolution devices, equipped with hard-copy printers that can produce copies of displays for the record. Separate, off-line, color CRT's are available for

graphics presentations; color slides or color copies can be produced.

2. *Information stored.* The information stored in the computer's disk files consists of more than two dozen major files (the count varies as the system changes) that can be grouped under four major headings: (a) point data (consists of information on more than 58 types of physical facilities, such as hospitals, campgrounds, and colleges) (Figure 5); (b) network data (describes each mode's networks, with greatest detail on highways, including traffic and VMT data); (c) area data (consists of Census and state data on socioeconomic matters); and (d) origin-destination data (includes commodity flows and railroad waybills). A representation of the data is given in Figure 6.

3. *Geographic systems.* In order to supply data in response to questions raised from different sources, conversion files are maintained. (See Figure 7 for a list of the conversion files along with the number of each file.) For example, if an economic development district wants to find out the condition of highways or the number of jobs in its area, this information can be supplied. Similarly, an information request from a legislator regarding his district can be filled—a potentially important factor in communications between the legislature and the transportation agency.

4. *Operating policies.* The following policies have guided the development and use of STMS: (a) The ability of the system beyond its capability of delivering answers has not been advertised; hence the system has been developed gradually. (b) Every effort has been made to bring all new data sets into the system and to avoid creating new or different geocoding systems that would not be compatible with existing systems. (c) Updating routines have enabled existing files to be changed to reflect current conditions. This has been especially beneficial where (as in the case of network files) the updating costs are small compared to the costs of original data collection. (d) The "windowing" approach has been used to focus on particular areas, collapsing information into gross areal units for the balance of the state. (e) All programs have been written as assemblies of modules for greater ease in debugging and subsequent modification. (f) High-speed response to inquiries has been a constant policy. (g) Graphics capabilities, including color, have been stressed for greater ease in understanding outputs.

5. *Simulation models.* The data in the information files are structured so as to facilitate the running of a variety of models. The range of models that have been available since 1973 is shown in Figure 8. Major revisions are presently being made to this diagram to reflect the completion of a fiscal modeling system used in the preparation of Michigan's State Transportation Plan. In addition to the usual transpor-

NAME	NUMBER	NAME	NUMBER
AIRPORTS	110	MINERAL PRODUCERS	312
AMBULANCE SERVICE	120	MOTELS	315
BUS TERMINALS	130	NEWSPAPERS, DAILY	320
CAMPGROUNDS, PUBLIC	140	NEWSPAPERS, WEEKLY & BIWEEKLY	330
CAMPGROUNDS, PRIVATE	142	NURSING HOMES	340
CERTIFIED INDUSTRIAL PARKS	150	NUTRITION CENTERS FOR THE AGED	341
CITIES OVER 30,000 POPULATION	160	OIL PROCESSING & STORAGE PLANTS	342
CITIES OVER 5,000 POPULATION	170	POLICE DEPARTMENTS, CITY	346
CIVIL DEFENSE TERMINALS	180	POLICE DEPARTMENTS, COUNTY	347
COLLEGES, NON-PUBLIC	190	POLICE DEPARTMENTS, STATE	348
COLLEGES, PUBLIC COMMUNITY	200	POLICE DEPARTMENTS, TOWNSHIP	349
COLLEGES & UNIVERSITIES, PUBLIC 4-YEAR	210	PORTS	350
COMMERCIAL CENTERS, MAJOR	212	RAIL TERMINALS*	360
CONVENTION CENTERS	220	SAVINGS & LOAN, FEDERAL	368
ELECTRICAL GENERATING PLANTS	225	SAVINGS & LOAN, STATE	369
GAME AREAS	230	SECRETARY OF STATE OFFICES	370
GAS DISTRIBUTORS	235	SEWAGE TREATMENT FACILITIES	380
GOLF COURSES	240	SKI RESORTS	390
GRAIN ELEVATORS	243	SNOWMOBILE TRAILS	400
HIGH SCHOOLS	250	STATE PARKS	410
HISTORIC SITES	260	TOURIST ATTRACTIONS	430
HOMES FOR THE AGED	270	TRAILER ON FLAT CAR TERMINALS	433
HORSEBACK ENTERPRISES	277	TRANSIT SYSTEMS, BUS	435
HOSPITALS	280	TREASURY OFFICES	440
ICE ARENAS	281	TRUCK TERMINALS	450
IMPORTERS	283	UNEMPLOYMENT OFFICES	460
MANUFACTURERS*	300	VOCATIONAL REHABILITATION CENTERS	465
MARINAS	304	WEATHER SERVICE STATIONS, NATIONAL	470
MENTAL HEALTH CENTERS	310	WHOLESALE TRADE CENTERS	480

* ONLY AT 547 ZONE

FIGURE 5 547 & 2300 zone statewide facility files (Michigan DOT).

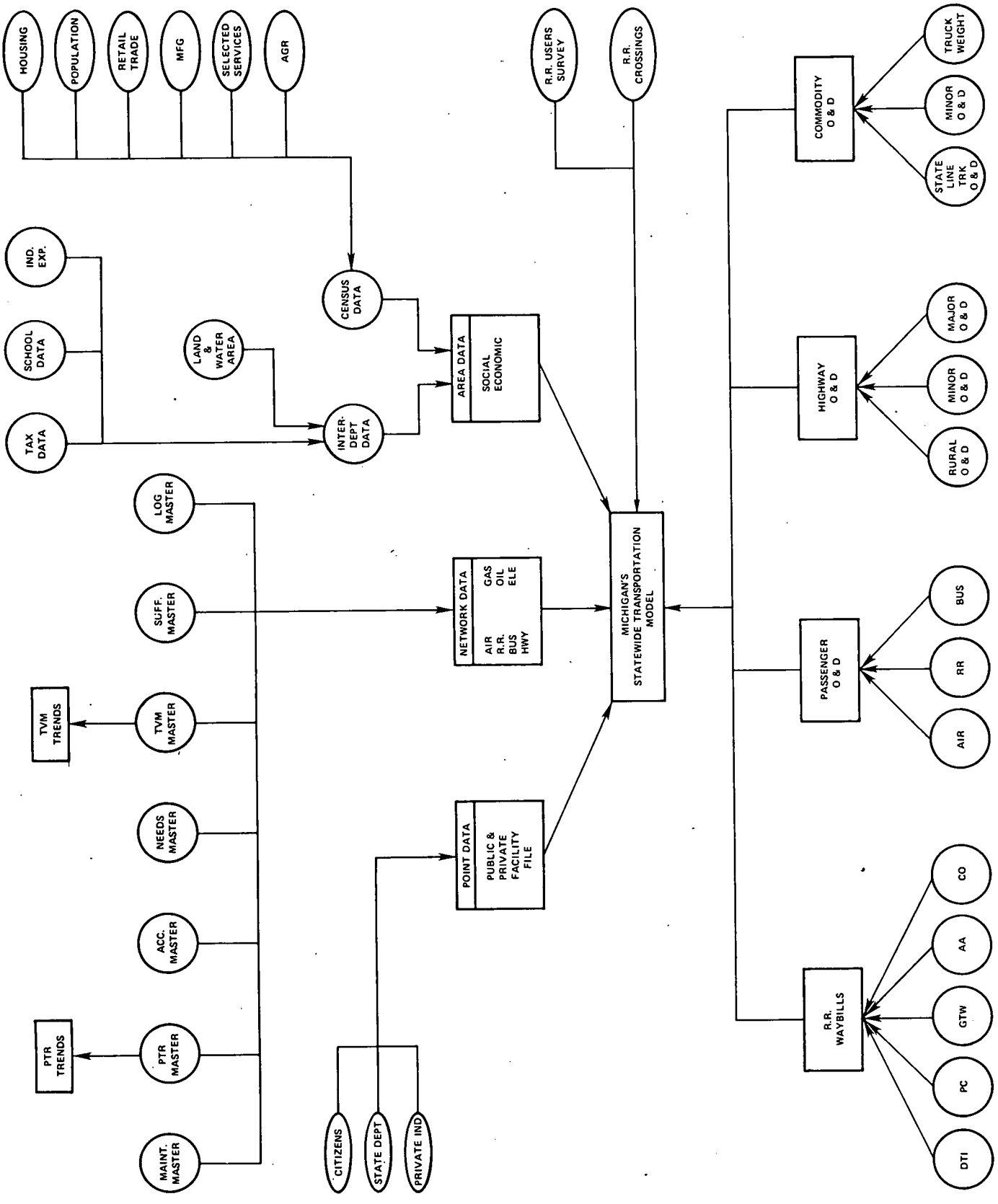


FIGURE 6 Statewide transportation modeling system's information (Michigan DOT).

COMMUNITY COLLEGE DISTRICTS
MICHIGAN COMMUNITY COLLEGE ASSOCIATION - 2
STATE BOARD OF EDUCATION - 3
COUNTIES - 4
ECONOMIC AREAS - 5
HEALTH SYSTEM AREAS - 6
HIGHWAY DISTRICTS - 7
PLANNING TEAM REGIONS - 8
STATE HOUSE OF REPRESENTATIVES DISTRICTS - 9
STATE PLANNING REGIONS - 10
STATE POLICE DISTRICTS - 11
STATE SENATE DISTRICTS - 12
WATER SHED REGIONS - 13
ZONE SYSTEM 2300 TO 547 - 14
ZONE SYSTEM 2300 TO 1500 - 15

FIGURE 7 Zone equivalent files (Michigan DOT).

tation models, the Michigan data base has been used to respond to a variety of nontransportation problems, such as accessibility to hospitals, in 11 other Michigan departments.

6. *Use for needs studies.* The needs study use of STMS has expanded and will expand further. The aim is to have a continuing assessment of needs and priorities, not only for the state system but for all roads in the state. Formerly, a needs study was a year-long effort, with analysis given insufficient attention at the end; under the new system, needs can be analyzed continuously. The same procedures used by the state can also be applied to municipal systems; all that is required is regular reporting by cities of road conditions and road work accomplished.

Comment: The Michigan STMS deserves careful study as an innovative use of computers for transportation planning purposes. In contrast with California's PYPSCAN procedure, which is mainly a management planning tool, STMS is definitely a substantive planning tool. There is no real barrier, however, in joining STMS with a PYPSCAN type of project management and programming operation, because both relate to the same highway system.

The principal gains of this system have occurred through: (a) storage of data on-line and availability of data for analysis and summarization at terminals handy to the planning staff; (b) common geocoding systems; (c) maintenance and regular updating of data bases; and (d) simplicity of files and organization to facilitate summarization and use of files in various models.

Gradual aging of the data will be a problem unless steady efforts are made to update. This will be particularly true of the more changeable information, such as travel, employment, taxation and the like; it will be less true of descriptors of physical infrastructure, such as buildings and roads.

With the use of STMS, substantial reduction of paper work can be expected, with accompanying increases in staff productivity. Much greater ease in responding to legislative inquiries is expected (in comparison to the tortuous process of assembling data by hand and insuring their consistency with previous responses to the legislature).

The STMS approach to data and inquiries is likely to expand due to the lowered cost of computer storage and the capability of the newer computers to connect with on-line inquiry terminals.

Example of Good Practice 9

Title: Management Information System

Organization: Texas Department of Highways and Public Transportation

Date: 1965 to date

Problem: Initially (1965) problems resulted from fragmentation of automated systems, primarily hardware. This led to the creation of a Division of Automation. More recently, there has been a need to (a) link independent computer data files and processes to the extent practicable, (b) simplify user interfacing with computers, (c) increase productivity generally, through the reduction of paper work and the increased use of exception reporting, and (d) integrate both management and engineering applications into a large management information system (MIS).

Approach: The creation of a management information system has been recognized as a major campaign that can only be achieved by a conscious effort through planning and an implementation program. A 5-yr plan has been published (*26*). Priorities have been established for different components of the MIS within the plan. The department is purchasing components of the MIS and their installation from software vendors. At present, the MIS is conceived as having eight major components, of which the first two listed below are operational.

1. Design and Construction Information System (DEIS) (primarily a management control system).
2. Contract Information System.
3. Financial Information System.
4. Human Resources, or Personnel Management System.
5. Equipment System.
6. Materials and Supply System.
7. Maintenance Management System (including a maintenance cost reporting system and a pavement evaluation system).
8. Salary and Labor System.

In addition to the foregoing, there are independent systems of various types, including (a) an interactive graphics design system, (b) word processing, and (c) motor-vehicle registration systems.

Six regional automation centers are planned "to increase productivity in highway design and preparation of construction plans. These automation and development efforts will result in a noticeable increase in plan sheet production by January 1982, with more substantial increases occurring by fiscal year 1983. The ultimate goal will be the complete generation and storage of plans and specifications through computer media" (*26*).

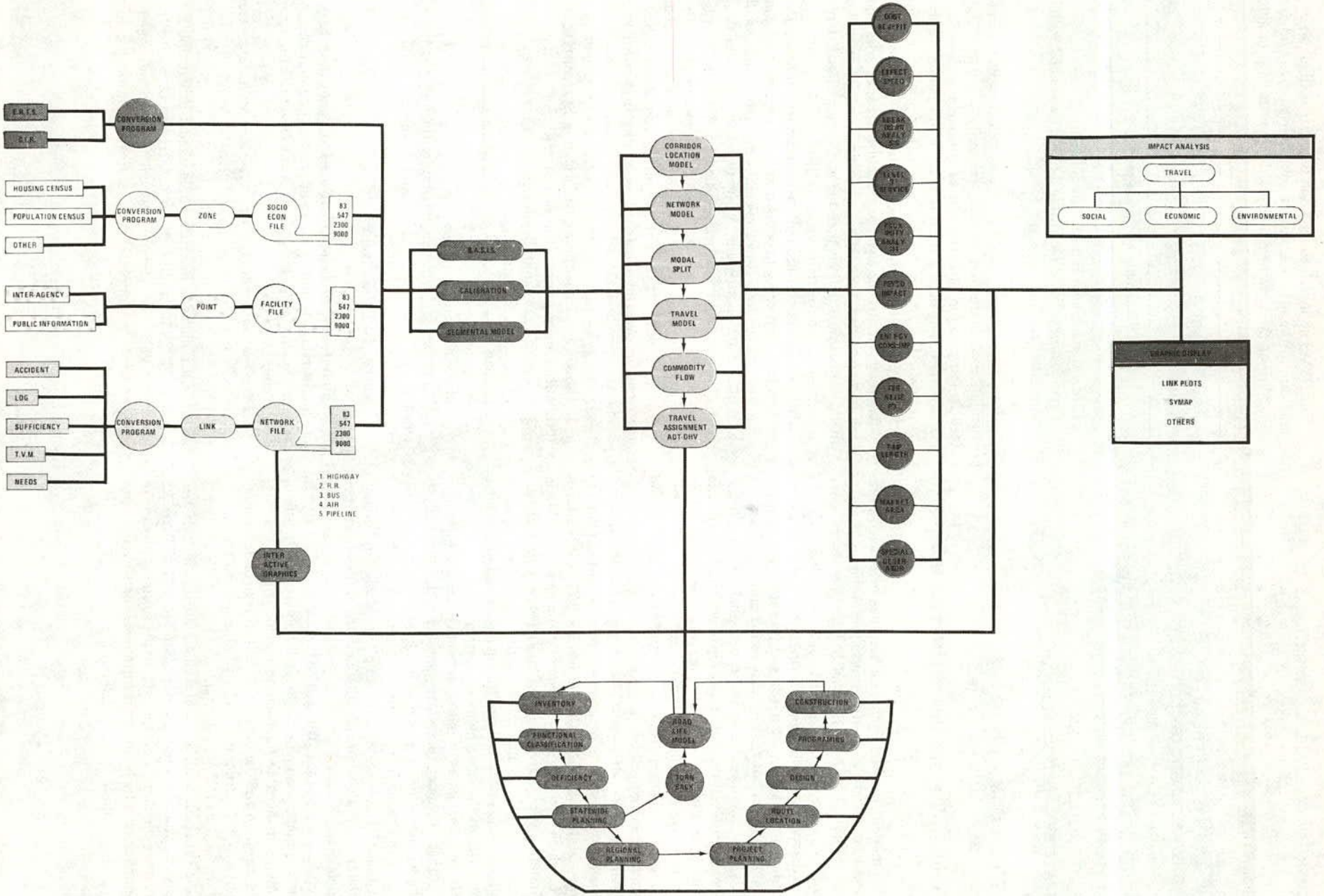


FIGURE 8 Michigan's statewide transportation modeling system (*55*).

The following paragraph povides an idea of the programming effort involved (*26*):

> Application software programs were designed, programmed, and put into production by Automation Division programmer/analyst personnel in response to specific user requirements. The Department is servicing in excess of 100 application areas with over 6,000 software program modules. Approximately 80% of the Department's programmer/analyst resource is committed to the maintenance of these software programs. With the advent of the integrated Management Information System an annual increase of 10% per year is projected for applications program modules.

Comment: The MIS is still in the process of being developed. Its scope and current technology—particularly in graphics and map production—merit inspection and consideration by other states. Given the financial resources that are being invested in this system, the probability that unit computation and computer storage costs will decrease, and the fact that computer programs and experience will accumulate over time, the accomplishment of the goals of MIS appears fairly well assured.

At present, the MIS is primarily concerned with management and engineering, although policy planning and programming are inevitable accompaniments when finances, needs and projects are considered together.

Example of Good Practice 10

Title: Centralized Local Accident Surveillance System

Organization: New York State Department of Transportation

Date: 1976 to date

Problem: Between 1966 and 1975, the NYSDOT developed a computer accident record system utilizing highway sections that had been previously established for purposes of recording traffic volume and highway condition data on the 15,000-mile (24 000-km) state system. During this period, accidents were recorded with improved geographic precision through the use of a reference marker system, posted every 0.1 mile on all state-maintained roads. With this system, the NYSDOT could identify "priority investigation locations" in each region, which could then be examined by regional traffic and safety engineers to determine safety improvements.

However, because nearly three-fourths of all accidents were on the 92,000 miles (148 000 km) of county and municipal roads, an additional system was needed that could supply local officials with accurate information on which they could base their safety programs. Although some local accident recording systems had been developed, it was believed that the best solution would be the creation of a central computer system for use by both the NYSDOT and the Department of Motor Vehicles. A centralized approach was selected to avoid duplication of effort by possibly hundreds of municipalities, to ensure uniform standards and economies, and to employ more sophisticated analytical techniques.

Approach: The Centralized Local Accident Surveillance System (CLASS) was established by creating two basic sets of files: a graphics file and a data base file (*personal communication*, D. Green, NYSDOT). The interactive graphics technology was selected based on ease of file creation and update, speed of data entry, flexibility of output productions, and potential for spin-off products.

The graphics file is a complete representation of all roads in the state, originally developed from the USGS 7.5-minute quadrangle sheets (1:24,000). The output is a single-line drawing of the highway networks for each of the approximately 1,600 municipalities in the state. In addition to highway alignments, the graphics file contains street names, route numbers, and node numbers.

The data base file contains a variety of information for links and nodes. Link data include surface type, area type, road system, functional classification, geometrics, traffic counts, etc. Node data include intersection type, road system, traffic control devices, approach lanes, area type, etc.

Accident data, including location by link or node numbers, are coded by the Department of Motor Vehicles. Although the entire accident record is coded, only the data essential to roadway safety analysis (42 fields) are stored in CLASS at the NYSDOT. The data are stored on-line on four 300-megabyte disk drives. The entire system (software and hardware) was provided as a "turn-key" package. Output products that can be obtained by local governments include (a) accident data and analyses, by location (e.g., a "priority investigation location") or for an entire county; (b) highway inventory data; and (c) cartographic products. Both tabular and mapped outputs can be provided.

Comment: CLASS has potentially more uses than just for accidents. Whether these are on-line uses or off-line (e.g., if the CLASS network is transferred to another computer for traffic assignments) makes little difference: the critical factor is the maximization of the use of a major resource, which is the data base.

However, as is the case for other applications to localities of large data bases, the need to input accurate accident and other local data quickly is an important factor. If this problem can be surmounted, there is no question but that local governments will benefit significantly from this central resource.

Example of Good Practice 11

Title: Tennessee Roadway Information Management System

Organization: Tennessee Department of Transportation

Date: 1974 to date

Problem: The Tennessee Roadway Information Management System (TRIMS) was created to respond to a variety of planning and management problems including:

- Files of papers and data scattered in different places throughout the department;
- Duplication of efforts because "we had people working on traffic statistics, accident reporting, and highway needs studies—all of whom needed information that crossed (organizational and subject matter) boundary lines" (*60*);
- Out-of-date information;
- Need to increase productivity of planners;

- High cost and large amount of time involved in preparing major reports, such as road logs and deficiency ratings; and
- Duplicate coding of many data elements into computer files.

Approach: The approach used in creating TRIMS was to organize data around a common highway identifier, consisting of county, route number, and log mile indicator. A wide variety of data is then entered into the data base, each item being related to this common identifier. These data include route features such as geometrics, bridges, road history, traffic, accidents, vertical and horizontal alignment, and surface conditions.

The data base can be accessed by terminals with CRT displays and/or printers. Either summary reports or individual records for segments between log mile points can be called up. Programming for TRIMS, like that for Michigan's STMS, is modular; new modules can be added as needed.

As Tennessee has remote display terminals, all the information in TRIMS is available to users in other DOT offices throughout the state (*61*).

Comment: TRIMS has all the desired attributes of a high-speed, easily accessed data base. Substantial increases in productivity have been achieved. Users appreciate the accuracy and instantaneous availability of information. It has made possible the related use of several data sets, for example, in programming.

PERFORMANCE MONITORING: EARLY WARNING

Performance monitoring is defined here as a regular program of measurement, analysis, and summary reporting by which a state transportation agency can determine the condition, use, and a variety of other parameters (such as safety, cost, and service to the public) of the different modes of transportation in the state. The term early warning conveys the idea that information obtained by surveillance/monitoring should be used in a forecasting mode to provide an early warning of problems that may need attention in the future by the transportation agency executive.

The concept of monitoring transportation systems has been around for many years. It is implicit in any regular survey of a transportation system, such as that used to prepare highway sufficiency ratings. The Federal Railroad Administration included monitoring in its requirements after rehabilitation of a light density branchline (*12*). More recently, monitoring has been an integral part of pavement management systems (*62–64*).

The purposes of monitoring are basically management-oriented. For example, Kinstlinger (*65*), at the 1979 Conference on Statewide Transportation Planning, argued that as the roles of state transportation agencies change from being predominantly construction-oriented to being predominantly the maintainers and managers of existing networks and services, new measures of performance would be required to enable them to manage better. However, such management must be viewed broadly, so that monitoring is used not only to judge the internal efficiency of a transportation agency and its components, but also as a means for demonstrating needs to the public.

Regular, multimode monitoring apparently has not yet become a formal, identifiable program of state transportation agencies. No specific documented material was identified during the preparation of this synthesis, despite the fact that many measurements are constantly being taken and that data on the condition of state systems and the levels of service provided are included in published statewide transportation plans. There are several possible reasons why monitoring is not a formal program of state agencies: (a) In the past, the preparation of statistical reports on state systems, such as highways, has been a time-consuming, manual process. Hence the idea of creating new statistical series has not been popular. (b) There may be some apprehension that a program of monitoring could be used not only for the expansion/improvement of programs, but also against a transportation agency. (c) The precision of measurement of some parameters may not be sufficient. (d) It may still be too early in the transition toward greater management orientation.

In the future, as data files are more completely mastered and stored on disk, disk-pack, etc., some of the problems noted here will be reduced greatly. The precision (or known variances) of statistical data will be understood better. "Exception reporting" instead of complete data series will be used. Given adequate study and research, the idea of monitoring may come into its own; this will be more likely if the statewide transportation plan becomes more of a management report, such as the annual reports of corporations.

ENERGY

During the 1970's energy became an increasingly important issue in transportation, both because of shortfalls in supply (as occurred during the 1973–74 and the 1979 crises) and because of increasing price. Although the shortfall issue receded from the public consciousness during 1980, 1981 and early 1982, it still lurks as a potentially important factor because of the possibility of war or other crisis in the Middle East, Africa, or the Caribbean. Both from a cost viewpoint and because of its importance in the national balance of trade, there is a need for continued efforts to conserve energy.

State transportation agencies and their planning staffs have been brought into this field, although their roles have changed over time. One principal factor in the roles of state transportation agencies in this area is the division of energy duties and responsibilities within state government between the transportation agency and an energy commission or office. For example, in California, this division of responsibility has been made the basis of a formal memorandum of understanding between the Department of Transportation (Caltrans) and the Energy Resources Conservation and Development Commission (CEC) (*66*). This memorandum spells out responsibilities in the following areas.

Area	Primary Responsibility
Supply Concerns	
1. Conventional Supply Forecasting	Shared
2. Alternative Supplies	CEC
3. Supply Emergencies	CEC
End-Use Concerns	
1. Mandatory Vehicle Inspection Program	Shared
2. Shifting Commuter Peaks	Caltrans
3. Ride-sharing	Caltrans
4. "Transportation Brokerage"	Caltrans
5. Freight Transportation Efficiency	Shared
6. TSM Demonstration Project	Shared
7. State Transportation Improvement Program	Caltrans

As is implied by the preceding list, there are two broad subject areas with which state transportation agencies may be concerned, depending on the responsibilities that have been assigned to them: (a) supply emergencies arising out of sudden energy shortfalls; and (b) long-range planning and implementation of energy conservation.

The subject of energy emergencies is not discussed here because (a) questions of alternative supplies and allocations of available supplies to different user groups are more often vested with state Energy Commissions, Energy Offices, or Civil Defense Agencies instead of with state transportation agencies; and (b) federal emergency regulations were rescinded in 1981 and states are no longer required to have energy emergency contingency plans.

Energy conservation, however, is a continuing need and state transportation agencies have a clear responsibility in this area. However, it should be pointed out that there are limitations to the ability of state DOT's to influence private individuals and firms, or even local governments, to conserve fuel in any substantial amounts. The reason for this is that the ultimate decision maker is the individual or the firm. The main force behind the recent national reductions in gasoline/diesel use has been the increased price of fuel. Since 1973–74, the price of fuel has forced individuals to buy smaller, more fuel-efficient cars and to reduce their travel. Nevertheless, the nature of the conservation problem requires an accumulation of many small actions, a good number of which are the responsibility of state transportation agencies. These actions fall into three areas:

- Departmental fuel conservation. A state transportation agency must set an example of conservation in the operation of its own vehicle fleet and construction practices.
- Support of fuel conservation measures by the driving public, including such measures as car and van pooling, HOV lanes, park-and-ride lots, truck climbing lanes, and TSM measures.
- Provision of accurate information and forecasts regarding gasoline consumption, VMT, travel needs, transit utilization, bus fleets, and the like.

Example of Good Practice 12

Title: Staff Energy Studies

Organization: New York State Department of Transportation

Date: 1974 to date

Problem: Ever since the 1973–74 energy shortfall caused by the Arab oil embargo, the problems of gasoline and diesel-fuel shortfalls and price rises have concerned state transportation agencies. New York's position has always been especially sensitive, because it depends more heavily than most states on oil imports from the Middle East. Consequently, it was important for NYSDOT to allocate ample staff resources to deal with all the varied aspects of both contingency planning and conservation planning. One of the principal problems to overcome has been the lack of adequate information, across the board, on all aspects of energy.

Approach: The Planning Research Unit of NYSDOT was assigned the task of providing the necessary data bases, studies, and recommendations for action. A substantial number of studies and papers were completed and published as "Preliminary Research Reports" (PRR's). A partial listing of the more recent studies is included in the Reference section (67–82). The studies cover the following subjects:

- Energy conservation plans
- Automobile purchasing patterns
- Estimating urban gasoline consumption
- The 1979 summer fuel crisis
- Energy contingency planning
- Impacts of fuel shortages
- Energy assessment for local government
- Long-range forecasts of energy consumption
- Impact on transit usage
- Sensitivity of work/nonwork travel to shortages and price
- Impacts of TSM actions
- Project level energy costs (TSM and construction/maintenance projects)

Thus a gradually increasing body of data and knowledge has become available to be used by NYSDOT in the decision-making process. These studies also constitute a significant resource available for use by other states.

Comment: The constantly changing nature and patterns of energy use and requirements clearly indicate the need for monitoring the many dimensions of this field, including vehicle type and use, distribution of travel within the state, fuel sales and price, transit fleets and use, and other factors. Such monitoring would be greatly aided by the use of an on-line data base such as Michigan's STMS (Example 8).

Example of Good Practice 13

Title: Energy Considerations in ConnDOT Decision Making and Operations

Organization: Connecticut Department of Transportation
Date: December 1980
Problem: The problem was defined as the investigation of "what, where, and how energy considerations are derived within the Connecticut Department of Transportation"; i.e., to take a broad look at all aspects of energy conservation in a state transportation agency, from enabling legislation to the details of enforcement (*15*).

Approach: The approach consists of a straightforward documentation of all aspects of energy conservation at the level of a state transportation agency, including (a) legislation and policies; (b) transportation planning process; (c) ConnDOT operations; and (d) ConnDOT fixed facilities. Approximately half of the 200-page report consists of documentation of legislation, state policies, ConnDOT directives to employees, tables of the department's energy conservation measures, and calculations of energy savings.

Comment: The report makes no claims that great savings will result from implementation of its recommendations. Instead, it leaves the clear impression that continuing work on small items is essential and that the reward lies as much in cost savings as in energy savings. The documentation is thorough, even including copies of all directives to employees on conservation matters; as a result, the report will be a useful guide for continuing work in this field.

THE ENVIRONMENT

From the perspective of statewide transportation planning, environmental planning is discussed below. Examples of significant reports are cited, but no examples of good practice are provided, because they are too extensive and technical to document.

Environmental Policy

Most policy or goal statements prepared by state transportation agencies include a declaration of policy with regard to the preservation and enhancement of the environment. A typical policy is stated in Wisconsin's "State Transportation Policy Plan" (*19*):

> The Department shall strive to protect and enhance the human environment in carrying out its basic transportation mission and shall consider all pertinent environmental factors in its decisionmaking.

Wisconsin's policy on the environment goes on to (a) explain the rationale (primarily the National Environmental Policy Act and the Wisconsin Environmental Policy Act) on which the policy is based, and (b) list nine implementation guidelines, which are, basically, detailed extensions of the initial policy. These guidelines include such declarations as finding better methods for evaluating environmental impacts, achieving compliance with federal air and water quality standards, and noise abatement.

Statements of environmental policy by state transportation agencies are essential because they indicate that the transportation agency will incorporate environmental considerations in their ongoing administrative, public participation, project planning, and design processes. The intent, of course, must be implemented or the policy becomes meaningless and ultimately demoralizing.

Figure 9, taken from the Wisconsin Policy Plan, indicates A–N policies, and examines their potential impacts on social, economic, physical, and energy categories. Policy A, for example, is on multimodal planning; Policy B is on investment programming; Policy E is on supporting the Wisconsin economy; and Policy H is on transportation safety. Policy E (support for the economy) is credited with the greatest "potential for negative environmental impact."

The summary of the analysis of the plan (*19*) states:

> Implementation of the plan is likely to produce mostly positive environmental impacts, depending upon the implementation strategy . . . the plan sets up a process . . . which increases the probability of arriving at environmentally sound decisions at subsequent stages of the Department's four-part decisionmaking process.

It is likely that this would be true for other states; where the statewide transportation plan is general, its impacts will probably be found to be beneficial. However, this will depend on subsequent work as more detailed corridor, project, and engineering design studies are prepared. This transfers most environmental responsibilities from the statewide transportation planning staff to the level of corridor and project planning.

The Statewide Air Quality Plan

Transportation planning at the state level can have a meaningful input in the area of air quality due to the following reasons: (a) the mandates set by the National Clean Air Act of 1970 (as amended 1977), (b) the fact that instrumentation can monitor performance, and (c) the fact that dispersion of pollutants may spread beyond the boundaries of metropolitan areas, thus converting a local problem into a state problem.

State interest in this field is significant because of the large sums of money involved, the economic impacts, and difficult interstate relationships.

The following excerpt from a New York State report (*83*) concerns a truck air pollution control measure being considered for New York City:

> As emissions from cars are reduced, pollution from trucks will be responsible for an increasing percentage of carbon monoxide pollution. Installation of catalytic converters on heavy duty gasoline trucks will reduce these emissions. Although workable anti-pollution devices for these trucks now exist, some design work and testing remains to be done. New York will undertake to demonstrate the effectiveness of anti-pollution devices on trucks and is committed to implementing a reasonable program to control truck pollution. However, before implementation can begin, the USEPA must assist New York through funding the initial demonstration and by urging New Jersey and Connecticut to adopt a truck control program similar to New York's.

It is likely that only a state transportation agency can negotiate such a matter successfully.

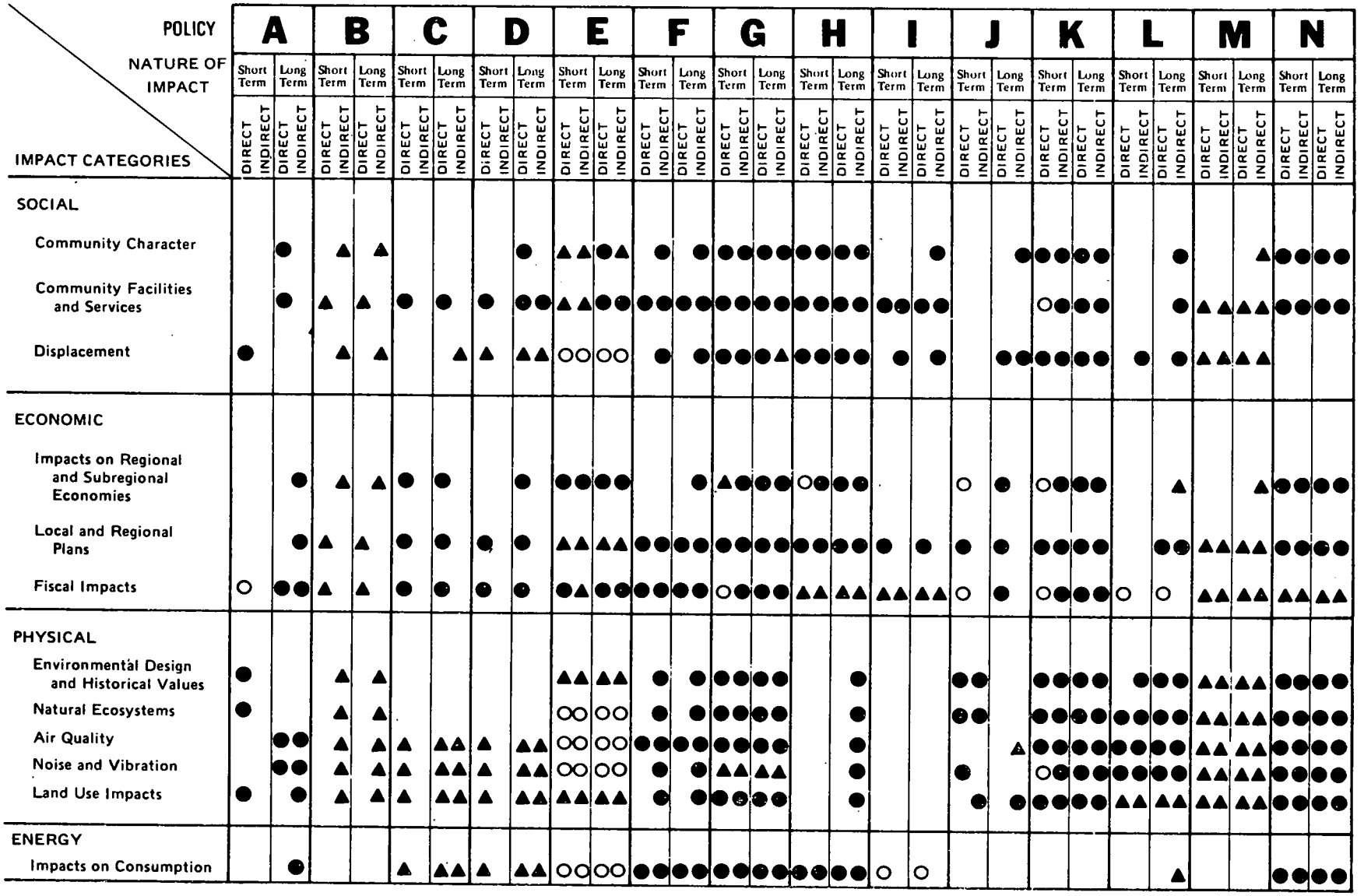


FIGURE 9 Potential impacts of state transportation policy plan by policy area (*19*).

CHAPTER THREE

EXAMPLES OF GOOD PRACTICE: THE SUBSTANTIVE SIDE

The substantive side of statewide transportation planning is defined here as planning for the various modes and for multiple modes where appropriate. From the materials supplied by the states and information gathered during visits to state agencies, it is difficult to find any strong trends or exciting new techniques in modal planning at the state level. The following conclusions, however, can be drawn.

1. Most states develop plans one mode at a time, and combine such single-mode plans in the published statewide transportation plan. This process may employ either single-mode or multimode demand models that take into account the "draws" of other modes (*84*). Michigan (*49*) has the capability for substantial multimode simulation. Washington, through its corridor approach to planning, can deal with multiple modes in corridors without excessive complexity. However, with these exceptions, the emphasis is primarily on single-mode planning.
2. Single-mode system planning has advanced steadily, but with greater emphasis on (a) precision of data inputs and (b) pragmatism in terms of economic outputs instead of simulation of flows over extensive networks. Generally, complex modeling appears to have decreased as an activity of state transportation agencies. Only three or four states appear to be active in the highway portion of this field. However, this situation may change when more on-line data sets, such as those in Michigan, are available. Further, even where there is flow simulation, the computer is being used primarily as an accounting tool by which costs and revenues of networks are summed up. This is extremely important for economic evaluation.
3. In some modes, notably intercity bus and rail planning, there is a down-to-earth trend in planning where the project and its implementation become dominant, and where the organization for administration/implementation has become a fine art.

HIGHWAY PLANNING

Over time, highway planning has evolved into a series of well-defined activities that can be organized by level, starting with systems planning, then corridor planning, the project development process, which includes project planning and engineering design, and eventually construction.

In addition to the preceding activities, the transportation planning staffs in some states may become involved in highway project planning and/or in providing highway planning services to counties or small urban areas. An example of good practice in the provision of planning services in Georgia is given in this chapter (Example 16).

The principal highway planning activities at the statewide level are identified and discussed briefly below, with particular attention to those changes resulting from the recent issues and the responses by transportation agencies described in Chapter 1.

Systems Planning

For many years, the design or layout of new systems of major highways serving an entire state was an exciting challenge to planners within and outside state transportation agencies. However, since 1956, when the Interstate system was established, or perhaps since 1965 when the Appalachian Regional Highway System was planned (*85*), the issue of developing grand new designs for major highway systems has subsided for most states, because most highways have already been constructed and construction funds have been reduced.

The systems planning problem, therefore, now consists of adapting and refining existing highway networks—deciding which highways to improve, where to add a link, and whether or not to complete a link that has been planned.

One aspect of systems planning has been the simulation of traffic flow over alternative highway networks. At the statewide level, such simulation has been difficult because of the size of the network, the cost of obtaining data, and the fact that most trips are extremely short relative to the sizes of zones and the size of the network. As a result, only a handful of states have successfully run computer traffic assignments. However, with the advent of large on-line data storage systems, it is now possible to overcome most of the difficulties of statewide assignments. The Statewide Transportation Modeling System in Michigan (Example 8) can be used with great flexibility either to make assignments at the statewide level or to "window in" on a smaller area (for example, the choice of alternative bypasses).

Functional Classification

The functional classification of highways is a continuing activity that is important in the management of state highway systems and their relationship with local systems. The methodology of classification is mature and well-documented (*86,87*) and thus is not discussed here.

Jurisdiction Studies

A report by the Wisconsin DOT (*88*) has identified 12 states (Arizona, Colorado, Florida, Illinois, Indiana, Iowa, Michigan, Minnesota, Nebraska, New York, Pennsylvania, and Wisconsin) that have undertaken jurisdictional studies in which the realignment of responsibilities among state, county, and other local governments was examined. The

thrust has been to bring jurisdictional responsibility into alignment with functional classification.

The difficulty with jurisdictional realignments is that financial and legal matters of considerable size and complexity have to be resolved. Changes may affect the level or type of federal funding, and state legislation is often required. Local approvals are, of course, an absolute necessity. Often the cost of a realignment in terms of staff time (especially if realignment is proposed on a statewide basis where every county must be dealt with) may exceed any efficiencies that are gained. Hence it is probable that jurisdiction changes will proceed only on a piecemeal basis.

Needs Studies

The needs study has been the classic approach to the development of highway policy. By assuming a given standard for each functional type of highway—in terms of geometrics, grade, horizontal and vertical curves, sight distance, volume-to-capacity ratio, and intersection type—it has been possible to compute future needs. These needs were then converted to dollar needs (long-term) to be used as the basis for budget requests, both at the state and federal level. The FHWA needs studies of 1968, 1972, and 1974 were carefully designed procedures that set the basic pattern for such work (*86,87,89*).

Given the financial problems of federal and state governments, however, the needs study as a planning activity may be in eclipse. The result of the needs study is preset by the standards that are accepted at the outset; thus the higher the standards, the greater the need. Also the needs study produces too coarse a product for decision making; it must be fine-tuned to comparisons between projects, or to alternative ways of serving the public with greater efficiency.

It should be noted here that variants of the needs study have been developed in which lower standards are accepted, using such terms as "tolerable," "acceptable," or "threshold." Lower standards will reduce estimates of financial need.

Pavement Management Systems

Maintenance and rehabilitation of highway pavements have become high-priority issues in the past few years as a result of sharply rising costs of materials and labor, the aging of the Interstate system, and the shortage of funds available for reconstruction, rehabilitation, and maintenance. Under pressure from these forces, state transportation agencies have searched for economical and effective pavement management strategies.

Should planning be involved in this type of work? Historically, the highway inventory function has been a planning function in many state transportation agencies, including the traditional "road life" studies. In addition, maintenance/rehabilitation cost estimates play a large part in total highway costs, whose estimation is a major input to policy analysis. Finally, the highway data base on computer may be the responsibility of planners as a part of the total transportation data base. However, there is no necessity for planners, with transdepartmental access to an on-line data base, to have more than access to the data base and the ability to obtain, on short notice, estimates of total needs and costs under alternative assumptions of investment policy.

The key elements of an adequate pavement management system are:

- Complete inventory or an adequate sample of all miles (preferably lanes) of the system, which must contain condition measurements or indicators regularly updated on an annual or biennial basis.
- Set of criteria, either in the form of "distress trigger values" or in the form of predictive equations, that will indicate the lanes or miles of highway in need of maintenance or rehabilitation. The criteria should be based on historical data to the extent possible.
- Equations for estimating the cost of maintenance and rehabilitation under alternative investment strategies. The equations must be based on historical data for the region or state.

In addition to these key elements it is helpful to establish procedures whereby a transportation agency's district or regional engineers can redefine the limits of projects identified by the computer program in order to utilize the more complete data provided by on-site inspections. Procedures for recording on the data base the types of actions that have been taken are also helpful.

In the future, this type of approach can be extended to apply to other problems such as bridge replacement, airport runways, and railroad lines. Extension to county and local roads is, of course, logical but will demand a high level of cooperation from local governments, most of which are underfunded.

Two examples of good practice (from Arizona and California) are given below. Other states reporting use of pavement management systems are North Dakota (*62*) and Washington (*90*).

Example of Good Practice 14

Title: Pavement Management System
Organization: Arizona Department of Transportation
Date: 1974 to date
Problem: The ability to predict future pavement conditions is the key to policy planning (for financial resources and needs) and to the careful management of maintenance/rehabilitation/reconstruction activities. Without the ability to predict, levels of future expenditures will tend to seesaw as a function of political reactions to pavement crises and funding pressures.
Approach: The following is taken, in part, from a paper by Way and Eisenberg (*91*).

A pavement management system (PMS) has been defined as "the systematic development of information and procedures necessary in optimizing the design and maintenance of pavements." To provide this type of management, the past, present, and future condition of the highway must be known. In addition, it is necessary to know the history of the highway—the date it was built, the materials used, and the thick-

ness of layers, overlays, seal coats, and flush coats used—as well as to obtain information on traffic and region.

The Arizona DOT has maintained good as-built records of what has been constructed and when it was built. Besides this information, the DOT began collecting highway condition measurements in 1972. These measurements include roughness, skid number, deflection, cracking, and rutting. Generally, measurements are collected at least every mile and either annually or biennially.

From this wealth of past condition data, prediction equations were developed by means of regression analysis. These equations predict future roughness and cracking from past conditions. By setting an acceptable condition level, it is possible to determine the optimal action for each mile of highway for each year. The cumulative cost of these yearly actions represent the budget required to keep the highway network at or above the acceptable level. A budget is constructed for each future year as well as for any condition level. Condition levels are a function of highway type (interstate, primary, secondary) and traffic level, thus giving the program greater flexibility. If future funding levels are fixed, it is possible to determine the best possible level of condition for the network by year and recommend appropriate actions to meet this level.

After running the network optimization program, projects are selected. Detailed designs are prepared for each project. Designers select from dozens of possible designs, provided the final design cost does not exceed the network programmed expected cost. Projects are constructed and the condition monitored to check actual performance against the predicted. In this way, prediction models are updated. In addition, miles of highway performing better or worse than predicted are detected. The cause of the good or bad performance is determined by subsequent project analysis; from these studies changes are recommended in design, specifications, construction, and/or maintenance.

The PMS in Arizona, which includes a network optimization process, has been used extensively over the past 2 programming years and has played a significant role in the priority programming process. The PMS is a fully operational, functional program within the DOT and will continue to provide input into the priority programming process.

Comment: From a policy and planning/management viewpoint, the ability to predict future conditions and the consequences of alternative investment strategies is a major gain. Like other management systems, a PMS requires a good data base, but once established such a base can be maintained, stored, and accessed at relatively low cost.

Example of Good Practice 15

Title: Pavement Management System

Organization: California Department of Transportation

Date: 1978–79 to date

Problem: With the aging of roadways, limitations on funds, and slowness of conventional (manual) methods in a large state, the need for objective, uniform, and high-speed methods for managing the rehabilitation of existing pavements became increasingly apparent. Management believed that there were inadequate data on which to base decisions and an inability to examine the impacts of alternative investment or budget levels. Better information was also needed on the condition of the state roadways in order to convince legislators of the need for adequate funding (*92*, *93*).

Approach: Caltrans determined that the following procedures were necessary to manage pavement on the state highway system: (a) a statewide condition survey, (b) a method for evaluating the condition of the pavement, and (c) a method to estimate program needs and costs and set priorities for rehabilitation projects.

The condition inventory is taken biennially, using a ride meter (similar to the PCA roadmeter) and a visual pavement distress survey. The ride value and measured pavement problems are recorded for each lane over sections having similar characteristics.

The condition evaluation is based on past experience in California with pavement performance and the effectiveness of alternative rehabilitation strategies. Each lane is evaluated separately, and a systematic procedure is used to select the best strategy for each section or group of sections. The selected strategy is used for the development of a plan and budget. This does not necessarily commit the district engineer to design the rehabilitation work along the indicated lines, since the district will have more detailed field structural condition information.

Finally, program needs and costs are summed for the state and for the districts. Alternative budgets can be prepared that will produce different performance levels for the traveling public based on different "distress trigger values."

Comment: This is another example of a computer-based system for dealing with the management of pavement maintenance and rehabilitation. It is noteworthy that the research undertaken to develop the system dealt with specific existing (physical) rehabilitation techniques and the conditions under which their application is most cost-effective.

Example of Good Practice 16

Title: Small Area Planning

Organization: Georgia Department of Transportation

Date: 1978 to date

Problem: Although the Georgia DOT maintains a 20-year statewide plan as a broad program guide, the Planning and Programming Division found that system planning at the state level was not suitable for identifying, in timely fashion, a sufficient number of improvement projects to enter into the programming-design-construction pipeline. The commissioner of the DOT wanted more direct involvement in the selection of such projects and desired a shorter-range focus, preferably with personal knowledge of the projects by planners.

Approach: The Office of Statewide Systems Planning selects a county, subcounty area, corridor, or small urban area on the basis of request from local or state authorities and of knowledge of existing problems and corridors identified in the long-range statewide plan.

The planner assigned to the project assembles data from the road inventory, the photo log, maps, traffic counts, accident records, and other sources. The state highways in the area are analyzed for deficiencies and needs. Small-scale traffic assignments may be prepared to study impacts of any new roadway that might be proposed.

A site visit is always made and photographs taken. Detailed information is collected on all features, including signing, road condition, guardrail, excess vegetation, that apparently need improvement as seen from the viewpoint of a professional who is, in effect, a newcomer to the area. Meetings are held with local area planning development commission staff, Georgia DOT district engineering personnel, and municipal and/or county authorities to discuss improvement needs.

Finally, a brief (10–25 pages) planning document is produced containing: location map, sketch plan (map form), list of projects recommended (short, intermediate, and long-term), supporting data and maps, and photographs. The report is prepared for approval by the commissioner. Recent reports make use of full-color xerographic reproduction.

Between 60 and 70 of these planning studies have been produced in the past 4 years. Each report requires approximately 6 weeks of preparation by an experienced planner or engineer.[1]

Comment: The production of practical and detailed plans for local areas, bringing together both local and main-office viewpoints and data, if carried out on a regular basis with a cycle length that is not excessively long, is of substantial benefit as a service to the head of a state transportation agency. This practice ensures a continuing flow of projects into the programming-design-construction pipeline, and the development of confidence in the planning organization. It also demonstrates to local governments transportation agency concern for their problems.

Other benefits cited by Georgia DOT personnel include: development of intratransportation agency competitiveness to "get things done" after needs have been identified by the main office planner; and provision of a fresh viewpoint on site to spot deficiencies overlooked by local (and state) engineers familiar with the situation.

The use of colored xerography for reproduction is a definite asset in presenting complicated maps to the layman. Color also enhances the photographs that appear in the reports.

[1] The Office of Statewide Systems Planning, Georgia Department of Transportation, provided the following short reports, which are examples of "area plans" and "corridor studies" produced by that office (copies are not available for distribution):

- Improvement Analysis S.R. 38-U. S. 84 Alabama State Line to the Brooks-Lowndes County Line (1978).
- Fort Valley Bypass and Railroad Grade Separation Study (1978).
- Madison By-Pass Study (1978).
- Corridor Study, U.S. 23 I-16 to McRae (1979).
- West Point Sketch Plan (1979).
- Lafayette and Walker County Transportation Study (1980).
- S. R. 225 Corridor Study, Calhoun to Tennessee (1981).

INTERCITY AND RURAL BUS PASSENGER PLANNING

Intercity bus transportation poses difficult problems for statewide transportation planning, especially in a era of financial constraints and deregulation. These problems include: (a) revenues that are just keeping pace with rising operating costs (*94*); (b) declining ridership (generally has been declining since 1945 but stabilizing after 1976; revenue passenger miles have been nearly constant since 1968) (*94*); lack of or inadequate bus service to smaller communities and sparsely settled areas; and (d) threatened termination of service on light-density lines. As to be expected, these problems are more severe in low-density areas and between the smaller cities.

The issues facing state transportation agencies are: (a) Whether, and how much, to subsidize the human-service types of rural public transportation service; (b) Whether, how much, and how to subsidize intercity private carriers that are not in the human-service business; (c) whether to support intercity bus terminals serving more than one bus line and more than one mode of person-transportation; and (d) what should be the distribution of state and federal funds among the different types of transit operations.

Three examples of good practice are provided below. Example 17 (Iowa) deals with regional transit planning and the summation of 16 regional plans into a state transit plan. Examples 18 and 19 (Michigan) deal with the question of state-supported intercity bus terminals and the Michigan program of loans for purchase of new equipment.

The techniques of intercity bus planning (emphasis on fixed-route service in rural areas and between smaller cities) are covered by NCHRP Project 8-25, "Intercity Bus Transportation Planning."

Example of Good Practice 17

Title: Regional Transit Development Plans
Organization: Iowa Department of Transportation
Date: 1980 to date
Problem: To develop implementable transit plans for each of 16 planning regions and to summarize these plans to permit the preparation of a state transit plan.
Approach: The Iowa Department of Transportation publishes a manual for regional transit development plans (*42*), which has served as a guide to each of the 16 regions in the state. The manual is designed to minimize the amount of time that must be spent by the regional transit planners in completing forms and preparing descriptive materials. The manual calls for a four-part report (excluding introduction and appendices) covering: present conditions; needs and policy directions; 1-year developmental alternatives; and recommended alternative and 5-year program. Most attention is focused on the first and second years.

The regional plans prepared in 1980 were summarized in the 1981 Iowa Transit Plan (*95*). This plan, with a structure parallel to the regional plans, presents the total picture of transit needs and plans, by type, for 33 public systems, including 16 predominantly human-service oriented regional systems, 10 small urban systems, and 7 large urban systems (see Figure 10).

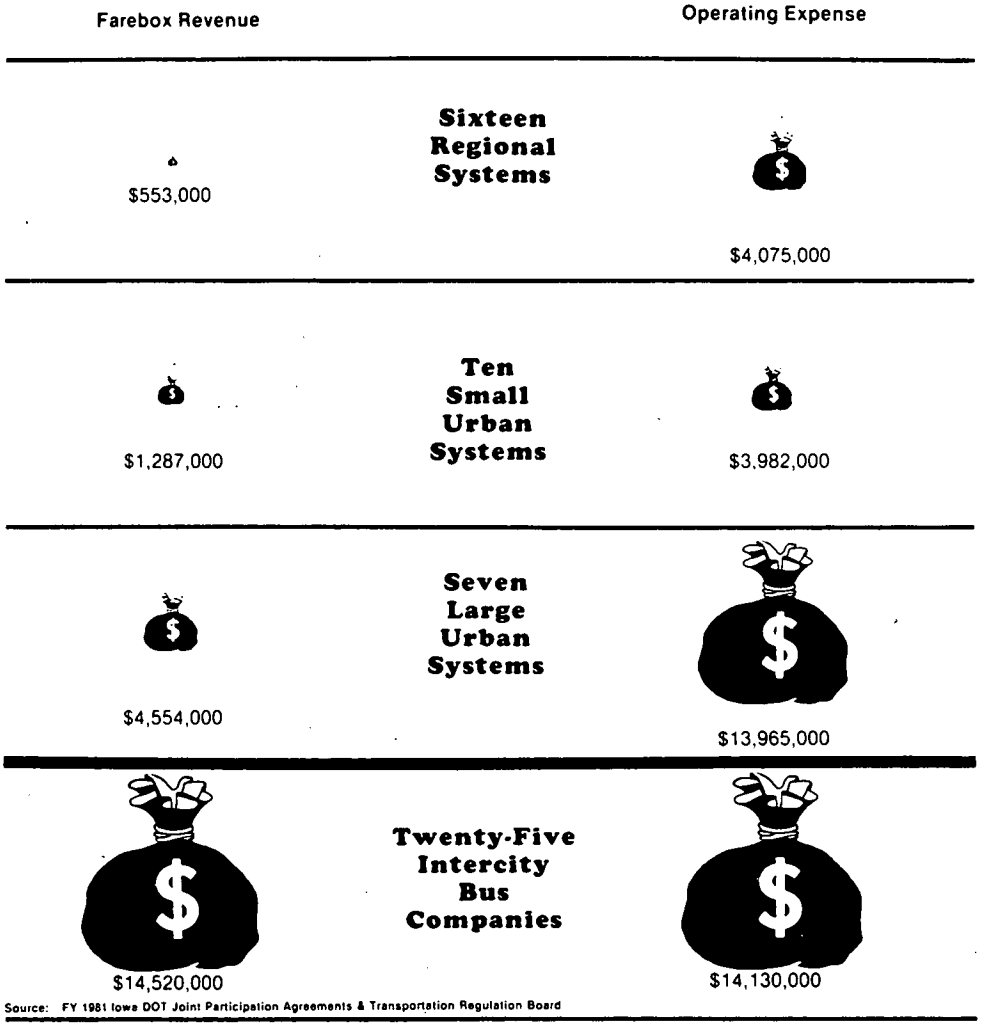


FIGURE 10 Revenue/expense comparison (*95*).

Comment: This is an excellent example of a disciplined planning process uniformly followed by all regions in a state. The process has obviously been structured so that the components can easily be summarized into a state plan.

The system works clearly through objectives established in a well-defined public participation process to an evaluation process that measures performance of each individual system against five parameters (ridership; ridership/expense ratio; cost per mile of operation; revenue-expense ratio; and expense per rider).

The state plan looks carefully at aggregate state and federal funding sources; the implications of recent federal policies have been identified in an addendum.

Example of Good Practice 18

Title: Passenger Terminal Program
Organization: Michigan Department of Transportation
Date: 1975 to date
Problem: The problem involved aid to bus transportation in the state, both intercity and local, and, where possible, to other modes through assisting in the construction of passenger terminals. Existing terminals tended to be unattractive and uncoordinated; i.e., serving separate intercity bus lines and not providing ready access to local bus systems or to rail. Such conditions do not foster increased ridership on mass transportation.

Approach: The Michigan DOT established the following objectives (*96*):

1. Assist communities in the development and construction of new or improved transportation facilities by providing conceptual guidance, direction, and financial assistance.
2. Ensure that all facilities are designed to serve all public transportation modes in the communities served through integration of all services and development of intermodal transportation and improvement of the convenience of travel by public transit.
3. Improve the safety and comfort of intercity travelers and stimulate increased patronage of intercity carriers by providing bright, safe, and attractive public transportation facilities.
4. Design facilities to become self-supporting operations with all income used to offset operating and maintenance costs.

In implementing the preceding objectives, the DOT opened the Kalamazoo multimodal terminal in 1975 to serve intercity buses, local buses, and Amtrak passenger trains. Subsequently, terminals of various types have been opened at Houghton-Hancock (in the upper peninsula), Battle Creek, Pontiac, Dowagiac, Cadillac, Alma, and Marquette. In general, the terminal buildings are paying their own way and have produced modest gains in ridership.

Comment: This program is a sensible way to aid intercity bus transportation, especially where multiple private bus companies would not otherwise combine their terminals. The program also links intercity bus services with local bus service and to rail terminals where applicable. At present, too many private intercity bus terminals repel, instead of attract, riders.

Example of Good Practice 19

Title: Intercity Bus Loan Fund Program
Organization: Michigan Department of Transportation
Date: 1975 to date
Problem: The state-formed Michigan Intercity Bus Task Force concluded in 1975 that the capital cost of new buses was a major problem to bus companies. Hence a policy was established to seek ways of funding bus purchases in a manner that would permit carriers to pay back the investment over time and eventually to secure title.
Approach: A revolving fund was established, to be administered by the Intercity Passenger Division, Bureau of Urban and Public Transportation, Michigan Department of Transportation.

Any carrier certified by the Michigan Public Service Commission and operating "at least 150 miles per day at sole company expense, without any form of public support, in regularly scheduled service is qualified to participate in the program" (*98*). Currently, payback is at 5 percent over a 6-year period and 9 percent on an optional 8-year payback. Whereas the program was originally permitted to be used for fleet expansion, now it may only be used to provide replacement buses.

Under the program, the state has purchased over 100 buses for 19 carriers since 1975. Over 30 percent of the original $10,500,000 investment has been repaid.

Comment: Without getting into expensive programs of subsidizing operating costs, this is a practical and low-cost method of assisting private carriers and helping to maintain intercity bus service in low-density regions.

RAILROAD PLANNING

The entry of states into rail planning began in the Northeast in 1974, following passage of the Regional Rail Reorganization Act of 1973. The Railroad Revitalization and Regulatory Reform Act of 1976 extended the local rail service continuation program and the rail transportation planning process to all states. Both acts were in response to the financial difficulties railroads were facing, the need for a fundamental restructuring of the railroad industry, and the high probability that thousands of miles of light-density lines would have to be abandoned. States were asked to plan and to be the conduits for financial aid to restore those branchlines that had economic viability.

The Federal Railroad Administration published a Rail Planning Manual (*11*, *12*) in 1976 and 1978 which, along with other FRA requirements, became the guidelines for state rail planning. Railroad planning became a continuing process, with annual updates required to be submitted by each state in order to keep current with the changing abandonment picture and to monitor the effectiveness of subsidies provided.

In general, the state rail planning program became a well-established and effective activity; some branchlines were saved through cooperative government-railroad-user support, but many had to be abandoned as victims of a changing industrial and transportation world. State transportation agency staffs became both knowledgeable and realistic about a mode with which they had been totally unfamiliar, and rail-freight transportation thus became an integral part of most transportation agency planning. So many examples of state rail planning are available (*99–104*) that it is unnecessary to report any specific examples of good practice.

The thrust of state rail planning under the guidance of the FRA was primarily toward the branchline problem. Although one or two multistate regional rail planning studies were launched, the tacit policy of the federal government appeared to be to have the states stay away from the restructuring of mainlines, except during the initial disaster-prevention act of creating Conrail. Restructuring was to be worked out mainly by industry and the courts. In some cases, however, the states have made their viewpoints known behind the scenes.

Because rail passenger transportation is nationally the responsibility of the National Railroad Passenger Corporation (Amtrak), most states have not been involved in rail passenger planning. Exceptions include Wisconsin's Rail Passenger Services Study (*84*, *105*), studies of comparatively short lines (e.g., Los Angeles to San Diego), and unique studies, such as the Willamette Valley study in which the cost impact of a new passenger service on existing freight operations was estimated (*106*).

FREIGHT PLANNING

Freight planning as an activity of state transportation agencies most often arises from a unique commodity or facility problem, not from a general problem of an entire system. For example, with respect to grain transportation, which has been the subject of both a Montana study (Example 20) and a combined New York-Connecticut study, in both cases the problem deals with only a narrow group of commodities within the total system of collection-storage-shipment. Other freight studies have been oriented toward a particular facility, such as a riverway (*107*), a canal (*108*) or a port.

Because the problems are unique, the recent thrust of state transportation agency freight planning has emphasized specific demand data, actual transport costs and rates, speeds of transport, specialized equipment requirements, varying rates as a function of volume, vessel sizes, and similar matters. Long-range, generalized, predictive equations are less frequently used. Where modal splits have to be estimated, the estimates are based on comparative costs and times with due consideration to any special needs of the commodity including its value, density, perishability, existing contracts, and seasonality factors. (It should be noted that data on demand and costs may not always be available from private businesses.)

NCHRP Project 20-17A, "Application of Statewide Freight Demand Forecasting Techniques," which is currently under way, is expected to produce a set of specific case examples and a manual on demand estimation procedures. In this case "demand" means not only the forecasting of the actual tonnages of freight output but also the estimation of mode used, route, final destination, and costs.

In Example 20 (*109*), the problem transcends railroads and trucking and involves the costs of the farmer-producer, the situation of the small country elevator operators with the extra services they offer, the opportunities for major investment in grain subterminals, and the patterns of shipment by rail to the West Coast or the Gulf Coast areas. This is an example of adaptation by private and public enterprise systems to obtain minimum cost solutions embracing the totality of production, transportation, storage, capital, and interest costs, which was identified as an issue in Chapter 1. Unless transportation agencies get involved with nontransportation items, they may be missing important variables in the freight problem.

Example of Good Practice 20

Title: Bulk Freight Grain Transportation Study
Organization: Montana Department of Highways
Date: 1980

Problem: A transition in the transportation and storage of grains produced in Montana occurred in 1979–80. The former system consisted of small grain elevators located on branchlines to which farmers trucked their harvests of various grains, predominantly wheat and barley. The small elevators could only be served by a few rail cars. The new system would require more long-distance trucking to large grain subterminals; these would be capable of filling entire unit trains (80 to 100 or more cars), and lower rail rates would result. Most shipments were to the West Coast, either to a river terminal or to a seaport. The problem consisted of the need to evaluate the alternatives.

Approach: A complete origin-destination commodity flow matrix was carefully developed. Probable locations of major grain subterminals were established. Grain flows were simulated over the existing network (truck-small terminal-rail) and over a future network (truck-large terminal-unit train). Special emphasis was given to establish reliable cost data, including costs of loading, unloading, and storage at different sizes of terminals, with capital costs being included in the equations.

The results were basically an economic evaluation of the total costs of the alternative systems. It was concluded that grain subterminals have a substantial economic advantage over the smaller elevator system in terms of reduced transportation costs (*109*).

Comment: This type of study, basically using cost-accounting methodology, represents a significant departure from earlier freight demand modeling that stressed theoretical relationships. Where theory had worked well in passenger demand estimation and mode choice, it was less successful in the freight field because of unique product characteristics, asymmetry of flows, and institutional factors. It should be noted, however, that the cost-accounting approach is best adapted to limited problems when all the facts can be obtained; it would be inappropriate for national applications.

WATERWAYS AND PORTS

Inland waterways and ports have for many years been low-priority items in the field of statewide transportation planning, even in those states where water transport is an important mode. This is because in most states the U.S. Army Corps of Engineers has been the planning and construction authority for inland and coastal waterways, whereas individual port authorities have dominated the scene in their respective urban areas. However, as a result of the increasing importance of imports and exports to the economy, the scarcity of financial resources (which makes investment decisions more critical), and the many interests that are affected by waterway construction activities (environmental, water supply, recreational, and commercial), states appear to be taking more interest in this subject.

Studies of ports and waterways generally contain the following major components:

1. Historical, descriptive, and statistical materials, which are essential to a background understanding.
2. Freight transportation demand estimates.
3. Technical data describing current or future vessel sizes, transloading equipment, storage requirements, and needs for land transportation connections.
4. Engineering cost estimates for port/waterway improvement.
5. Economic evaluation of improvements as a function of increased demand or lowered transport costs; evaluation of other impacts.

6. Miscellaneous land-side transportation improvement requirements.
7. Data on miscellaneous institutional matters, including labor costs.

Two examples of good practice are reported here: Example 21 covers the first item listed above, and Example 22 covers the second item. Wisconsin is currently conducting a study in which the fifth item listed above (economic evaluation of improvements) is being applied to a series of improvements proposed for Wisconsin ports so that the state transportation agency can make an informed judgment on priorities among ports.

Example of Good Practice 21

Title: The Gulf Intracoastal Waterway in Texas
Organization: Texas State Department of Highways and Public Transportation
Date: 1976; 1978; 1980
Problem: The State Highway and Public Transportation Commission was appointed by the Texas legislature in 1975 to act as agent for the state of Texas as the "single, local, non-federal sponsor" of the Gulf Intracoastal Waterway in Texas. This shallow draft (12 by 125 ft wide) (3.7 x 38 m) waterway has a length of over 400 miles (640 km) in Texas. The Commission was directed to assess the importance of the waterway, identify principal problems and possible solutions, evaluate needs for significant modifications to the waterway, and make recommendations to the legislature (*110*).
Approach: In response to Commission instructions, the Transportation Planning Division prepared three reports (1976, 1978, and 1980) that comply with the legislative mandate (*110–113*). These reports cover a wide range of subjects in detail, including (a) basic marine commerce and trade territories; (b) estuarial marshes and the environmental impacts of dredging; (c) recreational boating; (d) marine technology; (e) safety; (f) costs of channel improvement; (g) impacts of user fees; and (h) federal-state relationships.
Comment: These reports contain historical, descriptive and statistical materials dealing with a single, major waterway. Because they form a series, they are useful to an understanding of the changing factors that affect this mode of transportation. The longer the series continues, the more valuable it will become as a record of state policies and actions, data, and research.

Example of Good Practice 22

Title: Reconnaissance Level Economics Study of an "All American Navigation System Connecting the Great Lakes to the Eastern Seaboard"
Organization: Department of the Army, U.S. Army Engineers District, New York
Date: 1979
Problem: Proposals had been advanced to build an all-American navigation system linking the Great Lakes with the Eastern Seaboard. A study was undertaken to determine which of 13 different plans (base case plus 12 improvement plans consisting of different route locations and channel sizes) might be feasible economically. Engineering and construction costs were estimated separately; the problem was to estimate economic benefits that would accrue to shippers if the proposed navigation system were built (*108*).
Approach: Various data sets were assembled and potentially divertible traffic was estimated using the following process.

1. Commodity flows, by major commodity type, through the Great Lakes-St. Lawrence Seaway were estimated for origin-destination pairs that included the 19-state Great Lakes economic hinterland and domestic, Canadian, and foreign origins and destinations.
2. Transportation costs for alternative combinations of modes and routes were estimated, including nonwaterway routings.
3. Estimations of diversions to the 12 potential planned navigation systems were prepared.
4. Using an accounting model [Transport Cost Calculation System (TCCS)] developed for this purpose, the savings to shippers were calculated for the alternative plans (see Figure 11). The calculated savings for each system were then converted to net present worth.

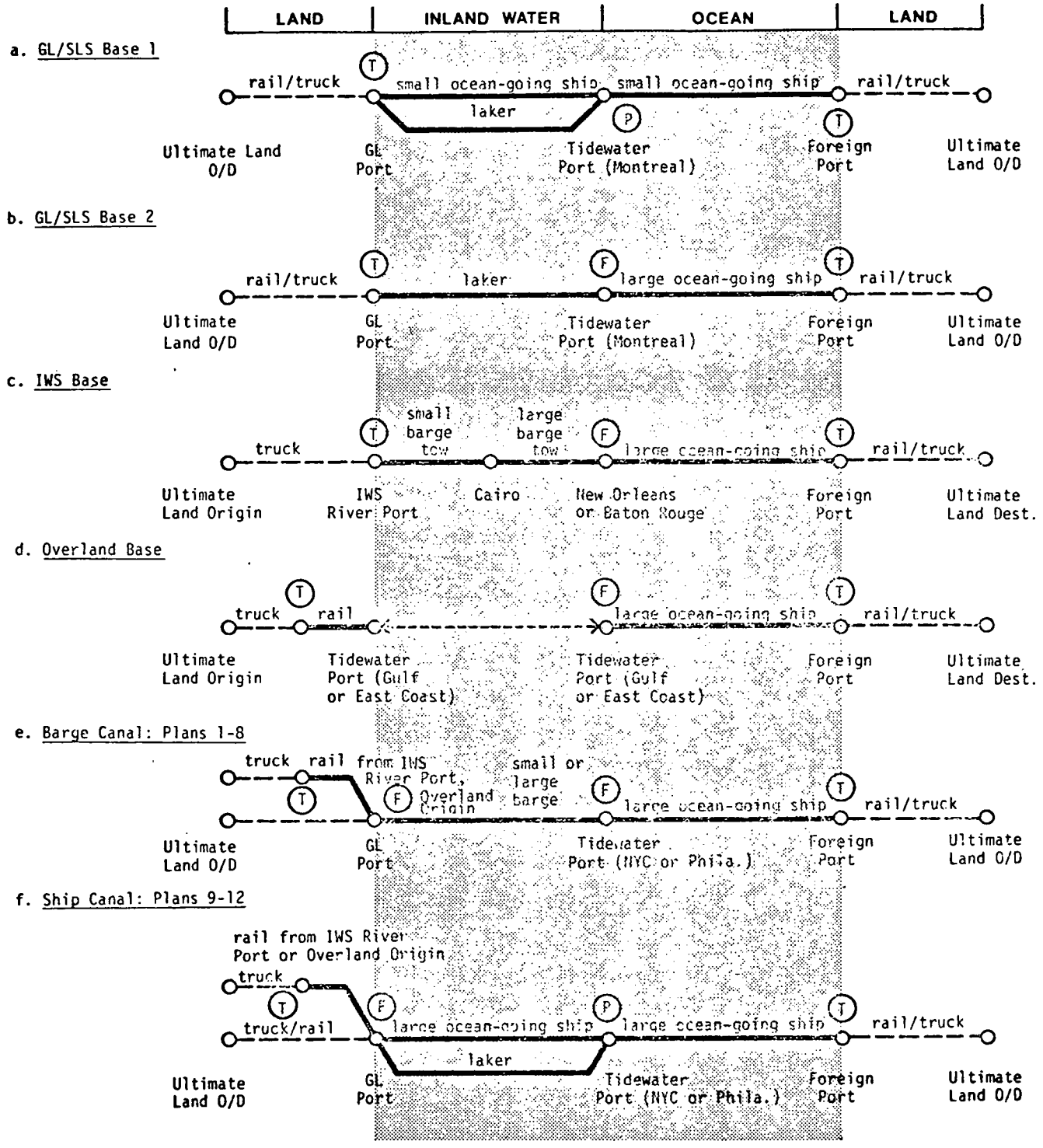
Comment: The significance of this type of study is that it deals with the specifics of a large number of practical matters that affect the movement of commodities. Because commodities themselves have special requirements (vessel types, loading/unloading equipment, value, perishability, origin-destination patterns, etc.), a study of the use of waterways requires careful investigation of these factors for all commodity types. The Transport Cost Calculation System permits the ready summarization of costs for all commodities over all types of routes, thus facilitating the final evaluation of total transport costs. Some of the methods used in this study will be reported in NCHRP Project 20-17A, "Application of Statewide Freight Demand Forecasting Techniques."

AVIATION

Issues in statewide aviation planning have changed substantially in recent years, away from the urgent need to provide new airport capacity to serve an apparently never-ending increase in air travel demand. Currently, the focus is on a more varied set of issues, with the response to the airline service changes resulting from deregulation perhaps being the most prominent issue.

The following list of issues reflects both the typical concerns of the state aviation planner (*114*) and the more recent concerns resulting from rising energy costs and deregulation.

- Noise impacts on adjacent communities
- Urban encroachment hindering airport expansion and increasing risks in the vicinity of glide paths
- Conversion of small airports to urban land uses
- Airspace congestion
- Safety



Legend

- Line-haul Movement: TCCS Component
- Feeder/Distributor Movement: Common to all alternatives. Not included as a TCCS component.
- (T) Intermodal Transfer: Feeder to Line-Haul or Line-Haul to Distributor. TCCS component.
- (F) Intermodal Transfer: Line-Haul to Line-Haul (full). TCCS component.
- (P) Partial Intermodal Transfer: Feeder to Line-Haul (topping off) or Line-Haul to Distributor (off-loading). TCCS component.

FIGURE 11 Schematics showing the major components of the TCCS models (*108*).

- Environmental impacts
- Adverse impacts of higher fuel costs on general aviation and commercial airlines
- Lack of funds for construction, new equipment, and airport maintenance
- Loss/reduction of service as a result of deregulation

One interesting approach is Iowa's airport sufficiency rating system, which is definitely a management tool designed to put project programming for airports on a more objective basis (see Example 23).

Another approach is New York's statewide aviation system planning framework—a three-phase approach calling for a statewide aviation framework to be developed (*115*) and a series of regional aviation system plans to be prepared, one for each of 10 regions covering upstate New York (exclusive of the New York metropolitan area) (*116*). The third phase is the continuing phase. One advantage of this approach is that it is possible, during the preparation of regional plans, to get close to the specific problems that affect individual airports, including interfacing with interested local officials.

Example of Good Practice 23

Title: 1979 Iowa Airport Sufficiency Ratings
Organization: Iowa Department of Transportation
Date: 1979

Problem: The 1976 Iowa legislature passed a law requiring sufficiency ratings to be prepared for all public airports in Iowa. This law, in effect, demanded that the same kind of objective rating procedure be applied to aviation as had been applied for many years to the highway field. The intent was that sufficiency ratings be updated annually as an aid to sound management of the state's transportation program.

Approach: Under the impetus of the legislation, the Iowa Department of Transportation created an airport sufficiency rating system as a planning tool for the administration of the programming (scheduling) of short- and intermediate-range improvement projects. "The Sufficiency Rating Analysis assigns a numerical rating to each airport. This rating is determined by comparing structural conditions and design features of the existing facilities to design standards. These conditions and features are called design items" (*117*).

Rating items fall into two categories—airfield and runway. The ratings are based on (a) structural adequacy, (b) safety, and (c) service; these items are given point distributions in the ratio 30:40:30, respectively, with a maximum sufficiency rating of 100. Table 3 lists the various items rated along with relative point scores.

Comment: This sufficiency rating concept is clearly designed to facilitate comparisons of airports not only based on total scores, but also based on the separate items of structural adequacy, safety, and service. Thus it falls primarily within the management side of transportation planning.

Reaction from local communities on the ratings is reportedly favorable: those communities with lower scores see it as a lever to gain greater funding, whereas those with higher scores make use of that fact in promotional activities. A few airport operations have resented receiving a low rating (*personal communication*, C. I. MacGillivray, Iowa DOT).

The "1979 Airport Sufficiency Ratings" (*117*) contains a section that is, in effect, a manual of procedures, which should be helpful to other states. Steps are being taken to computerize some of the procedures.

TABLE 3
IOWA AIRPORT SUFFICIENCY RATING ITEMS (*117*)

ITEM	MAXIMUM POINTS
STRUCTURAL ADEQUACY	
Paved Runways	
Wearing surface (R)[a]	8.0
Base subbase (R)	10.0
Drainage (R)	6.0
	24.0
or	
Turf Landing Strips	
All structural factors (R)	24.0
Taxiways and Aprons (A)[b]	
All structural factors	6.0
Maximum Total	30.0
SAFETY	
Runways (Turf and Paved)	
Physical length (R)	5.0
Physical width (R)	4.0
Surface condition (R)	9.0
	18.0
Primary Surface Geometrics	
Lateral and runway end safety area (R)	4.0
Primary surface obstructions (R)	2.0
Lateral clearances (R)	3.0
Horizontal and vertical sight distance (R)	2.0
	11.0
Approach Obstructions	
Displaced threshold (R)	7.0
Turnarounds and Taxiways	
Square footage or number of exits (R)	4.0
Maximum Total	40.0
SERVICE	
Runways (Turf and Paved)	
Physical length (R)	8.0
Lighting (R)	5.0
Capacity	
Airport (A)	4.0
Lighting and Navigational Aids	
Airfield (A)	5.0
Aprons	
Terminal and parking (A)	4.0
Land	
Total airport area (A)	4.0
Maximum Total	30.0
Maximum Total Basic Rating	100.0

[a]Rated for each runway individually.
[b]Rated for the airfield as a whole.

PIPELINES

A number of states have included sections on crude oil, petroleum products, natural gas, and slurry pipelines in their statewide transportation plans. The contents of such sections are generally (a) map(s) depicting the locations of major pipelines, by type and diameter, and (b) statistics on flows or capacities. Such materials are essential to an understanding of freight travel demands by mode; lack of a pipeline may mean the availability of a less expensive mode. For example, eastern New York State has no crude oil or petroleum products pipelines because the Hudson River and Lake Champlain Canal provide an inexpensive alternative.

Only one extensive report (from Arizona) was received on pipelines (Example 24). The report basically concludes that the Arizona DOT should not become involved in comprehensive pipeline corridor planning. This appears to be the consensus among most states.

Example of Good Practice 24

Title: Pipeline Corridors Study
Organization: Arizona Department of Transportation
Date: January 1979
Problem: Determination of (a) the issues surrounding pipeline transportation of natural gas, crude oil, petroleum products, and slurries, (b) the facts and scales of pipeline transportation, and (c) the role of a state transportation agency in a field that is dominated by the regulatory powers of other agencies.
Approach: Basically this is an investigation to supply background information to be used as the basis for establishing transportation agency policy (*118*).

A nationwide investigation of pipeline systems (facilities; ownership; mileages; tons transported; energy used to transport liquids, gases and solids; safety; and eminent domain) and plans was conducted. Next a study was undertaken of Arizona's pipelines that transport petroleum products, crude oil, coal slurry, and natural gas. Finally, regulations were examined. The conclusion was reached that "under the contemporary regulatory establishment it would be impractical for the Arizona Department of Transportation to attempt and impossible for the Arizona Department of Transportation to accomplish comprehensive corridor planning."
Comment: Any state interested in studying pipeline transportation would be well advised to examine this report. The lists of references are most helpful as is the overall organization.

THE STATEWIDE TRANSPORTATION PLAN

In Chapter 1, a framework was proposed for statewide transportation planning dividing the field into two major parts: one dealing with substance (i.e., the modes) and the other dealing with management (i.e., the spectrum of procedures, from policy analysis, communications, and project scheduling, to the monitoring of system performance). As previously noted, this framework has important implications for the function of the statewide transportation plan.

With the older, more "classical" planning process, a systems plan dealing with the substance of transportation (all modes) and presenting the ideal system of the future would be produced. This would be published and then implementation would begin. However, defining the statewide transportation plan exclusively as a plan for physical systems and services is inconsistent with the framework proposed here. The framework calls for equal emphasis to be given to:

- Policy (financial, institutional arrangements, regulation, and shared policies with other sectors such as land use, energy, and the environment);
- Communications;
- Scheduling of projects; and
- Reports on the performance of the existing transportation system.

It is difficult, given the complexity and comprehensiveness of most state plans, to be certain that the states are actually moving forward on all these management fronts, but it is clear that financial policy, communications, and the scheduling of projects are receiving far greater attention in recent plans.

At least 12 states have published statewide transportation plans since 1975, either as final documents or as drafts for public review: Arizona (*6*), Connecticut (*119–121*), Florida (*122*), Georgia (*123*), Hawaii (*7*), Iowa (*32, 124, 125*), Maryland (*9, 126*), Minnesota (*41*), North Carolina (*127*), Rhode Island (*128*), Tennessee (*129*), and Washington (*8, 130–132*). Most of these plans were published between 1978 and 1981. The preceding list does not include two major policy plan documents from California (*29*) and Wisconsin (*19*).

That so many states are preparing and publishing plans is indicative of a continued need for and interest in documenting substantive and management plans. Furthermore, it should be noted that several states regularly update their plans. Iowa has published three of its "Transplan" documents; Connecticut has published a revised plan each year for the past 10 years; and Maryland annually updates its plan. This is an indication of the transition in the function of the statewide transportation plan from a document that is primarily concerned with substantive plans to a document that is more management oriented.

Purpose

The five basic purposes for the preparation of a statewide transportation plan are identified below.

1. *Mandate from legislature.* When a transportation agency is formed by special legislation, that legislation frequently mandates the preparation of a statewide transportation plan in the first 2, 3, or 4 years of the new agency's life. This is a reasonable requirement or expectation on the part

of the legislature, as the *lack* of coordination in the existing transportation system and the lack of a consistent state policy toward transportation are forceful arguments that are often used to justify creation of a state transportation agency, just as these arguments in the 1960's justified the creation of the U.S. Department of Transportation.

2. *Communication.* The published transportation plan is often considered an important means of communication by a state transportation agency. Having a transportation plan shows that the transportation agency has done its homework and knows where it is going. The plan may be addressed to a variety of audiences (see discussion under Audience); and may stress the particular subjects considered to be important by the state transportation agency, such as physical plans, departmental role, financial need, service to the state's economy, and major accomplishments (see discussion under Content).

3. *Forcing internal decisions.* Preparing a statewide, multimodal transportation plan is a means whereby a state transportation agency can force itself to reach decisions on both the substance of transportation systems and services and on management policies and means of implementation. Decisions must be made on individual (modal) systems and services, finances, regulation, and how the modes should be interconnected, coordinated, or allowed to compete with one another (this is the essence of multimodal planning).

There is no better way of finding inconsistencies among modes, or of uncovering problems with single-mode plans or with financial policies, than by committing these things to paper by means of maps, text, and tables and then critically reviewing the results internally and publicly. All kinds of problems and inconsistencies can be obscured when the different elements of a plan are lying around in various bureaus or offices.

4. *Creation of a benchmark.* When a statewide transportation plan has been published, especially that portion that lays out physical systems, then a benchmark has been created. This benchmark can be referred to by other agencies (federal, other state agencies, regional, private transportation companies, and local governments) when their plans are being prepared. Thus it is an important means for interagency coordination.

5. *Reporting on progress.* Most published plans do not take a retrospective view of what has been accomplished. As the statewide transportation plan matures, this purpose of the plan document may increase in importance, and could be supplemented by performance monitoring reports on the levels of transportation service delivered to residents and firms (see discussion under Content).

Audience

One of the difficulties of preparing a statewide transportation plan is the diversity of audiences that must be addressed. The legislature and the governor must be convinced of the necessity of adequate funding and the fairness of geographic and modal allocations of proposed expenditures. The public and the business community must be informed of the rational nature of the planning process, the completeness of plans in meeting present and anticipated needs, and the necessity of adequate funding. Other federal, state, and local agencies must be addressed in order to establish a benchmark with which other programs can be coordinated.

Because these groups are so diverse, writing the plan can be very difficult. The common procedure is to prepare one set of documents that are impressive because of their coverage, printing, and composition, and a second set, in summary form, for popular consumption.

Content

An examination of published plans indicates that despite a bewildering variety of formats, there are many common elements in the content. The elements listed below may not all be included in each state's plan; much will depend on whether the document is the first plan of a state transportation agency, its second, or one of a continuing series.

1. *Description of existing transportation systems and services.* Maps, charts, and basic statistics convey that the transportation agency knows how and why the transportation system works, and has an orderly way of viewing the complexities of transportation systems (e.g., functional classification) and the uses made of them. Sometimes the historical development of these systems/services is also presented.

2. *Definition of the role of the transportation agency.* This statement establishes what the transportation agency can and cannot do, and its relationships to other governments, other agencies, the private transportation industry, and the public. The Maryland State Transportation Plan of 1978 (*9*) contains a statement of this type.

3. *Establishment of goals and policies.* The trend appears to be to obtain prior consent from the legislature concerning goals and policies; this has been done in Washington (*130*) and is a part of the continuing close liaison between the Iowa Department of Transportation and the Iowa legislature.

4. *Physical system and service plans.* These are maps and tables that describe the desired future transportation systems of the state (all modes) and identify the improvement projects that will implement the plan. Wide variation exists in the level of detail in which plans and/or projects are identified. For example, the 1968 New York "first round" plan (*133*) contained very little detail; the 1973 plan (*134*) was quite specific as to projects and programs.

5. *Programming.* Many recent statewide transportation plans contain a capital budget or capital program identifying specific projects, their costs, and either priorities (in broad groups) or actual scheduled year(s) of construction. Funding may be identified. Connecticut's plans are heavily oriented to programming (*119–121*).

6. *Financial resources.* Increasingly, as real revenues have decreased, state transportation agencies are including chapters or even separate volumes (Example 25) on finance. These have shown increasing sophistication. Needs and financial resources may be compared to demonstrate shortfalls and to document the need for new revenues.

7. *Performance monitoring.* This element has not been included formally in the published statewide transportation plan. However, it is likely that as annual revisions of plans

become more common, performance reports will take their rightful place. The Maryland DOT (*135*) currently prepares a quarterly staff report on utilization of the different modes; it would be most helpful to the reader of a regularly revised plan if the report were amplified to indicate quantitatively the performance of the transportation system with respect to goals (such as safety, cost, speed, etc.).

Example of Good Practice 25

Title: State Transportation Plan

Organization: Washington State Department of Transportation

Date: 1977–1980

Problem: In creating the Washington State Department of Transportation in 1977, the Legislature "directed the Transportation Commission and the Washington State Department of Transportation to develop a state Transportation Policy by January 1978. . . ." This was to be followed by the preparation of a preliminary plan in 1979 and a recommended plan in January 1980. The intent was to achieve a consensus among the Transportation Commission, the Legislature, and the Washington State Department of Transportation on basic policy that would guide the Washington State Department of Transportation in its preparation of the State Transportation Plan (*130*).

The basic purpose of the policy and plan was "to guide the development, maintenance, and operation of a comprehensive and balanced multimodal transportation system."

Approach: The approach to the preparation of the plan is shown in Figure 12. As noted above, the process started with a legislative mandate (1977) followed by agreement on a Washington State Transportation Policy. The policy itself consists of a preliminary goal followed by 15 other policy statements. As the document states, because the 15 policies are broad and generalized, each is explained so that its relevance to decision making on key issues is made clear.

Given a consensus on policy (a sound step in view of problems of other states that have launched into planning without such an agreement), the second phase of plan development was to identify key problems and issues through a participatory process involving the public at large, transportation interest groups, local governments, and state officials. Alternatives were proposed and evaluated. Next a Preliminary Transportation Plan containing the alternatives was prepared and published (January 1979). This also was extensively circulated for public review.

The final Washington State Transportation Plan was prepared and submitted to the Legislature in January 1980. The document was adopted by the Legislature and will pass into the continuing phases of implementation and update.

Content: As an example of good practice, it is worth expanding on the content and features of this document, including some features that may not be appropriate in other states.

The Washington State Transportation Plan is a large document—three 11- by 15-in. volumes plus a one-volume 11- by 8½-in digest. Volume I, "Background and Basic Data" (*130*), begins with four short chapters—Introduction, Role of the Washington State Department of Transportation, Transportation Policy, and Development Process by which the State Transportation Plan was prepared. Chapter 5 is entitled Factors Affecting the Development of Transportation Systems; socioeconomic, physical, environmental, and energy considerations are covered. Chapter 6, Transportation Background, makes up the bulk of Volume I. Mode by mode, all the essential quantities, characteristics, services, and locations (maps) are presented clearly and crisply. The unusual feature is the Washington corridor approach, in which multimode presentations are given for six major and nine minor corridors. The corridor approach is a natural one for the state of Washington, whose mountains dominate a series of valleys.

Volume II, "Future Directions and Actions," contains the plan proper (*131*). There are three short chapters: Introduction, Analysis of Future Requirements, and Major Transportation-Related Policy Issues. Calculations and forecasting methodology are not included; only the results are provided. It is very much "big picture," but numerous subjects are considered (U.S. internal factors, Pacific Rim trade modal forecasts, the energy-environment group, etc.) and the coverage is comprehensive. Chapter 4 contains modal plans, Chapter 5 corridor plans, and Chapter 6 "non-corridor and other transportation requirements and directions." Chapter 4 presents truly a multimodal analysis and identifies specific projects (but not costs).

Volume III is the "Financing Plan." The two key chapters are Costs, Existing Revenue, and Shortfall; and Funding Alternatives (*8*).

Comment: The Washington State Transportation Plan deserves examination by other states. The large size of the document permits a wide variety of page layouts, which is necessary for the many types of tables, graphs, figures, and maps utilized. The type is large and legible; hence, despite the mass of material, the volumes attract the reader.

On a more technical level, however, the corridor approach will have to be evaluated by those states where topography is not so dominant. A March 1982 letter from R. S. Nielson of the Washington State Department of Transportation indicates that the first update of the Washington State Transportation Plan is nearly complete and will be published in a one-volume, 8½- by 11-in. format. By statute, the plan must be updated every 3 years.

Example of Good Practice 26

Title: 1978 Maryland Transportation Plan

Organization: Maryland Department of Transportation

Date: 1978

Problem: The legislation that created the Maryland Department of Transportation also required that a master plan of transportation be prepared and maintained by the Secretary of Transportation. Accordingly, a preliminary transportation plan was published in 1976, the first multimodal composite of the Maryland Department of Transportation's programs and plans. A basic concern addressed by the 1978

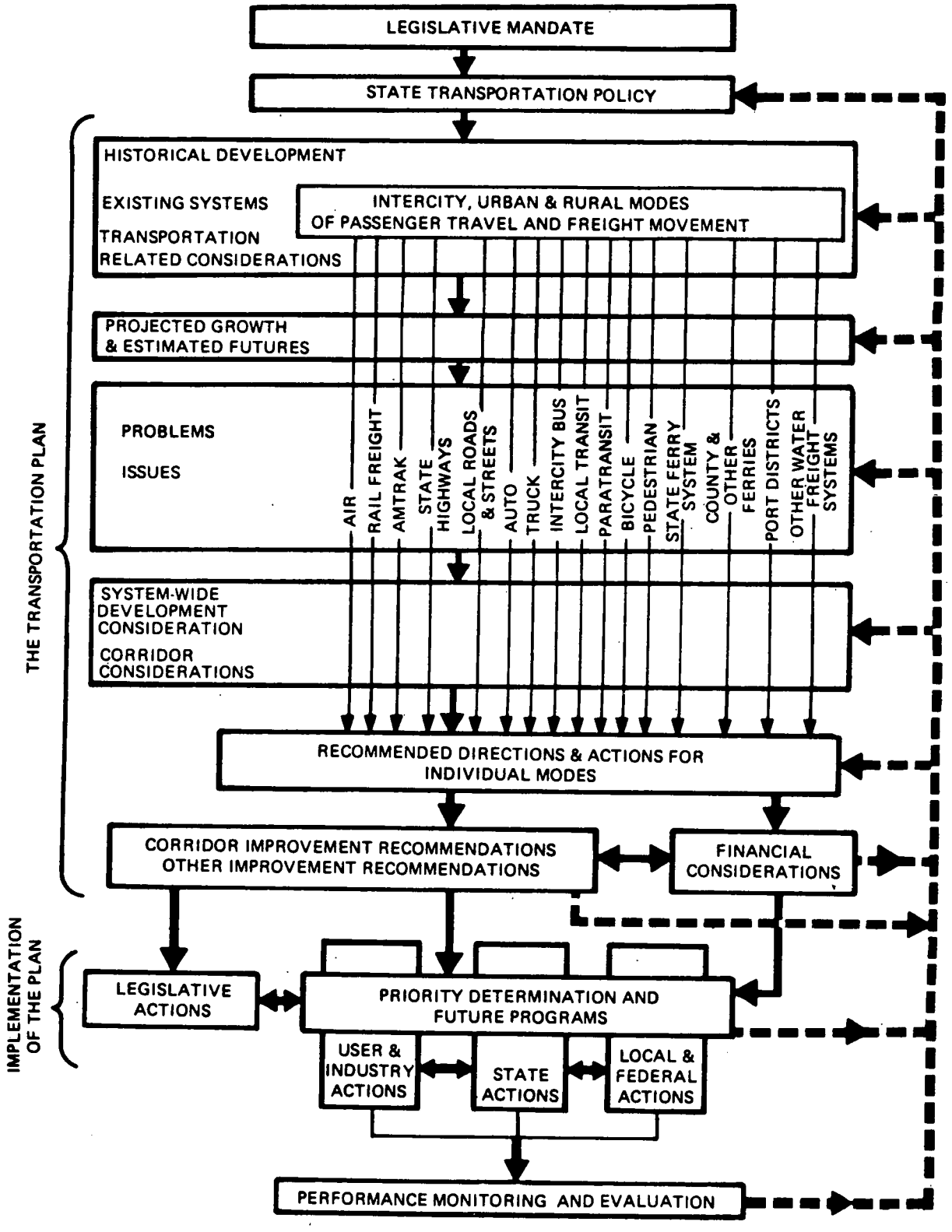


FIGURE 12 Transportation systems plan development (*130*).

plan was the comparison of needs with estimated future financial resources. The 1978 plan was intended to have as its principal function the communication of departmental policies and programs to the legislature and the general public.

Content: In line with its communication objective, the 1978 Maryland Transportation Plan is introduced (following an executive summary) by several sections that cover the basics: transportation trends and outlook; the mission and role of the department; the process of transportation planning; and the goals and objectives of the department.

Next, a major section deals with the balance between needs and potential revenues. Significant financial shortfalls were found. The report states: "Clearly, Maryland will not be able to meet all the identified needs . . . within the 20-year planning period. However, the Maryland Transportation Plan will provide a continuing mechanism for improving the process of identifying needs, evaluating all identified needs, and selecting high-priority projects to achieve a 'balanced' State transportation system" (*9*).

In the final chapters (Interregional Person Transportation, Regional Person Transportation, Freight Transportation, Management Support, and Federal Legislative and Program Needs), projects are identified, additional facts and considerations are discussed, and regulatory and operating measures are described. Projects are assigned to one of three priorities and are mapped. Regional detail (five substate regions) is provided where appropriate.

Comment: The Maryland Transportation Plan fulfills its intention of serving as a means of communication. The text is clear and readable, the illustrations and photographs are of high quality, and the separate "spread sheet" Summary Report is extremely clear. The plan is one of the first to put a chapter on finances ahead of the plan proper, instead of including it as an afterthought.

CHAPTER FOUR

FUTURE TRENDS IN STATEWIDE TRANSPORTATION PLANNING

The hazards of making projections in these years of rapid change are well known to transportation planners; nevertheless, some assessment of future trends in statewide transportation planning is needed if preparations for changed conditions are to be made. Preparations, by state transportation agencies, for example, may consist of retraining of personnel, purchase of the necessary amount of computer power, development of software, providing new directions regarding plan preparation, reorganization of processes and staff around new capabilities, and development of closer relationships between the CAO and the planning staff.

There will also be a need for research in support of the above procedures. The need for continued adaptation by state transportation agencies is demonstrated by the number and diversity of new techniques and new solutions discussed in this synthesis, most of which have been developed during the past 5 years.

The trends discussed below appear likely to persist in the next few years, based on the problems and issues identified in Chapter 1, which are likely to continue. These trends are also likely to persist because of the increased capabilities available to state transportation agencies, particularly in data management and computation.

1. *Staff productivity*. There will be a continued movement to increase staff productivity through: (a) standardization of procedures; (b) use of larger-scale word-processing equipment; (c) use of microcomputers; (d) computer management/storage of basic data; and (e) elimination of paperwork, particularly in the preparation of standard forms.

Once a staff becomes convinced through experience that substantial personnel time can be saved by programming regularly repeated processes for the computer, this trend will be reinforced. Increasingly, programs can be written economically through the use of higher-order programming languages, and in many cases the programs can be run on microcomputers.

Staff productivity can be increased in both the substantive and management parts of statewide transportation planning.

2. *Increased storage of data in accessible computer files*. A number of diverse data sets are needed for transportation planning—in both substantive and administrative aspects. The optimal arrangement, content, and means for updating these files will become increasingly important as more states put their files into the large scale, accessible storage media that are now available. State and federal policies that largely prevented new data collection in the 1970's must now be completely re-examined in light of the capabilities of new computers and the importance of adequate data to the management (as well as to substantive planning) of transportation systems.

3. *Coordination of data sets*. Data files will become increasingly coordinated; for example, road condition data, engineering plans data, and contract data will be linked so that management will be aware of the condition of a road, the plans for improvement, or the stage of construction.

4. *Performance monitoring*. Although no state is currently monitoring performance in a formal manner, it appears likely that methods and procedures will be devised for state transportation agencies to measure both their accomplishments

and the condition and performance of all the transportation systems of a state. As emphasized in Chapter 2, the functions of monitoring and surveillance are consistent with good management, and include both retrospective and future study. Reports on the condition, use, and performance of transportation systems and services will become regular features in published plans.

5. *Regular plan updates.* The publication of the state transportation plan will probably become a regular activity, either on a biennial or annual basis. This is a logical extension of the shift in planning to incorporate management activities. Regular progress reports on the performance as well as the utilization of transportation systems (all modes) should be features of each plan. The plan will increasingly become directly linked with management activities.

In conclusion, a condition for accomplishing the foregoing is the availability of substantial additional "intelligence resources" in each state transportation agency. Methods development and information dissemination at the national level are extremely important; however, the field of statewide transportation planning, in both substantive and management aspects, is becoming increasingly complicated. To apply new methods and procedures requires, in each state transportation agency, a staff of highly trained persons with skills in multiple disciplines. Therefore it is extremely important that state transportation agencies both support continuing, advanced education for existing personnel and bring in persons with advanced degrees whose skills will complement those of the present staff.

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