

# Developing and Implementing the Intermodal Surface Transportation Efficiency Act Management Systems: New York State's Approach

JOHN J. SHUFON, CLARENCE R. FOSDICK, BARBARA P. GIGLIOTTI, AND JOSEPH P. MCCLEAN

Section 1034 of the Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA) mandates that states develop six management systems and an associated traffic monitoring system. Whereas states have direct responsibility to implement these systems, ISTEA requires that each system be developed in cooperation with other agencies receiving federal highway or transit funds, and with metropolitan planning organizations in urban areas. Federal regulation further requires that a mechanism be established to coordinate development and implementation of the systems administratively, functionally, and technically. Described are the steps that the New York State Department of Transportation (NYSDOT) is taking to ensure compliance with these requirements and to integrate the management systems into the state's program planning and development process. The management structure implemented to oversee system development is detailed, as are the procedures that have been put in place to coordinate these activities among NYSDOT system developers and other affected transportation providers. In addition, guidance provided to system developers to ensure timely implementation is presented. The guidance focuses on the appointment of formal technical committees and the development of concept plans, which carefully define system scope, at the same time building on existing processes and technical tools. Staged system implementation is also recommended, the January 1995 certification deadline being a major milestone.

The Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA) is seen as marking a change in philosophy from building the Interstate highway system to managing the nation's entire transportation system as effectively and efficiently as possible. Section 1034 of ISTEA mandates that each state develop six management systems and an associated traffic monitoring system to meet this charge. Each state is to engage in a multiyear effort to develop and certify implementation of the following management systems by January 1, 1995:

<i>System</i>	<i>Responsible Organization</i>
Pavement (PMS)	Planning Division
Bridge (BMS)	Structures Division
Safety (SMS)	Traffic Engineering and Safety Division
Congestion (CMS)	Planning Division
Public Transportation Facilities and Equipment (PTMS)	Transit Division

<i>System</i>	<i>Responsible Organization</i>
Intermodal Transportation (IMS)	Commercial Transport Division
Traffic Monitoring (TMS)	Planning Division

As stated in the proposed federal regulation (23 CFR Part 500) governing ISTEA management system implementation:

The primary purpose of the management systems is to provide additional information needed to make effective decisions on the use of limited resources to improve the efficiency of, and protect the investment in, the nation's existing and future transportation infrastructure at all levels of jurisdictional control.

Thus, those under development within the New York State Department of Transportation (NYSDOT) are decision-support systems for use by public and private transportation entities in objectively evaluating performance, identifying deficiencies, and helping construct and evaluate alternative solutions and investment strategies. For NYSDOT, the systems will support and enhance the decision-making process, in particular the goal-oriented programming (GOP) element of that process.

Although envisioned as separate systems or subsystems of an overall transportation management system, all six systems have several important elements that run throughout (1):

- **Cooperation:** The state is the responsible agency for developing and implementing each management system. In metropolitan areas, this must be accomplished in cooperation with metropolitan planning organizations (MPOs). Transit agencies and local governments must also be involved.
- **Objectives:** The fundamental purpose of the management systems is to improve the efficiency of transportation systems and to protect public and private investment in those systems through more effective decision making.
- **Implementation:** Transportation needs and improvements identified by a management system must be considered by the states and their MPOs in their planning and programs and in making project-selection decisions.

It should be recognized that although systems' outputs must be considered, the systems themselves will not be the end products—their implementation and use will not force particular program or project decisions. NYSDOT will continue to function in a decentralized decision-making environment. Project decisions will be

made in the 11 regional offices; policy guidance and goals will be determined in the central office. Current responsibility and authority will not be diminished. The systems will simply provide decision makers with more structured and comprehensive data, along with necessary analytical tools that can be used to develop a quality program that is balanced and integrated.

The purpose of this paper is to introduce the concept of management systems and to address how they will function within NYSDOT's decentralized decision-making culture. Administrative, functional, and technical processes to be used to coordinate and integrate management systems development and implementation are defined. In addition, guidance is provided to assist individual system developers in implementing a system consistent with the federal regulation by the January 1, 1995, deadline.

## BUSINESS OF THE DEPARTMENT: AN OVERVIEW

The opening paragraph of ISTEA states:

... it is the policy of the United States to develop a National Intermodal Transportation System that is economically efficient and environmentally sound, provides the foundation for the nation to compete in the global economy, and will move people and goods in an energy efficient manner.

NYSDOT's goals and objectives certainly support this policy, as affirmed by the department's mission statement: "It is the mission of the New York State Department of Transportation to provide adequate, safe, balanced, and efficient transportation at reasonable cost to the people of the State."

The department's business, broadly speaking, is to achieve this mission by performing numerous direct and supporting tasks aimed at maintaining and improving the state's transportation infrastructure and its operation. These range from planning, design, and maintenance of the highway system to various administrative activities, both fiscal and organizational, which are required to support capital construction and operational programs across all program areas. The management systems are central to these activities and will provide the connecting framework for a consistent approach and criteria to judge competing priorities among the state's surface transportation systems.

The concept of management systems is not new to the department. Pavement and bridge management systems have provided valuable input to the program development process for several years. The Highway Safety Improvement Program has for two decades provided a systematic process for selecting safety projects and evaluating the effectiveness of safety treatments. Computerized systems maintained throughout the central office and the regions have been developed to assist in managing congestion and financing transit operators. ISTEA requires that these systems be enhanced and their coverage expanded; however, their function will remain the same: to provide input to program development decision making, particularly that of the department's GOP process.

The GOP process is the primary mechanism for planning, evaluating, implementing, and monitoring the department's transportation program efforts. Originally designed to address the capital program, it was broadened in 1992 to reflect such noncapital activities as maintenance and operational work performed by state

forces. GOP provides a method to manage the program by establishing goals, setting clear measurable objectives, and then measuring program performance in attaining those goals and objectives. The GOP product is a recommended program of projects explicitly balancing needs, priorities, and resources.

Historically, the GOP process has addressed the department's bridge, pavement, capacity, and safety programs. Implementation of the ISTEA management systems provides the opportunity to sharpen decision making for those program areas and, for the first time, to include transit and intermodal elements in the programming process. Ultimately, the management systems are intended to provide the consistent data, analysis tools, and administrative procedures to assist decision makers in making the best decisions, within and across all functional areas. The development of multimodal solutions to transportation problems is a goal of ISTEA. The department's GOP process serves as the framework to achieve that goal.

Figure 1 shows a simplified flowchart of the GOP process. Data from the existing management systems are used by executive management to set statewide goals and to establish policies. They are also used to develop performance measures and selection criteria and as input to the allocation of capital and operating funds to the department's 11 regions. Working within their allocations and given their goals, each regional office uses data from the management systems for annual development of 5-year programs of capital and operations projects, including maintenance. It is here, at this early stage in the process, that each regional office works with MPOs, local governments, and transit providers. Technical tools such as the department's pavement, bridge, and congestion forecasting models are used by the regions to evaluate the impact of alternative construction, operational, and preventive program strategies on "end conditions." Trade-offs are made and programs are selected that explicitly balance needs, priorities, and resources.

Each region then prepares a report detailing the programs selected, describing the rationale used in arriving at program choices, both among transportation programs and within each program, and comparing the results with regional conditions. This report is transmitted to the central office, where it undergoes technical review to ensure that proposed programs are consistent with goals and policies established by executive management.

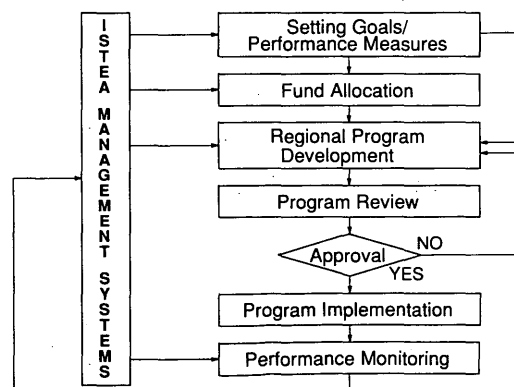


FIGURE 1 Integrating management systems into the NYSDOT GOP process.

Once programs are approved, implementation commences. The data collection component of the management systems is used to monitor performance and update the data bases, which in turn provide feedback for the next year's goal-setting activity.

## INTEGRATION AND COORDINATION OF THE MANAGEMENT SYSTEMS

ISTEA clearly cites Congress's intent for coordination of management systems' implementation. The legislation requires that management systems be developed and implemented in cooperation with MPOs and other affected agencies. In addition, system outputs must be considered in developing metropolitan and statewide transportation plans and improvement programs and in making project selection decisions under both Title 23 and the Federal Transit Act. Federal regulation emphasizes and expands upon this intent by requiring each state to have

procedures within the State's organization, for coordination of the development, establishment, implementation and operation of the management systems. The procedures must include:

- An oversight process to assure that adequate resources are available for implementation;
- Complementary target dates of the systems to ensure that outputs of all systems can be given timely consideration in development of metropolitan and Statewide transportation plans and programs;
- The use of data bases with a common or coordinated reference system and methods for data sharing methodology; and
- Interrelationships among the systems to address outputs and issues related to the purposes of more than one management system.

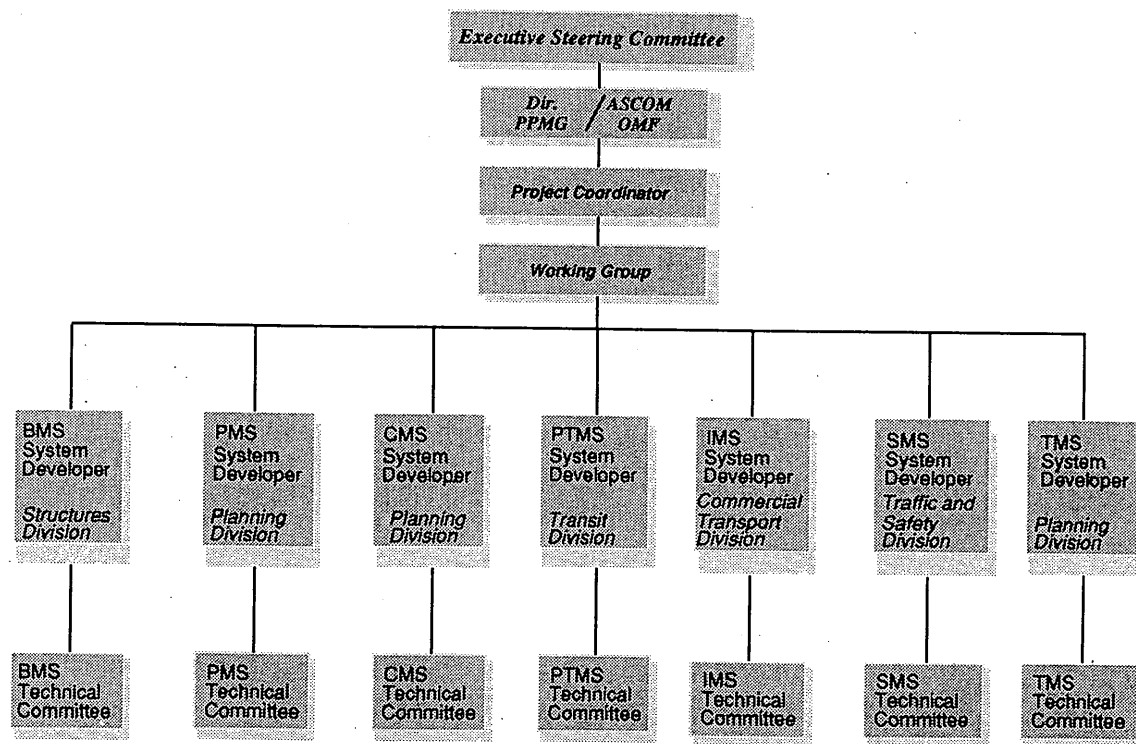
The steps NYSDOT has taken to ensure the required coordination and integration will now be discussed from three perspectives—administrative, functional, and technical.

### Administrative Coordination

Administrative coordination of the ISTEA management systems involves policy development and project management, such as agency resource allocation. The management structure designed to ensure administrative coordination of the ISTEA systems is shown in Figure 2 and consists of the following components:

- **Executive steering committee (ESC):** General oversight of the system development effort is provided by an ESC consisting of the first deputy commissioner; the director of the planning and program management group; the assistant commissioners for management and finance, operations, engineering, and public transportation; and two regional directors. The committee meets approximately quarterly to be briefed on the status of each management system and to address high-level issues affecting relationships among the systems. Among issues to be addressed are annual budgetary allocations to each system development team, adjustment of resource allocations as necessary, ratification of policy proposals, and resolution of policy disagreements.

Because of the advanced stage of implementation of the department's bridge management system (BMS), its steering committee, although quite similar to the ESC, will continue as currently constituted. The BMS will be developed and coordinated in a manner consistent with ISTEA requirements and federal regulations.



Note: While this chart shows the BMS development effort under the illustrated management structure, it was subsequently decided that the BMS committee structure will remain as currently exists.

FIGURE 2 NYSDOT management structure for management system development.

- **Executive directors:** The assistant commissioner for management and finance (OMF) and the director of the planning and program management group (PPMG) have joint responsibility for overseeing coordination and progress of the systems development effort. As the organization responsible for automation standards and policies and for providing systems development services, OMF is responsible for ensuring that each effort is consistent with these policies and standards. As manager of planning and implementation of the department's program, PPMG has specific responsibilities to ensure that these systems meet the state's program planning and development needs.

- **Project coordinators:** The Systems and Program Planning Bureau of the planning division of the PPMG has been designated project coordinator for development and implementation of the management systems. Under supervision of the executive directors, the project coordinator is responsible for the following administrative activities: ensuring that the project is placed on the department's priority list and that adequate resources are devoted to development; assisting system developers to ensure that the project is progressing at an acceptable pace and that systems are designed using appropriate systems-development methodology; acting as staff to the ESC by scheduling meetings, arranging agendas, and so forth; resolving conflicts and raising issues to the joint directors with recommendations for remedial action; working with system developers to address individual problems in conjunction with staff from the information management division and strategic planning and management systems division; and attending technical committee meetings and disseminating information to the various system developers.

- **Technical committees:** Their role is to provide system developers with expertise as well as to outline customer needs to be considered during management system development. ISTEA is specific about the interests that must be involved in developing the management systems. The department decided that the technical committees would act as forums for that involvement. The committees are chaired by the system developers; membership is consistent with federal regulation and must be approved by the ESC. The recommended composition of each technical committee is discussed later.

- **System developers:** System developers are responsible for developing management systems that satisfy ISTEA requirements for function, performance, schedule, and customer involvement, as well as department requirements for compatibility, customer access, and information management. The system developer is required to outreach to MPOs and other customer groups to ensure meaningful input and buy-in from all affected parties and to fulfill obligations under the law and regulation.

## Functional Coordination and Integration

Functional coordination and integration addresses program interrelationships among the systems. For example, output of one system may serve as input to another. The department's SAFEPAVE program illustrates functional coordination. Safety evaluation findings have suggested that a simple resurfacing with high-friction asphalt will reduce wet-weather accidents by 50 percent at locations where wet-weather accident rates are significantly above the mean. Locations identified by the pavement management system are now matched with high wet-weather accident locations, and

project lists are developed that address both considerations. Thus, a PMS output serves as an input to the SMS.

Currently, functional coordination is achieved by the regional offices as part of the GOP development process. Each regional program committee, which is a formal group consisting of functional group managers chaired by the regional director, meets regularly to discuss proposals for the pavement, bridge, safety, and capacity programs. Trade-offs among these programs are discussed and, within fiscal constraints, a program of projects is selected that best meets the goals established by executive management. Formal subcommittees specializing in each program area provide ongoing technical input to this process. Implementation of the management systems will broaden and enhance this input.

Functional integration involves development of policies and procedures so that various programs are coordinated to promote effective and efficient deployment of resources to achieve the agency's mission. For instance, all systems performing economic analyses of project proposals should be bound to the same policy premises. Thus, all benefit-cost work should use the same discount rate for invested funds, the same value for user costs, and so on. In addition, if life-cycle cost is a corporate investment policy, then all systems should be capable of providing such assessments.

The management structure described in the preceding section ensures functional coordination and integration in developing management systems. Important policy issues that are strategic in nature will be discussed and resolved by the ESC. On a day-to-day basis, the project coordinator works with system developers so that each system's needs are addressed while the other systems are being developed.

In addition, a working group has been formed consisting of system developers, the coordination team, FHWA, MPOs, and other department personnel with a direct interest in the management systems. This working group will advise and assist the project coordinator to facilitate discussion, share information, develop common definitions, ensure coordination in system scoping, and develop staff-level consensus on issues affecting development and implementation.

## Technical Coordination

Federal regulation is very specific on the need for technical coordination in developing the management systems, specifically in using common data bases with a common or coordinated reference system, and for data-sharing methodology. Certainly, the aforementioned management structure (along with the working group) aids the coordination of management systems from a technical standpoint. In addition, NYSDOT has decided that this coordination will be achieved, in part, by implementing a geographic information system (GIS) to link data components of the management systems. GIS technology permits assimilation, integration, and presentation of data collected and stored in each of the management systems, regardless of the referencing system used to locate the data elements (e.g., reference markers, mile points, and coordinates). Figure 3 illustrates conceptually how the GIS will operate.

The department has taken several steps to implement GIS technology. A GIS selection committee has been appointed to evaluate software and recommend a GIS solution to system integration. A technical subcommittee has been designated to work with the regions in assessing proposed applications using various GIS plat-

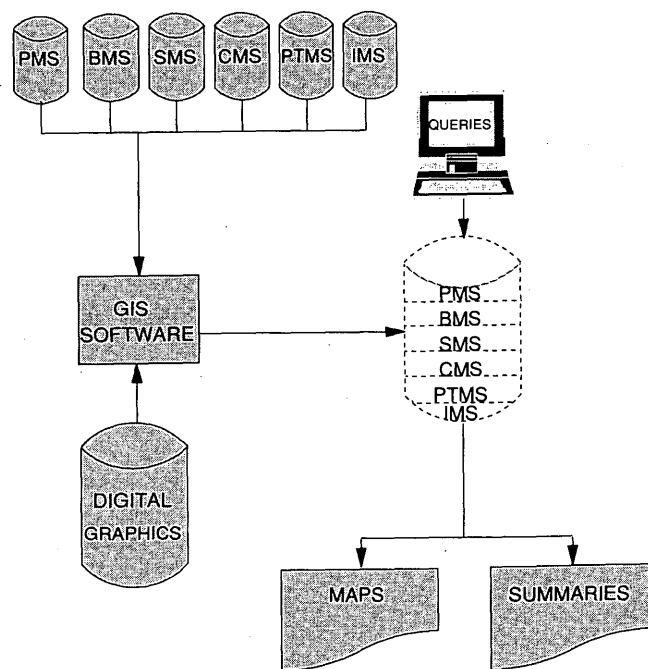


FIGURE 3 GIS and the management systems.

forms. In addition, a detailed work plan to implement GIS has been prepared by the information management division and approved by the department's Management Information System Steering Committee (2). It is anticipated that the GIS selection committee will complete the required work and make a final recommendation by early 1994. It is well recognized that GIS implementation, although important, is only one step in ensuring technical coordination. A GIS is not a substitute for traditional systems analysis. Much work must be done in technical design of the management systems, for example, determining user needs, identifying relationships among the systems for data-sharing purposes, and developing common data definitions. To accomplish these tasks, the information management division has assembled a team of computer analysts to work full-time with the systems developers, GIS specialists, and other data-processing staff from the user groups in developing and integrating automation elements of the management system project.

#### **GUIDELINES FOR MANAGEMENT SYSTEM DEVELOPMENT**

This section provides system developers with guidelines for developing their respective management systems. The following discussion is a generic overview applying to all systems. System developers should refer to the federal regulations for details specific to each system and work with FHWA and the project coordinator to ensure that development and implementation comply with ISTEA's minimum requirements.

##### **Appoint Technical Committees**

ISTEA mandates that each management system be developed and implemented in cooperation with MPOs in urban areas and with

affected agencies receiving assistance under the Federal Transit Act. To meet this charge and ensure appropriate integration and consistency among systems, NYSDOT decided that each technical committee should include representatives from each of the following:

- Planning division;
- Information management division;
- Strategic planning and management systems;
- Professional staff from one of the state's MPOs;
- Professional staff from a non-MPO area of the state;
- Department central office staff involved as users of the system (in each case, the staff person should be one appropriate to speak for his or her program area in discussing issues and making decisions);
- Regional staff—two representatives, one from downstate and one from upstate;
- FHWA division office; and
- Principal customers and interested parties for each management system as identified by the individual management system concept plans and federal regulation. Examples include the regional and local transportation authorities and FTA for the PTMS, and county highway superintendents for the BMS and PMS.

##### **Prepare a Concept Plan**

Preparing a concept plan is perhaps the most important step in the successful development and implementation of a management system. The document serves as the overall charter for the system, and as such it is reviewed and scrutinized by executive management. The plans should be written clearly and concisely but, at the same time, must be comprehensive enough to provide a road map to future system development. Each plan should identify ISTEA goals and objectives, critical issues, system development and integration considerations, overall schedule, and major project milestones. Specifically, the concept plan should include the following components (3):

- Appropriate legislation and regulations governing system development;
- System-specific goals and objectives that relate to and support the agency's overall ISTEA management system goals and objectives. This should be a vision statement that describes the "as-is" condition (i.e., how the functional areas affected by the management system currently do business) and the "desired" condition (i.e., how the functional areas will do business under ISTEA) as well as highlighting significant business or process changes that must be accomplished to comply with ISTEA requirements;
- Summary of key system-specific issues that must be addressed for system development to succeed;
- A system framework, that is, a detailed model or schematic (e.g., flowchart) of the overall system should be provided showing system components and principal points of functional and technical integration with other ISTEA or agency systems. The framework also should specify to what extent existing agency programs, processes, and procedures satisfy ISTEA requirements;
- Identification of the data bases and information necessary to develop the system;
- Detailed project work plan that identifies project tasks, milestones and schedule, deliverables, and task responsibilities; and

- An estimated annual budget, including automation needs (hardware, software, additional programming expertise), staffing needs, and incremental required data collection costs.

### Carefully Define Management System Scope

Management systems are often thought of as data-intensive computer systems designed to answer difficult questions at the touch of a keyboard. This is far from the case. Although the automated data base is an important component of a management system, it is only a supporting component. A management system must also address the administrative side of the organization—its relevance to business policies, plans, and processes. Failure to recognize administrative considerations during system scoping will impede success as surely as technical inadequacies. Furthermore, the processes selected must be within the organization's resources and compatible with existing policies and procedures. Systems require resources, principally people and money. System developers must be sure that the scope and relevance of the management system can and will be borne by the agency. Otherwise, the scope must be changed until the planned processes and commitments match (4).

Another important consideration in scoping management systems is early identification and definition of outputs of their automated elements. Data are valuable corporate commodities. They are extremely expensive to collect and maintain. Thus, data should be collected only if they are to be used in decision making. Systems developers must avoid the tendency to collect all possible information "just in case we might need it someday." Inputs should be defined by output requirements. Understanding this is the key to successfully scoping the automated component of the management system.

### Recognize Existing Processes and Technical Tools

Successful deployment of a management system requires that it be tailored to an agency's organizational structure, at least during initial stages of implementation. Even introducing the management system concept may create major stress because this causes a change in the way an organization does business. Such change should be slow enough to allow all functional groups involved to buy into the new processes and procedures. Because deadlines for implementation are rapidly approaching, there is no time to introduce radically new system constructs. Thus, system developers are considering the department's existing decision-making culture and shaping the architecture of the management system accordingly, thereby increasing the chance that the system will be embraced by users and immediately integrated into the decision-making process.

Furthermore, existing technical tools, data bases, and procedures should form the basis for management system design whenever possible. It is much easier and more economically feasible to build on technologies and administrative procedures already germane to an organization than to start from scratch. Efficiency in data collection is explicitly recognized in the federal regulation recommending use of four currently available data sources—the Traffic Monitoring System, the Highway Performance Monitoring System, FTA's Section 15 reporting requirements, and the National Bridge Inventory.

### Incorporate Essential Components into the Management Systems

The proposed federal regulation states that each management system requires data to define and monitor the magnitude of problems, identify needs, analyze alternative solutions, and measure the effectiveness of implemented actions. To accomplish these activities, each system should have the following components:

- An inventory identifying problem areas,
- A process to establish performance measures,
- A data-collection element to monitor system performance (e.g., condition),
- Analysis capability to identify needs and analyze alternative corrective strategies,
- A process to implement the strategies selected, and
- Procedures to evaluate effectiveness of the strategies implemented (i.e., a feedback loop).

Developers are advised to build their systems around these essential components. They must determine early in management system development which components are already available or can be completed by in-house staff. For others, it might be necessary to engage consultants or universities funded through the department's research program. If consultants must be hired, considerable lead time must be allotted because of the time requirements for consultant selection. Figure 4 shows the framework of a typical management system.

### Build in Staged System Implementation

Building the data bases and developing such complex analysis tools as the GIS may take years and will require significant re-

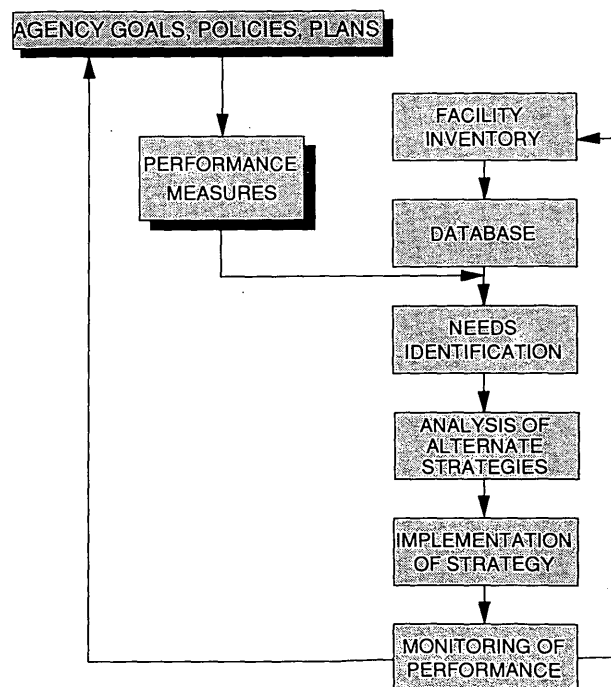


FIGURE 4 Components of a typical management system.

source commitment by executive management. One way to promote this support is by providing executive management with an immediate return on investment. This can be accomplished by staging system implementation so that products become available early in the process. Certainly a major milestone and early goal of all the systems must be meeting the federal deadline for certification.

Staged implementation can take different forms. For example, the NYSDOT pavement management system is being implemented in three stages—crawl, walk, and run. Crawl-stage activities basically involve development of methodologies and technical tools to sharpen existing practice, whereas walk- and run-stage activities focus on further refinements to these tools in a microcomputer and mainframe environment. Such an approach to staged implementation might not be appropriate for all systems, but the important point is that early benefits must be realized from the management systems development effort.

Another advantage of staged implementation is that functional groups involved with the management systems will have time to learn the newly developed processes and be more likely to accept the system once it is fully operational. The sooner a system is institutionalized, the sooner it will serve an integral role in an agency's day-to-day operations.

## SUMMARY

Successful development and implementation of ISTEA management systems require support of top management. At NYSDOT, general oversight of the system development effort is provided by an executive steering committee. Two of these managers (the assistant commissioner for management and finance and the director of the planning and program management group) have joint responsibility for direct supervision of system development. The systems and program planning bureau of the planning division

acts as project coordinator to oversee day-to-day development activities. Outreach to MPOs and other affected transportation providers is ensured through formal technical committees charged with providing ongoing input to development of each system.

History has shown that timely implementation of a management system requires that it be tailored to the organizational structure and processes of the implementing agency. Thus, system developers are advised to consider existing culture, processes, and technical tools when developing management system architecture. Up-front planning and careful scoping are key considerations in meeting the federal deadlines for system implementation.

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