

Metropolitan Planning Organizations and Pavement Management: The Massachusetts Experience

CORNELIUS W. ANDRES AND MATTHEW TURO

Management system mandates contained in the Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA) quadrupled the roadway mileage that must be included under a pavement management system (PMS) in Massachusetts. Most of the additional mileage is local jurisdiction roadways that are eligible for Surface Transportation Program funds under ISTEA. To handle this additional responsibility, the Massachusetts Highway Department is working cooperatively with the commonwealth's metropolitan planning organizations (MPOs). This partnership is in keeping with the spirit of ISTEA and takes advantage of Massachusetts MPOs' experience in pavement management as well as local agency investments in pavement management systems. An appropriate interagency PMS is being developed to address planning, programming, budgeting, design, and maintenance requirements of a roadway network composed of various classes of pavement under the control of many jurisdictions. This is being accomplished by harmonizing (making the individual systems work together) rather than by standardizing a single PMS. The PMS is being integrated into a geographic information system data base shared by other management systems.

Several years ago, the Massachusetts Highway Department began the process of developing a statewide pavement management system (PMS). This effort was being accomplished in cooperation with regional and local agencies. Since that time, federal legislation has mandated that each state have a pavement management system for all roadways eligible for federal aid, regardless of jurisdiction. This includes all public roadways except for rural minor collectors and local roadways. This legislation, the Intermodal Surface Transportation Efficiency Act (ISTEA), has acted as a catalyst to accelerate the development of the statewide pavement management system. In two years, it will have quadrupled the number of miles that must be included in the state's PMS.

This paper describes how Massachusetts is unifying state, regional, and local pavement management efforts so that they provide consistent data for the statewide PMS. Consistency is required to determine overall network condition and to assess the priorities of projects from all regions of the state.

The state, however, did not want to achieve this consistency at the cost of compromising the individuality of the existing PMSs, which use various software packages. These software packages have been refined over time and rely on specific condition survey procedures. The procedures range from automated data collection at the state level to windshield surveys at the local level. The various software packages trigger actions (candidate projects) based on specific criteria. If condition data are not appropriate, the ability of the PMSs to accurately predict actions and budgets may be severely diminished.

The state, therefore, chose to harmonize the individual pavement management systems (make the systems work together) rather than mandate a standardized system because there is no single pavement management system that is appropriate for all agencies. Additionally, standardization is politically difficult. Local and regional agencies have a great deal invested in their individual systems. Standardization would also be financially devastating to many private consultants who have developed PMS software.

BACKGROUND

The Commonwealth of Massachusetts comprises 351 cities and towns. These are contiguous jurisdictions with no unincorporated land between them. Each has responsibility for the local public roadways within its jurisdiction. There are 14 counties in the state. These counties, with a few exceptions, are an archaic level of government with few responsibilities. They are not responsible for roadway maintenance. The state is also divided into 13 regional planning areas that, in most cases, do not follow county bounds. There is a regional planning agency (RPA) for each of these areas.

All the regional planning areas, except for three, include urbanized areas with populations of over 50,000 people and are thus mandated to have metropolitan planning organizations (MPOs). In Massachusetts, the MPOs are generally composed of the RPA, the regional transit authority, the Massachusetts Highway Department, and the Executive Office of Transportation (1). The three regional planning areas that are not MPOs have been organized as informal MPOs and will hereafter be referred to as MPOs. The transportation staffs of the RPAs are the recipients of transportation planning funds provided to the state by the FHWA. The RPAs provide technical assistance to the local communities and serve as the transportation planning staff of the MPO. ISTEA also recognized the usefulness of this regional approach and mandated MPO involvement with pavement management.

There are five district offices of the Massachusetts Highway Department (MHD). Their bounds are not common with those of the counties or RPAs.

Available Resources

State

The Massachusetts Highway Department Pavement Management Section was established in November 1986. Its main purpose is to coordinate the pavement-related activities involved in planning, design, construction, maintenance, research, and rehabilitation. It is

C. W. Andres, Town of Bourne Public Works, P. O. Box 290, Buzzards Bay, Mass. 02532. M. Turo, Massachusetts Highway Department, 10 Park Plaza, 4th Floor, Boston, Mass. 02116-3973.

staffed by six full-time engineers. The Pavement Management Section has an automatic road analyzer (ARAN), skid testing unit, and a falling weight deflectometer. Organizationally, the MHD has a fully equipped materials laboratory and a pavement design and engineering section.

MPO

The transportation staffs of the MPOs are primarily planning staffs. Given that several jurisdictions control the roadways in any region, it is reasonable that the MPOs could serve a necessary and coordinating role in network-level pavement management. This role has been described as "ranging from that of an 'initiator' or 'facilitator' to that of a 'coordinator' or 'doer' " (2). The MPOs, however, are not organized to handle the detailed engineering requirements of pavement management. They typically turn to the state highway agency (SHA), technology transfer center, local engineering departments, or private consultants for this type of assistance.

In the early 1980s, the MPOs in Massachusetts started to assist local communities with implementing PMSs. Typically, the MPO would provide training, analysis, reports, and presentations to local officials. The local community would collect data. Some MPOs pooled these local efforts to estimate regional needs (3). The recent ISTEA pavement management mandate has focused MPO resources toward examining all federal-aid roadways in their jurisdictions rather than all the roadways under the control of specific municipalities. This new direction, however, takes advantage of the previous pavement management efforts, as well as the MPOs' familiarity with independent local pavement management efforts in their regions.

Local

There is tremendous variation in the resources and abilities of the local highway agencies. They range from cities with engineering and maintenance staffs to small maintenance departments run by working foremen. Massachusetts has encouraged pavement management at these local agencies through the regional efforts described above, as well as through its pavement management policy (4). This policy, which was established in 1989, allows local highway agencies to use state-aid funds to establish PMSs.

Coordination

The state PMS works cooperatively, through the MPOs, with the more advanced local agencies, some of which have established PMSs. This avoids duplication of effort. In the smaller communities, which may have only a few federal-aid roadways within their jurisdictions, the MPOs coordinate data collection, which is performed by MPO staff, summer engineering interns, or contracts with private consultants. MPO coordination ensures consistent data collection.

ISTEA Requirements

This section describes parts of the Intermodal Surface Transportation Efficiency Act that are relevant to the development of Massachusetts's statewide PMS.

Section 1024. Metropolitan Planning

23 USC 134(f) contains factors to be considered (in the development of long range plans):

- (1) Preservation of existing transportation facilities;
- (9) The transportation needs identified through the use of the management systems; and
- (12) The use of life-cycle costs in the design and engineering of bridges, tunnels, and pavements.

Section 1025. Statewide Planning

23 USC 135(b) addresses coordination with metropolitan planning, the state implementation plan. In carrying out planning under this section, a state shall coordinate such planning with the transportation planning activities carried out under Section 134 of this title for the metropolitan areas of the state.

23 USC 135(c) covers the state planning process. Each state shall undertake a continuous transportation planning process that shall, at a minimum, consider the following:

- (1) The results of the management systems required pursuant to Subsection (b) (see above);
- (5) The transportation needs of the nonmetropolitan areas through a process that includes consultation with local elected officials with jurisdiction over transportation;
- (15) The transportation needs identified through use of the management systems required by Section 303 of this title;
- (18) Long-range needs of the state transportation system; and
- (20) The use of life-cycle costs in the design and engineering of bridges, tunnels, and pavements.

Section 1034. Management Systems

(a) The states shall develop pavement management systems. In metropolitan areas, the management systems shall be developed and implemented in cooperation with the MPOs; 500.107 (From Proposed Rule Making for Management Systems):

(a) Each state shall have procedures, within the state's organization, for coordination of the development, establishment, and implementation of the management systems. The procedures must include an oversight process to ensure that adequate resources are available for implementation and that target dates of the systems are complementary so that the outputs of all the systems can be given timely consideration in the development of metropolitan and statewide transportation plans and programs.

(d) Each state shall be responsible for overseeing and coordinating such activities.

STATEWIDE PMS OVERVIEW

The procedure with which Massachusetts will meet the requirements set forth in ISTEA incorporates the evaluation and inventory of the entire federal-aid eligible highway system in the state—regardless of jurisdiction. This statewide-PMS also includes linkages with a central computerized geographic information system (GIS) data base, the development of economic models and budgets, procedures to assess the priorities of pavement maintenance and rehabilitation projects, and an institutional framework for the

statewide PMS. Figure 1 presents the activities at both the state and MPO levels that are required to proceed from a network evaluation to the development of rehabilitation projects and needs.

As indicated in Figure 1, the responsibilities for evaluating and analyzing the federal-aid roadway system have been divided between the state highway agency and the MPOs. The state will survey all roadways that can be tested with the department's ARAN. These roadways include the entire national highway system (NHS) and other roadways that are eligible for Surface Transportation Program (STP) funds. The MPOs will be responsible for the coordination of data collection for the remainder of the federal-aid system. As previously stated, this will include gathering data from the more advanced local agencies that already have acceptable pavement management systems, as well as obtaining data for the roadways in communities that do not yet have an acceptable PMS.

Because each PMS has distinctive data requirements for triggering treatment selection, all data will be analyzed using the PMS for which they were collected. Analyzing the condition data within the respective system keeps the individual integrity of each PMS intact. Correlating condition data to a standardized index before analysis would severely diminish the strengths of each individual system. These strengths include features such as triggering actions based on the type of distress, drainage conditions, or curb reveal (insufficient curb reveal can prohibit certain actions in urban areas). During this phase of network-level analysis (conducted by the state for national highway system roadways and the MPOs for Surface Transportation Program roadways), potential treatments for candidate projects and estimates of overall budget needs are developed. Treatment selection will, of course, be based on costs and pavement performance for typical pavements in the region.

Based on this analysis, the state will forward candidate projects and cost estimates for local roadways evaluated with its ARAN to the MPOs for inclusion in estimates of their regional needs. The candidate projects will then be refined through project-level analysis conducted by qualified personnel (town engineers, state-aid engineers, MPO staff, consultants, etc). The MPOs will, in turn, forward the network-level project list for state roadways to the state for inclusion in estimates of state highway needs. Project-level analysis will then be carried out at the district level of the Massachusetts Highway Department.

Until this point, emphasis has been placed on developing a list of candidate projects and determining network-level budget needs. However, to observe existing and projected statewide conditions, and to assess priorities across the state, a uniform measure of pavement condition must be developed. This is the point at which the individual systems will be harmonized. This will be accomplished through a correlation of condition surveys. In Massachusetts, this task requires the correlation of the condition ratings of the three most common PMSs to the SHA's PMS. The harmonized condition data will be used by the SHA to assess network conditions and to develop a ranking of all NHS and STP projects to determine regional funding requirements.

Eventually, through the statewide and metropolitan planning processes (which consider the results of the other management systems), projects will be programmed for construction. After construction, the PMS data base will be updated with "as-built" data. The SHA will be responsible for maintaining historical records for its pavements. The MPOs will serve as regional repositories for the historical roadway records of all other federal-aid roadways within their jurisdictions. This regional approach offers the advantage of

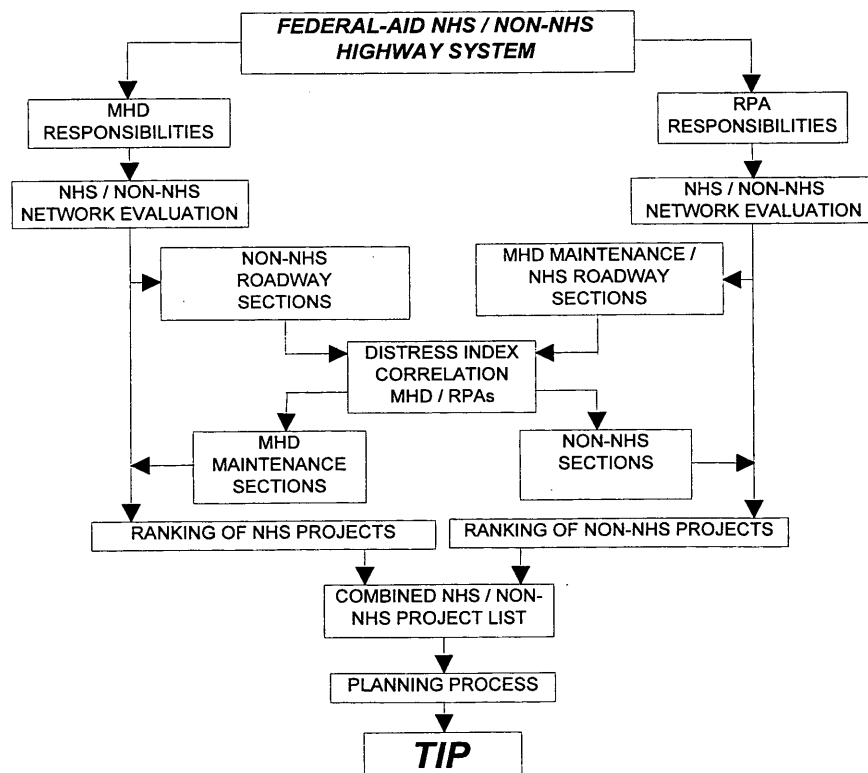


FIGURE 1 Massachusetts pavement management activities.

allowing the pooling of regional deterioration data so that accurate multiyear projections can be made quickly. Obviously, feedback will be crucial and necessary to ensure the credibility and reliability of the overall PMS process.

COORDINATION WITH OTHER MANAGEMENT SYSTEMS

Coordination with other management systems is being accomplished through the use of a shared GIS platform. This approach is a natural outgrowth of previous work efforts mandated by ISTEA. It also takes advantage of the latest technology available for transportation planning.

Massachusetts began the coordination of the management systems by accomplishing the revision of the urban-rural boundaries and the functional classification update with the GIS system. The completion of these steps determined the federal-aid roadway network that the statewide PMS had to address. Existing state inventory numbers were attached to the roadway segments in the GIS so that existing attribute data, such as lane width, pavement type, and jurisdiction, could be attached. The functionally classified network has also been used for transportation modeling purposes. Traffic monitoring, safety, bridge, public transportation, and intermodal facilities data also share a common GIS platform.

The results of all the management systems will be examined through the planning process. It is anticipated that coordination of condition, capacity, safety, and mobility factors identified through the respective management systems will provide valuable information to decision makers.

CONCLUSIONS

- PMSs must fit into institutional systems. In Massachusetts, the PMS fits into the existing MPO structured regional planning arrangements. This approach is practical and fully consistent with ISTEA.

- Massachusetts chose to harmonize the individual pavement management systems (make the systems work together) rather than mandate a standardized system because no single pavement management system is appropriate for all agencies. Various pavement management software packages are used to develop candidate projects and cost estimates. The distress indexes of the individual PMS software packages will then be correlated to the state condition index. This allows comparison of the condition of different roadway segments without compromising the ability of the individual network-level PMS software packages to predict potential treatment.

- PMSs can share a common data base with other management systems. The roadway inventory portion of the statewide PMS development was based on the urban-rural boundary revision and functional classification update requirements of ISTEA. These efforts resulted in a GIS data base that is shared with the other management systems.

- Communication between agencies is essential. In Massachusetts, communication was facilitated by establishing user groups (pavement management and transportation modeling) for regional agencies. These organizations have fostered communication between the state and the regions and helped to reduce institutional barriers.

REFERENCES

1. Luce, D. *Regional Planning Agency (RPA) and Metropolitan Planning Organization (MPO) Activities: The 3C Transportation Planning Process in Massachusetts*. Massachusetts Highway Department, Boston, 1993.
2. Ofori-Darko, E. *The Role of Metropolitan Planning Organizations in Pavement Management*. Master's thesis, University of Massachusetts, Amherst 1991.
3. *Funding the Rehabilitation and Maintenance of Locally Maintained Roads in the MAPC Region*. Metropolitan Area Planning Council, Boston, Mass., 1987.
4. Johnson, R. H. *Policy Directive No. 89-21*. Massachusetts Department of Public Works, Boston, 1989.