NCHRP
SYNTHESIS 288

NATIONAL
COOPERATIVE
HIGHWAY
RESEARCH
PROGRAM

Data Sharing and Data Partnerships for Highways

A Synthesis of Highway Practice

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Data Sharing and Data Partnerships for Highways

A Synthesis of Highway Practice

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SUBJECT AREAS
Planning and Administration

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NATIONAL COOPERATIVE HIGHWAY RESEARCH PROGRAM

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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 community, the American Association of State Highway and Transportation Officials has, through the mechanism of 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 report will be of interest to department of transportation (DOT) administrators, supervisors, and staffs, as well as to the consultants that work with them. Metropolitan Planning Organization (MPO), regional, and local agency staffs might also find it informative. It was initiated in response to a recommendation made during the Highway Performance Monitoring System (HPMS) Reassessment undertaken by the Federal Highway Administration in 1997–1998 to expand data sharing and partnering more widely among states, MPOs, and local governments. It documents current arrangements among state DOTs, MPOs, and other regional and local agencies to partner in the collection and share in the use of HPMS data. Key elements examined include institutional arrangements, the use of data and data sharing, cost and resource requirements, technical capabilities/barriers, implementation processes, data quality and capability, as well as successes, failures, and difficulties.

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 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.

This report of the Transportation Research Board includes case studies of successful partnerships. Interviews extended queries into the use of data management systems, where HPMS is an element, but not the sole reason for the data management system.

To develop this synthesis in a comprehensive manner and to ensure inclusion of significant knowledge, the available information was 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 author's research in organizing and evaluating the collected data, and to review the final synthesis report.

This synthesis is an immediately useful document that records the 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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Information on current practice was provided by many highway and transportation agencies. Their cooperation and assistance are appreciated.

DATA SHARING AND DATA PARTNERSHIPS FOR HIGHWAYS

SUMMARY

This synthesis was initiated in response to a recommendation made during the Highway Performance Monitoring System (HPMS) Reassessment undertaken by the Federal Highway Administration (FHWA) in 1997 and 1998. The recommendation was that a synthesis be initiated to identify and document successful instances of data sharing and data partnering within the HPMS process and identify where those instances might be expanded or where new opportunities might exist for data partnering.

The FHWA conducted the reassessment in cooperation with its state and Metropolitan Planning Organization (MPO) partners and many HPMS users in the broader transportation and research communities. The reassessment outcome included a consensus on maintaining the HPMS as a state-based reporting system. The extent of the required reporting was reduced significantly, but the overall framework of a revised HPMS remains very similar to the prior system.

The HPMS is more than a reporting system. Analytical tools have been developed for use in conjunction with the HPMS data, which allow a powerful array of analysis methods to be used in conjunction with the data to produce standard as well as tailored policy reports.

During the course of a National Workshop on the HPMS held in Minneapolis in the summer of 1997, state, MPO, and local representatives recommended that an objective of the HPMS should be to evolve the HPMS to a data system which:

- builds from the data systems of local, regional, and state governments;
- is connected with a common geo-referencing system; and
- avoids, whenever possible, collecting data that is not used by the collecting agency.

This objective was accepted by the FHWA, and this synthesis was proposed and developed in direct response to this new objective in an attempt to expand data sharing and partnering more widely among the states, MPOs, and local governments.

The synthesis research and associated inquiries resulted in the following findings:

- Currently there are only limited instances of data sharing or data partnering within the HPMS process.

- The practice in those states and metropolitan areas where data sharing occurs indicates significant opportunities for savings in data collection costs within HPMS data collection programs. These savings would occur primarily through the more efficient collection and use of traffic volume data. These savings are over and above

the savings that will be achieved by the revisions associated with the implementation of the HPMS reassessment.

- Data partnering in HPMS programs, whenever and wherever practiced, has created advantageous situations for all participants in the partnering. The greatest benefit occurs through multiple use of the data collected. An additional benefit is improved data quality, brought about by the greater care and attention paid by partners in the HPMS process.

- True data partnering in the collection of data from the HPMS sample sections only occurs in three states: California, Michigan, and Pennsylvania. In these states the MPOs have a major role in the collection process.

- There is a more limited amount of partnering in HPMS data collection in an additional 16 to 18 states through MPO and/or local government involvement in the collection of data on HPMS sample sections not on the state highway system.

- Approximately 30 states undertake all HPMS data collection with their own staffs or, in a few instances, with the involvement of state consultants.

- Financial arrangements within the HPMS data collection system vary considerably. Only the three states noted as involved in true data partnering make "extra" funds available to MPOs for HPMS-associated expenses. HPMS data collection work undertaken by MPOs and local governments is an "eligible" cost under federal financial assistance rules and MPOs can charge their costs against their metropolitan planning fund allocation. In no instance was it apparent that local governments participating in HPMS activities had federal-aid funds made available to them.

- The use of HPMS data is extensive, going beyond the FHWA's use in the biennial condition and performance reports to the U.S. Congress.

- Practices relating to the use of HPMS-derived vehicle miles of travel estimates for air quality conformity analysis vary considerably among the states and even among MPOs within the same state.

- Data partnering is much more apt to occur when a state has a comprehensive data management system designed to be accessed from throughout the agency. State data management systems make it much easier to expand access to other partners.

- Research results indicate that at least eight states have used the FHWA analytical process or the Highway Economic Requirements System in some way. Of these states, Idaho, Nevada, North Carolina, Oregon, and South Carolina seem to have used the analytical process most frequently. Their experience has generally been positive, in each instance enhancing the array of quantified policy options available to senior administrators. In the most successful applications the models have been tailored to address specific, currently relevant, state policy issues.

- The following is a listing of specific practices that have come to be regarded as best examples of partnering within the HPMS process today:

- Establishment of state and MPO data coordinating committees with representation from states, MPOs, and major local jurisdictions.

- Incorporation of HPMS data into broader data management systems by states and MPOs.

- Provision by states of highway system performance data to MPOs and local jurisdictions on either a real-time or annual basis.

- Recognition of state, MPO, and local agency roles and costs for HPMS data collection through formalized financial arrangements.

- Provision by the FHWA of analytical software to states and MPOs to permit them to undertake HPMS-based performance and needs analysis.

- States permitting MPO access to Intelligent Transportation System loop detectors and other traffic monitoring devices within an MPO's jurisdictions.

- Oregon's use of the Highway Economic Requirements System models in an innovative approach to corridor planning.

- California Department of Transportation/Southern California Association of Government's establishment of a data coordinating committee, which is overseeing their pioneering look at data sharing between the state, MPO, and major local jurisdictions.

- The Kalamazoo, Michigan, MPO's use of the unified planning work program as a basis for allocating HPMS data collection responsibility and for crediting local data collection costs against the local share of MPO costs.

- The Kansas Department of Transportation's use of the analytical process to evaluate the extent of its principal arterial system and the standards applied to the system. The application resulted in a downsizing and rationalization of the system with the potential of significant reduction in highway user costs.

The HPMS is a successful planning system, but its full potential has not been realized. After a broadly based reassessment, and following significant streamlining, a decision has been made to continue the system. This synthesis presents successful instances in partnering in both data collection and in the use of the completed data set that provide opportunities for exploiting the full potential of the HPMS system.

CHAPTER ONE

INTRODUCTION

BACKGROUND

The Highway Performance Monitoring System (HPMS) has its roots in the 1960s when the Federal Highway Administration (FHWA), in cooperation with the states, devised a continuous highway condition reporting system, although the term HPMS did not come into use until 1978. The system developed following a series of congressionally mandated national "needs" assessments. These studies included reports to the U.S. Congress that were expensive, "one shot," efforts. Many states also conducted needs assessments for their state legislatures. The states and the FHWA determined that it would be better to devise a continuous reporting system rather than proceeding with a series of ad hoc efforts. Recognizing that such a system was under development, Congress in 1965 required the FHWA to report biannually on the condition and performance of the nation's highways. The first report to Congress in response to this mandate was submitted in 1968.

To make the HPMS process more than a data collection mechanism, the FHWA developed an efficient needs assessment mechanism, which has come to be known as the analytical process (AP). The AP, through a series of models, transforms the raw inventory into a comprehensive needs assessment. It consists of an integrated series of models that examine each individual sample section, measure its deficiencies against established standards, and use cost models to estimate the cost of improving the section to an acceptable standard. Because each section is a sample, it serves as a proxy for a larger number of similar sections. Expansion factors, based on the sampling rate, are used to expand the section estimates to a universal estimate.

The HPMS has been modified and improved over the years. For example, the term HPMS once was limited to the characterization of the sample sections of highways inventoried for needs analysis. Beginning in 1978, the term HPMS began to be used to characterize the entire highway database for FHWA statistical purposes, because increasingly HPMS became the source of many key statistics. In more recent years the AP needs assessment has been supplemented by the Highway Economic Requirements System (HERS), which adds an economic component to the engineering needs analysis of the AP.

The HPMS is in the process of undergoing significant changes as a result of the reassessment study conducted in 1997 and 1998 (*1*). In response to many recommendations by the user and provider community the FHWA has made substantial reductions in the number and detail of the data items required by the HPMS. The study recommended eliminating 15 data items and changing 21 others, with the net result that 90 reported detailed data lines will be eliminated, with only one new item added. The reassessment identified opportunities for the states to reduce the HPMS sample size by 35 percent in the aggregate from 123,000 samples to 80,000 samples, and for the FHWA to reduce the number of records by two-thirds by means of grouping. Estimated annual cost savings of $3 to $5 million were identified. The base cost of the HPMS, before the reassessment, has been estimated at $15 to $20 million. After a final round of public comment the reassessment recommendations were adopted in December 1998. Workshops were conducted around the country in early 1999 to introduce state and local officials to the changes. Three reports document the reassessment study (*1–3*).

During the 1997–1998 outreach associated with the HPMS reassessment, a number of positive comments were made regarding the practice of "data sharing" or "data partnerships." The comments were made in several contexts. First, where states viewed Metropolitan Planning Organizations (MPOs) as partners in the HPMS data collection process, MPOs were much more inclined to view HPMS in a positive light. They were also more likely to include HPMS data in regional databases and to make use of the data for their own purposes. The same situation occurred when local governments, in particular large cities or large urban counties, were made part of the process. The likelihood of the use of the data outside the FHWA process of preparing the biennial reports to Congress increased greatly when sharing or partnering was practiced during data collection.

The second context of data sharing in this synthesis involved the use of HPMS data in state or local analyses. This context was further limited during this synthesis study to mean use of inventory data from the roadway sample sections in electronic formats, as opposed to use of areawide (summary) HPMS data published in reports of statewide statistics. Lastly, the terms data sharing and data partnerships are used interchangeably in this report. No distinction between them is intended.

The role of the FHWA in sharing was also explored in considerable detail. Because the FHWA provides the basic repository of HPMS data it plays a key role in any sharing process. The FHWA has, since the inception of HPMS in the 1960s, always published HPMS-derived information in its annual publication *Highway Statistics* (*4*). These statistics, such as lane-miles, traffic volumes, and pavement condition, are published annually by state in a fairly aggregate form. The biennial reports to Congress on the condition and performance of the nation's highways always provide highway conditions and their associated needs at the national level. The HPMS has been designed to estimate highway needs for each state. There are sufficient sample sections in each state to allow state estimates of selected statistics with predetermined accuracy. The FHWA, however, has always analyzed and published only national level needs estimates.

The FHWA has made the AP models available for state use in a mainframe version for more than 20 years. Only a few states have availed themselves of this opportunity. More recently, the AP has been available in a microcomputer version. The HERS model, which supplements the AP by adding an economic component, is much newer, but has not generally been available for state use, except by special arrangement.

OBJECTIVES

This synthesis was designed to document current arrangements among state departments of transportation (DOTs), MPOs, and other regional and local agencies to partner in the collection and share in the use of HPMS data. The key elements examined include institutional (contractual and administrative) arrangements, use of data, data sharing, cost and resource requirements, technical capabilities/barriers, implementation processes, and data quality and compatibility, as well as successes, failures, and difficulties. The synthesis includes case studies of successful partnerships.

METHODOLOGY

The 1997–1998 FHWA HPMS strategic reassessment used a questionnaire to survey state DOTs and MPOs concerning the HPMS program. It included questions about practices used in the collection of HPMS data and the uses made of the data collected. The survey also requested state and MPO opinions on the merits of the HPMS program and the value to them of the individual data items. This synthesis study focuses primarily on responses regarding state and MPO data collection practices and uses/applications of the data collected. The reassessment surveys have provided a wealth of information on the HPMS, and state and MPO roles and practices. Unfortunately, they also reveal that there are relatively few true data partnerships or instances of data sharing. There are, however, indications that various practices have the potential to be expanded or combined with the innovations of others to form significant improvements in current practice. Conversations with a number of state officials indicated that the HPMS reassessment questionnaires remained valid because very few changes had been made in HPMS practices pending the outcome of the reassessment. Therefore, an initial questionnaire survey for this synthesis was determined to be unnecessary. The 50 responses to the state DOT survey and the 53 responses to the MPO survey were reviewed in detail along with all available documents pertaining to the reassessment. The several reports relating to the reassessment were valuable resources for this synthesis study. The surveys already conducted were supplemented with practitioner interviews to identify selected agencies, topics, and practices for a series of intensive case studies.

In addition, the Transportation Research Information Services (TRIS) was queried for (1) relevant information in reports of state DOTs and MPOs, (2) relevant research based on the use of HPMS data for policy analysis or transportation system performance measurement, and (3) other direct applications of the HPMS. Specific topics explored in the literature review included:

- state needs studies
- traffic counting programs
- air quality conformity
- congestion management
- pavement management
- Intelligent Transportation Systems (ITS)
- Geographic Information Systems (GISs).

The results of reviews of the HPMS Strategic Reassessment surveys and literature reviews, as well as further discussions with federal, state, and local officials and comments from the Topic Panel, were used to develop the following candidate list of case studies.

- HPMS data partnering practices in California, Michigan, and Pennsylvania.
- The use of the AP and the HERS in policy analysis starting with the experiences in Arizona, Georgia, South Carolina, and Nevada.
- The role of the HPMS in benchmarking for urban travel and air quality analysis.
- The role of technology in the HPMS process as brought about by ITSs, GISs, Global Positioning Systems (GPSs), and Congestion Management Systems (CMSs).
- The role of HPMS data as a measure of exposure for calculating crash rates.

For each case professionals associated with the specific practices of states and/or MPOs were interviewed by phone to secure confirmation of the practice and a verbal summary of work accomplished. Wherever possible, written reports were also obtained. For research identified through TRIS, copies of the relevant publications were obtained and reviewed.

A number of excellent unpublished state and MPO reports not generally available were identified through telephone contacts. These were often supplied as compressed file attachments to e-mail, serving to demonstrate the revolution that is occurring in data transfer. The web sites of state DOTs and the U.S. DOT were an added resource. These sites proved very helpful in capturing recent practice and served to showcase data and other information available electronically.

These case studies were originally designed to probe, in depth, the nature of the "partnerships" or "data sharing arrangements" that exist within the HPMS process. The scope was expanded from this initial focus because it is evident that the HPMS is not the centerpiece of most state and local data management systems. It is a key component, but it is clear that data partnerships have a broader rationale and role in many instances. Therefore, the scope of the interviews included queries into the use of data management systems where the HPMS is an element, but not the sole reason for the data management system.

The definition of partnering proved difficult to establish, particularly with respect to the financing of HPMS data collection. In the federal/state partnership that constitutes the federal-aid highway program, virtually all state activities are eligible for federal reimbursement. The practice of reimbursing MPOs and local governments that become involved in HPMS partnering arrangements varies greatly. Therefore, the case studies were selected not only to explore data sharing in data collection and use, but also to examine the funding arrangements that buttress the sharing.

The original scope of the synthesis was expanded in a number of areas as a result of the interviews with state and MPO officials. These expansions are described in the individual case studies.

In summary, this synthesis was based on the review and evaluation of (1) the reassessment questionnaires, (2) publications identified in the TRIS search, (3) other research reports, and (4) information provided through numerous face-to-face, telephone, mail, and e-mail contacts.

CHAPTER TWO

STATE AND MPO CASE STUDIES

California, Michigan, and Pennsylvania were identified during the HPMS reassessment as states that had a higher level of partnering than other states. The distinction that served to set these states apart was the significant role their MPOs played in HPMS data collection. It could be said that in these three states the MPOs take on a role in HPMS data collection that state DOT district offices serve in other states.

Where appropriate, the state and MPO case studies include a discussion of the role of HPMS in air quality conformity analysis. Air quality uses will be discussed more fully in a subsequent section of this report, but for purposes of the case studies conformity analysis is a process to access the compliance of any transportation plan, program, or project with air quality implementation plans. The conformity process is defined by the Clean Air Act (CAA). The FHWA has prepared an excellent publication describing the conformity process (*5*).

CALIFORNIA

The California Department of Transportation (Caltrans) has historically had a strong relationship with its MPOs. The California legislature has enacted into state law a strong linkage between Caltrans and the MPOs and a strong role for MPOs. In most states the linkage between state DOTs and MPOs exists because of federal legislation. California is one of the few states that have assigned MPOs responsibility under state law. California MPOs have planning responsibility for federal-aid highways and also for state-aided highways. There are 170,506 miles of roadway in California, of which 18,252 are under state control. There are 53,530 miles of roadway in the functional classes requiring section level monitoring through the use of HPMS sample sections. California has 6,367 sample sections.

The HPMS reassessment questionnaire prepared by Caltrans indicated support for the HPMS, but also stated a desire to see the federal requirements limited to those essential for federal purposes. The state response, along with seven responses from California MPOs, indicated a higher degree of cooperation between Caltrans and the California MPOs than exists in most other states.

Caltrans provides federal-aid state planning and research funds to the MPOs over and above their normal PL (metropolitan planning) allocation. This funding supports the MPO's coordination of HPMS data collection by local governments on HPMS sections that are not on the state highway system. The MPOs are coordinators/facilitators for the data collection and thus a formal part of the process. The MPO role includes making the estimate of traffic growth on the HPMS sample sections. In California, 68 percent of all road mileage is functionally classified as rural minor collector or local and thus not covered by HPMS sample sections.

In 1998 Caltrans established an HPMS Optimization Team charged with optimizing current and potential use of HPMS data for analysis and decision making within Caltrans. This effort was a part of Caltran's Total Quality Management Program. As an element of the optimization study the Caltrans staff looked at current and potential, internal and external data providers. The many providers, shown in Tables 1 and 2 (*6*, p. 7), serve to illustrate not only the complexity of Caltrans' HPMS data collection, but also the need to coordinate the actions of the many providers.

TABLE 1
CURRENT AND POTENTIAL HPMS INTERNAL DATA PROVIDERS

Data Providers	Data Type
Maintenance	International Roughness Index data and Pavement Serviceability Rating for state highways
TSIP (State Highway Inventory)	State highway data: "D" and "K" factors, percent trucks, capacity calculations
TSIP (GIS)	Linear referencing system, visual depictions: Nonattainment areas, gross land area, sample locations, postmiles, etc.
TSIP (Office of Travel Forecasting and Analysis Modeling)	Statewide vehicle miles of travel
TSIP (Office of Highway System Engineering)	Functional classifications, urban/rural boundaries, route ID, jurisdictional boundaries
Traffic Operations (Traffic Census)	Annual average daily traffic for state highways
Traffic Operations (TASAS)	State highway data: Accidents, shoulders, medians, access controls, segment lengths, number of lanes, terrain types, right-of-way, etc.
Local Programs	Monthly county mileage totals

TSIP = Transportation System Information Program; TASAS = Traffic Surveillance and Analysis System.

TABLE 2

CALTRANS HPMS OPTIMIZATION STUDY—CURRENT AND POTENTIAL EXTERNAL HPMS PROVIDERS

External Data Providers	Data Type
Urban Cities/Counties through Metropolitan Planning Organizations (MPOs)	HPMS principal arterial and sample data Items for non-state roads
Rural Cities/Counties through Caltrans District Offices	HPMS principal arterial and sample data items for non-state roads
Federal Highway Administration	Legislation, precision levels, sample data items for non-state roads
California Highway Patrol	Fatal and injury accidents on non-state highways
California Environmental Protection Agency	Nonattainment boundaries definition
California Department of Finance	Population, net land area

The results of the study shown in Table 3 (*6*, p. 4), in the form of an implementation plan, demonstrate that optimizing HPMS at the state level has many facets. This plan appears to be relevant for many state DOTs.

To further assist the HPMS process Caltrans has published a user friendly, 50-page set of "Instructions for Reviewing and Updating Data Items" (*7*). This document includes state contacts, annual deadlines, and an item-by-item description of the data to be collected including relevant California geographic codes. The document is designed for use by Caltrans, MPO, and local government staff involved in the HPMS data collection process.

Caltrans annually publishes a comprehensive (the 1996 report contained 166 pages) "Assembly of Statistical Reports," which is described as "A compilation of California public road data including Highway Performance Monitoring System (HPMS) data" (*8*). This report, containing a wealth of state and substate statistics, is presented in a simple, straightforward format. The document has a wide annual distribution to a standing list of public and private groups, and additional copies are used throughout the year to respond to specific requests for highway information. Caltrans also has a Transportation System Information Program web site, http://www.dot.ca.gov/hq/esc/, which increasingly serves as a source for California highway information.

Caltrans also has financially supported and participated in a significant pilot effort to coordinate highway data collection in a large area of southern California. This initiative is discussed here.

TABLE 3

IMPLEMENTATION PLAN (*1*)

Recommended Optimization	Policy/Procedures Required	Approximate Time Frame
Provide Internet access to HPMS data	Obtain required management approvals. Develop web page. Coordinate final implementation	6 months initially, then ongoing
Educate Caltrans staff on HPMS	HPMS staff develop market/education plan. Produce and distribute newsletters, brochures, Internet. E-mail on the HPMS. Include HPMS in Caltrans directory. Make presentations where appropriate.	Ongoing
Collect additional truck data	Add truck classification count data to current traffic monitoring service contracts.	Ongoing
Establish HPMS interface to GIS and corporate databases—Train HPMS staff	GIS Service Center and ISSC develop GIS linkages to corporate database. HPMS and GIS Service Center to maintain and ensure database linkages.	1 year development, then ongoing
Reduce "lag-time" in HPMS data delivery	Prepare electronic forms to expedite data collection. Establish goal to publish data within 6 months after reporting year.	Collection process is ongoing. 60 day development upon completion of the database system linkages. (approximately July 2000). Ongoing thereafter.
Merge State Highway Inventory into HPMS	Conduct feasibility study, analyze current process, and develop plan. Produce design, coordinate, develop, test, refine, and update.	3 years for full implementation after completion of the database system linkages (approximately July 2000). Ongoing thereafter.

ISSC = Information System Service Center.

TABLE 4
TRAFFIC DATA APPLICABLE TO EACH STUDY/ACTIVITY TYPE

Data	Traffic Impact	Corridor Studies	Design Traffic	Travel Models	Impact Fees	Noise	AQ Analyses	RTP and RTIP	Goods Movement	HPMS	CMP	VMT	Market	Public Inquiry	Regional
Average annual daily traffic (AADT)						X	X			X		X	X	X	X
AADT—future year						X	X			X		X	X	X	X
Average weekday daily traffic (AWDT)	X	X	X	X	X	X	X	X	X		X			X	X
AWDT—future	X	X	X	X	X	X	X	X	X		X			X	X
Intersection turning movements	X	X	X	X			X		X		X			X	
Lane occupancy								X			X				X
Level of service	X	X	X		X			X	X		X		X	X	X
Link speed		X		X		X	X	X	X						X
Link travel time		X		X				X							X
Trip time (origin to destination)		X		X				X	X				X	X	X
Peak hour link volume	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Peak period link volume		X		X								X			X
Queue length		X	X												
Roadway congestion index									X						X
Truck volume daily		X	X	X		X	X	X	X	X	X	X	X	X	X
Truck volume peak hour	X	X	X	X		X	X		X		X				X
Vehicle delay							X								X
Vehicle hours of travel		X		X			X	X	X		X				X
Vehicle miles of travel		X		X	X		X	X	X	X	X	X			X
Vehicle occupancy		X					X				X				X
Volume/capacity ratio	X	X	X	X	X			X	X	X	X		X	X	X

RTP = regional transportation plan; RTIP = regional transportation improvement program.

Southern California Association of Governments (SCAG)

Working in coordination with Caltrans, SCAG distributes and collects an annual 80-question HPMS survey form. They work primarily through local agency public works departments. SCAG conducts workshops for local agency staff, and after completion of the fieldwork, assembles and transmits the questionnaires to Caltrans. The state is responsible for all HPMS sample selection and for adjustment of the sample sections due to changed conditions. In the HPMS reassessment survey a number of the California MPO agencies expressed concern about frequent changes in the location of sample sections.

During an HPMS reassessment workshop held in Minneapolis on June 30–July 2, 1997, a SCAG participant was impressed by the apparent success of data partnerships reported on by some MPO attendees. As a result, SCAG, with support from Caltrans, conducted a study of opportunities for data sharing and the potential for developing a comprehensive database for all transportation system data collected within SCAG's jurisdiction. The first phase addressed the establishment of a Regional Highway Monitoring System (RHMS) to cover highway-related data. In 1998, SCAG, in cooperation with Caltrans, formed a task force composed of members of the region's six county transportation commissions, Caltrans (headquarters and district offices), and SCAG to evaluate different alternatives and to develop a methodology for a RHMS. The establishment of the task force represents a practice for other regions to emulate.

The intent of the RHMS is to consolidate multiple data gathering and analysis functions dealing with highway traffic data into a unified framework that will:

- Provide a system that can serve as a clearinghouse of traffic monitoring data to address the range of planning needs for SCAG and agencies that conduct transportation planning and engineering analyses in the SCAG region.
- Provide the necessary data to fulfill mandated monitoring requirements at the state, regional, and federal level.
- Streamline and eliminate duplication in data collection efforts as much as possible (*9*, p. 1).

The task force meetings provided an opportunity to discuss data collection programs, coverage, equipment, etc., and opportunities for data sharing and data partnerships. Table 4 (*9*, p. 6), taken from the final report prepared by the RHMS consultant, shows the many traffic data elements being collected in the SCAG region classified by potential user applications.

The recently completed study represents an important milestone in advancing the exchange of highway information by the various governmental units in the SCAG area. One important finding of the study was that "designing the RHMS, or any other multi-jurisdictional data management system is not merely a technical challenge, but an institutional one" (*9*, p. 2).

The study concluded that the RHMS provides substantial opportunity for improvement in how the Southern California highway system is monitored. It recommended proceeding with a multiyear effort, but cautioned, "the devil is in the details," and that success would require difficult technical and institutional progress.

More than 10 years ago SCAG increased their HPMS sample size from the FHWA recommended levels in order to have more accurate data for travel model validation and for other planning uses within the SCAG region. The Los Angeles basin has for many years had a significant air quality problem. SCAG has made a major commitment to the development of strategies needed to overcome the problem and to monitoring vehicle miles of travel (VMT) as a means of tracking progress in implementing strategies related to VMT reduction.

SCAG is unique among MPOs identified through the case study process in that they have a strong interest in using the AP and HERS programs. In cooperation with local jurisdictions they have enhanced their HPMS sample in several counties and intend to undertake a pilot HERS approach as soon as the microcomputer version becomes available. SCAG maintains an informative website (http://www.scag.ca.gov/).

Bakersfield—Kern Council of Governments

This MPO has a traffic-counting equipment loan program for jurisdictions that do not own such equipment. Local jurisdictions may use the equipment for their own purposes while it is on loan, but are also expected to count the HPMS sections in their jurisdiction.

Santa Barbara County Association of Governments (SBCOG)

Santa Barbara County's Clean Air Plan, which SBCOG coauthored with the county air pollution control district, includes a description of VMT tracking using HPMS data along with a graph depicting the VMT forecast relative to the base VMT estimates. This graph is updated annually and circulated to the air district and the state as a part of the county's interagency consultation agreement.

San Francisco—Metropolitan Transportation Commission (MTC)

The MTC is the liaison between Caltrans and the 90 local jurisdictions in the Bay Area that collect HPMS data. The HPMS is not used for conformity determinations. The MTC Travel Demand Forecast Models are used for all conformity analysis. MTC views the HPMS as a national sample with national users. The HPMS data are not used currently by either MTC or the local governments. The MTC does use Caltrans freeway count data in its model validation process.

Sacramento Area Council of Governments (SACOG)

As the MPO, SACOG assembles data submitted by local jurisdictions. SACOG provides traffic forecasts to any jurisdiction upon request if the sample segment falls on the regional traffic network used in their analysis system. Most samples in smaller jurisdictions require special counts for HPMS, whereas the larger jurisdictions have data collection systems that include the HPMS samples. SACOG's regional traffic forecasting model is used instead of the HPMS for all air quality conformity analysis. Their travel-forecasting model is validated by incorporating four times as many local counts than are included in the HPMS.

San Diego Association of Governments (SANDAG)

SANDAG coordinates the collection of HPMS data for 19 local agencies for HPMS sections not on the state highway system. They also provide forecasts of future traffic where requested. Base year HPMS VMT estimates are used to validate the SANDAG traffic model. Recently, the base year model estimate has been within 1 percent of the HPMS VMT. The HPMS is not used, however, in conformity determinations, because SANDAG staff has more confidence in their travel models, which are annually validated through 2,000 sites of count data.

California Summary

Caltrans has a very ambitious program to facilitate the collection of HPMS data using MPOs as partners wherever possible. They have an excellent state HPMS program, which provides for frequent adjustment of HPMS samples in order to keep statistically valid as traffic conditions change. The degree to which the MPOs accept the role of partners in the process varies throughout the state.

MICHIGAN

There are 117,620 miles of roadway in Michigan, 9,622 miles of which are on the state highway system. There are 33,155 miles in the functional classes requiring HPMS sample section monitoring and there are 3,515 sample sections in the state.

Along with many other states, the Michigan DOT (MDOT) experienced budgetary constraints during the past decade, which caused a reevaluation of the work that could be accomplished with available staff. One of the results was to forge a stronger relationship with MPOs and to begin to consider MPOs as partners, and to a certain degree, as extensions of MDOT staff. As early as the 1970s, MDOT started working with local agencies to collect required HPMS data. This included requesting that MPOs collect or coordinate the collection of all HPMS sample sections that fall within the jurisdiction of the MPO and that are not on the state highway system. There are differences of opinion about whether additional funds were provided to fund the expanded MPO efforts. At one point the Michigan legislature established a fund for MPO activities. The funds were over and above the required state allocation of federal-aid metropolitan planning (PL) funds to the MPOs. Some MPOs argue that these funds could be used for a number of eligible activities including the HPMS. Regardless, MPOs receive state funds over and above their PL allocation, a practice that only rarely occurs in other states. Some of the Michigan MPOs use PL funds to complete the HPMS data collection. Although requiring MPOs to collect HPMS data, MDOT has maintained a flexible policy concerning how the data are collected. Actual experience shows the following:

- MPOs perform counts themselves with state funds used to purchase equipment.
- MPOs purchase equipment and pass it on to local governments or road agencies on a rental or loan basis to do the counts.
- MPOs act only as a coordinating agency and pass on tasks to local governments and road authorities.
- Various combinations of the above functions.

MDOT, in responding to the reassessment of HPMS, affirmed support for the current level of data collection for all federal-aid roads. MDOT also reported use of the HPMS in air quality analysis. Additionally, Michigan was one of the states that reported use of the AP. They used the results for comparison with a Michigan needs process that established deficiencies and the cost of eliminating the deficiencies.

Michigan MPOs determine the appropriate growth factors for their assigned HPMS sample sections. If there are differences between state and MPO growth estimates, they are resolved by mutual agreement.

MDOT has been a national leader in the development of management systems, including the development of a comprehensive data management system. The HPMS data are integrated into the MDOT data management system.

Detroit–Southeast Michigan Council of Governments (SEMCOG)

As the MPO for the greater Detroit area, SEMCOG coordinates the collection of data for the HPMS sample sections not on the state highway system. The HPMS data are integrated with the SEMCOG database, and thus are used in base year benchmarking, travel model development, traffic forecasting, and emission inventory development. SEMCOG bought traffic counters a number of years ago and lends them to local agencies that agree to provide HPMS counts. The local agencies are permitted to use the counters for their own purposes as well. Local agencies are asked to focus on counting, whereas SEMCOG handles the update of other HPMS items. SEMCOG periodically trains local agency staff in traffic counting and also hires consultants for this activity. SEMCOG is not interested in taking counts with their own staff, although they must do so occasionally. SEMCOG has developed a comprehensive transportation GIS system including all local roads in southeast Michigan. A linear referencing system is used based on the Michigan Accident Location Index. SEMCOG partners with local agencies to devise applications that meet local agency needs. Their system is used to process all SEMCOG area crash data and integrates the data with other traffic-related data.

Lansing—Tri-County Regional Planning Commission

The Tri-County Commission follows Michigan practice and coordinates the collection of HPMS data on sample sections. They provide about one-half the required information from their own files, with the remainder provided by local governments. Tri-County reports that they do not routinely use the HPMS data for their own modeling and conformity activities. They have amassed 8 years of HPMS data, but have not had the staff time to integrate it into their own database. In 1999, Tri-County programmed $12,000 for HPMS, including $3,000 in state funds and $9,000 in PL funds. No funds were made available to local governments. Traffic counts on local sections were on a 3-year cycle.

Kalamazoo—Kalamazoo Area Transportation Study (KATS)

KATS reported a long history of involvement in the HPMS program. They also appear to have one of the most comprehensive approaches to the coordination of their entire transportation planning work program, including the

HPMS. At the start of each year the work to be accomplished is determined and the MPO staff and local participants decide who is going to do the work. Local expertise is freely drawn on in areas such as pavement evaluation and bridge inspection. Bridge inspection is outside the HPMS system, but is noted because it is very unusual for an MPO to become involved in bridge inspection. Specific local contributions to the needed work are credited with a dollar value in the work program. The local government's matching share of KATS costs can be met through "in-kind" contributions of HPMS data. The HPMS data become an integral part of the KATS data system and are used extensively. The MPO reported that they are beginning to use the state's management systems, particularly the safety management system. They also report extensive MPO involvement in the development of safety statistics.

Michigan Summary

MDOT, although requiring MPO involvement in HPMS data collection, has a flexible policy on the nature of that involvement. The competencies of the individual MPOs are recognized and in individual instances local agencies are credited for their role in the process to a greater degree than observed elsewhere in this synthesis.

PENNSYLVANIA

There are 118,952 miles of roadway in Pennsylvania, 44,148 miles of which are under state control. There are 34,183 miles in the functional classes requiring HPMS sample sections, and there are 5,646 sample sections in the state.

The Pennsylvania DOT (PennDOT) is a strong supporter of the HPMS concept. For a number of years they have provided funds to MPOs to collect HPMS data for highway sections not on the Interstate system. They provide PL funds to the MPOs to facilitate the process. The funds are administered under a longstanding policy that reserves a small share of PL funds for distribution to the MPOs for state priority activities. The 1997 source of funding for HPMS data preparation was:

SPR	$740,000
State matching	340,000
Other PL	800,000
Local government	100,000
Total	$1,980,000

PennDOT officials stated that they consider MPOs to be full partners in the HPMS program. They annually contract with MPOs through the Unified Planning Work Programs for collection of HPMS information. PennDOT reports that HPMS-derived VMT are used in the formulas that determine the allocation of state maintenance funds to counties. They also report the use of several of the other data items, such as the International Roughness Index (IRI), VMT, mileage, and functional classification throughout the department. PennDOT intends to use the analytical package and HERS when they are available for microcomputers.

PennDOT is one of the state DOTs that approached the Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA) requirement for management systems in a comprehensive manner. Significantly, they began the development of a comprehensive Roadway Management System (RMS) well before the ISTEA requirement. The HPMS sample section data are integrated into the RMS.

PennDOT has developed a cooperative program for estimating growth on the HPMS sample sections. The state actually codes this item, but only after consultation with the appropriate MPO. In practice, the state uses the MPO forecasts for all the sections for which the MPO has a forecast available.

Philadelphia—Delaware Valley Regional Planning Commission (DVRPC)

The DVRPC is covered under Pennsylvania because Pennsylvania is a case study state, although the Commission also has a role in New Jersey's HPMS program. They have a very complete role in Pennsylvania's HPMS program including updating the physical and operational characteristics of non-Interstate sample sections and selective field verification of data items reported by local governments. They have responsibility for all traffic counts except for the Interstate system. The DVRPC traffic counting program is very extensive and includes significant project-related counting in addition to the HPMS. The DVRPC count about 1,100 locations each year, of which 100 or more are HPMS sections. The vast majority of the counters are owned by the DVRPC and operated by their own staff. The equipment is loaned to counties on request. Purchase of the equipment is financed with DVRPC planning funds. The DVRPC has an annual HPMS budget of $110,000, which includes both Pennsylvania and New Jersey. The DVRPC reports that HPMS data are used in developing VMT for the region and that the classification counts are used for project purposes. The traffic counts are also incorporated into the DVRPC GIS database.

The DVRPC has a somewhat complex VMT estimation process. They combine their HPMS counts with other count data to develop one estimate of VMT. They use their simulation (travel forecasting models) for a second estimate and they combine their Pennsylvania and New Jersey estimates to achieve a regional estimate. Based on experience they have chosen to use the simulation results as the basis for conformity analysis.

The DVRPC region includes nine counties in the two states with 20,400 miles of road. The DVRPC role in New Jersey is more limited than in Pennsylvania. The DVRPC does not make field site visits to verify data and reports that their current role is more limited than in the past.

Pittsburgh—Southwestern Pennsylvania Regional Planning Commission (SPRPC)

The SPRPC is responsible for all aspects of HPMS data collection for sample sections not on the Interstate system. Their boundary has recently been expanded from six to eight counties, requiring major adjustments to their data collection operations. In 1997 the SPRPC programmed $122,000 for HPMS work. Although they play a major role in the HPMS data collection, limited direct use of the HPMS data was reported on SPRPC's reassessment questionnaire. The HPMS data are entered into a terminal for electronic transmission to PennDOT.

Current year VMT estimates are used to validate base year travel modes. The travel models are used for conformity analysis because of their sensitivity to alternative future transportation systems. PennDOT provides VMT summaries derived from the HPMS to the SPRPC.

Harrisburg—Harrisburg Area Transportation Study (HATS)

HATS follows the Pennsylvania practice and provides HPMS data to PennDOT at an annual cost of $21,250 (1997). HATS collects all non-Interstate HPMS data within their three county area. HATS reports the use of PennDOT RMS county data files recently made available on CD-ROM. This CD-ROM includes information derived from HPMS. HATS staff reports that they expect to greatly increase their use of HPMS data and all data in the PennDOT RMS now that they are available in a user-friendly format on a continuing basis.

Allentown—Allentown–Lehigh Valley Transportation Study

The Lehigh Valley MPO follows Pennsylvania practice by completing HPMS traffic counts on a 3-year cycle and updates the physical inventory with a field review each year. The HPMS data are used as a partial source of data for calibration of the regional traffic model. The data also come into play in air quality conformity analysis. They also report a practice that is common to other Pennsylvania MPOs—access to loop detectors installed by PennDOT on major highway facilities. Using traffic counters supplied by PennDOT they are able to easily download the count data from the loop detectors.

Pennsylvania Summary

PennDOT has forged increasingly stronger ties with MPOs in recent years. They have also devoted significant resources to the development of a statewide database. The MPOs have become partners in data collection and as the state transportation data management system has evolved the state has made it available to MPOs.

CHAPTER THREE

APPLICATION OF THE ANALYTICAL PROCESS AND THE HIGHWAY ECONOMIC REQUIREMENTS SYSTEM

BACKGROUND

The HPMS as viewed today has two components, a data system and an analytical process. This chapter will describe the use of the HPMS database in the analytical process. Subsequent chapters will describe other applications of the HPMS data. The HPMS from its inception was designed as both a national monitoring program for reporting the conditions of the highway system and a series of models that allow the user to investigate needs and performance under varying sets of assumptions. Policy use of the basic data set beyond the comparison of statistical totals requires an analytical system or model. Most policy applications of the HPMS include an evaluation of the consequences of improvement programs of different investment levels on the transportation system. That is, the HPMS analytical process can quantify the system benefits expressed in benefit–cost terms that would accrue from a high investment level and can also quantify declines in system performance that would result from inadequate investment levels. The process also allows the analyst to examine life-cycle costs of investment options.

The term highway system in the context of HPMS and AP/HERS applications means all roads not functionally classified as local roads or rural minor collector roads. This means that the HPMS sample sections cover the 20 percent of the roads that are freeways, arterials, and collectors, and which carry 80 percent of all traffic. HPMS sample sections do not cover the 80 percent of the roads that are classified as rural minor collectors or locals.

The HPMS has as a key element a random sample of highway sections that form a statistically designed framework to provide specified levels of accuracy for estimates of key system parameters. Conditions on the highway sections are monitored on a periodic basis. The conditions monitored include those section characteristics such as basic geometry, pavement type, and thickness, which change only when an improvement is undertaken, and those more dynamic characteristics, such as traffic volumes and truck use, which are constantly changing. To monitor changing characteristics the section is visited, traffic counted, and other changes noted. In some instances, the required data are available through other programs such as a pavement management program or a capital investment program. For example, a pavement management system might provide pavement condition ratings and a traffic counting program for traffic volumes. Capital improvement program files might indicate if the section had been improved and indicate the nature of the improvement.

The AP works from the inventoried highway section characteristics to undertake highway needs and performance assessments. As has been noted, the HERS models have been developed in recent years to add an economic component to the AP engineering standards approach. An important element in the estimation of future conditions is the establishment of some measure of growth. In the HPMS process growth is entered as a growth rate for traffic on each sample section. How the growth rate is determined, by whom, and who enters it into the data set, varies greatly.

In summary, the capabilities of the AP/HERS models include:

- Assessment of base year condition and performance,
- Forecast of future highway system needs,
- Simulation of highway system conditions for a given investment level,
- Analysis of investment strategies using engineering and/or economic criteria, and
- Estimation of highway user costs and life-cycle costs for each set of assumptions.

It has been difficult to define the relevant universe of applications for AP and HERS for this synthesis. This is because the AP has evolved in both capability and availability since being developed in the late 1960s. Originally, states wanting to use the AP had to request that the FHWA make special computer runs on the FHWA mainframe computer. Later, the FHWA made its mainframe programs available. More recently, the AP has been available to states and MPOs in a microcomputer version. The HERS model is not yet available for general use, although as noted in the case studies, some states have made special arrangements to use HERS on a trial basis.

Characterizing the use of the AP and HERS also is made difficult by the fact that some states are consistent users of the software, some are intermittent users, and some have tried the programs on an experimental basis. The majority of states have never used the analytical models associated with the HPMS. No instances of MPO use of the AP or HERS were identified, although as was noted earlier, SCAG, the MPO for the Los Angeles area, is gearing up to undertake a pilot HERS application. SCAG's application will involve a programming exercise to identify candidate improvement projects based on a complete look at a two county arterial system. This will require a full HPMS inventory of the arterial system.

STATE AP AND HERS APPLICATIONS

Since the HPMS AP was made available for state use in the 1980s, approximately 15 states have used HPMS or HERS in an actual application. The following 11 states are the most recent users or those states with the most significant applications of the AP or HERS.

Kentucky

Kentucky was the first state to use the AP. Over the years the Kentucky Transportation Cabinet (KTC) has periodically called on FHWA staff to make special computer runs to aid in policy analysis and the preparation of policy reports. Kentucky has historically used an adequacy rating approach for determining highway deficiencies and needs. More recently, KTC staff used the AP to demonstrate that the adequacy rating approach yielded results comparable to those of the HPMS AP. Kentucky staff used this outcome to support their continued use of the adequacy rating. Thus, this application of the AP did not result in a direct use of the AP on a continuing basis, but rather for intermittent validation of KTC's long-established practices.

Oregon

Of all states, the Oregon DOT (ODOT) has used the AP at the most advanced level. This statement is made because Oregon has used the AP on an extensive basis and also used the HERS model. In addition, ODOT has used the models for corridor planning, as well as for policy analysis.

ODOT's initial experience with the AP led to its use in the Oregon Road Finance Study (1992–1993). More recently, the AP model was used to develop supporting data for the Corridor Plans (1993–1996), the Oregon Transportation Initiative (1996), and the Oregon Highway Plan (1997–1998). For each analysis ODOT modified the model inputs to those appropriate for their specific study requirements and to match conditions specific to Oregon and to reflect Oregon policy assumptions.

Oregon's use of the AP to assist in planning improvements to major corridors is unique. First, some 26 corridors were identified as having statewide significance. In each corridor, an HPMS data set was developed for each corridor section. This resulted in 100 percent coverage of the corridors. The HPMS AP usually requires 75 data elements for a needs analysis. ODOT identified 40 variables that were essential for their corridor planning and that were sufficient to run the models in the corridor application. These data items were available in ODOT's Integrated Transportation Information System and related databases, or could be derived from them. To establish desirable performance standards, values relevant to Oregon were substituted for national values. For corridor planning the AP was set to evaluate highway conditions in 1996 and 2016. The information for the base year was taken directly from available databases. Future year analyses involved a number of steps, including calculating changes to system conditions based on forecast growth and on usage impacts. Both base and future year analyses included the computation of a service index (a measure of congestion levels) and an impact index analysis (a measure of overall travel speed, vehicle operating costs, and fuel consumption).

During the analysis process for the 1999 Oregon Highway Plan, ODOT began using the HERS model. The Oregon consultant for the plan initiative, Cambridge Systematics, had developed the HERS models for the FHWA and thus was very familiar with its operation. The HERS model allows the analyst to introduce benefit–cost into the development of highway needs. It complements the AP engineering standards-based analysis with the HERS benefit–cost analysis. Sections of highway determined to require upgrading must pass a double test. First, they have to fail to meet engineering standards specified in the AP and second, the proposed improvement has to demonstrate a benefit–cost ratio exceeding a predetermined level.

Both the AP and HERS allow the analyst to tailor the assumptions on which the calculations are based and to test alternative assumptions. Oregon made full use of this flexibility while looking at three scenarios: (1) a preservation-only scenario, which limited improvements to those necessary to preserve the system; (2) a restricted modernization scenario, which allowed limited system improvements; and (3) an unrestrained modernization and improvement scenario, which allowed all deficiencies to be overcome. Two additional reference or "benchmarking" points were analyzed. These were the "existing condition," which determined the performance level of the system in the base year, and the "zero funding" situation, which looked at the performance of the system over time if no improvements were made.

For each scenario and for the two reference points ODOT looked at (1) average effective system speed, (2) user costs per mile, and (3) total annual costs, weighted by VMT.

It is also possible to look at the individual highway sections to examine the specific recommendations of the AP and HERS under varying scenarios. In its national analysis FHWA staff examines selected highway sections to test the reasonableness of the results. Oregon's corridor analysis coded all sections of the corridors and thus had the ability to examine the results on a full corridor basis. This application allowed a policy level look at options for developing an investment program aimed at the major corridors in the state. The AP and HERS models allowed this to be accomplished more quickly and more cost effectively than a typical engineering analysis. It was also possible to test a greater array of options, including both funding levels and improvement program assumptions.

Idaho

The Idaho DOT (IDOT) reports having used the HPMS AP for the past 10 years. IDOT has completed three major policy studies using the AP mainframe package, but would like to use the microcomputer version. For those wanting to examine their latest study, information on it is available at http://www.state.id.us/HOME/transport.htm. The Idaho analyses address state, county, highway district, and city road systems. The AP package was used to estimate highway system deficiencies, and based on those deficiencies, to estimate investment requirements. The package was modified so that it could address needs on roads functionally classified as local. Special needs assessment criteria (minimum tolerable conditions, design standards, and unit costs) were developed to reflect Idaho conditions and practices. In addition, the models were used to develop a composite index for each highway section. The index is a weighted measure of physical condition, operating characteristics, and safety.

Idaho also used the Bridge Needs and Investment Process (BNIP), an FHWA companion bridge model to the AP. By combining the BNIP with the AP IDOT is able to present bridge needs and highway system needs and thus present a more complete picture of highway program needs. The FHWA uses a similar approach in its biennial reports to Congress. The National Bridge Inventory is a complete inventory of all the nation's public bridges both on and off the federal-aid system. No additional data collection is needed for any state that chooses to undertake a similar bridge analysis because the FHWA's bridge needs model uses the National Bridge Inventory data. The bridge inventory includes both the physical characteristics of each bridge as well as periodic condition ratings.

South Carolina

The South Carolina DOT has used the HPMS AP since 1988. Most recently, it was used in conjunction with the development of a statewide transportation plan. As an aid in the plan preparation process, estimates were made of the backlog of existing deficiencies and the costs of overcoming these deficiencies. Future needs were also identified. The combined analysis served to demonstrate that there was a revenue shortfall and that future revenue would have to be increased or the condition of the highway system would deteriorate over the 20-year analysis period.

Texas

The Texas DOT (TxDOT), along with all other Texas state agencies, is required by the state legislature to prepare a strategic plan every 2 years. One of the required elements of the Strategic Assessment is an External/Internal Assessment. This assessment must address a variety of fiscally related topics. As noted in "Planning for Texas Needs Using Highway Performance Monitoring System Analytical Performance (*10*), Texas used the HPMS AP to develop the highway component of the funding requirements analysis. The AP model was also used in the development of a state transportation plan.

TxDOT also has used the HPMS AP to develop its Strategic Mobility Plan. This analysis, similar to those being required of most state and federal agencies, links TxDOT's mission and required goals to the funding required to fulfill those goals. The Office of the State Auditor undertook a review of TxDOT's use of the HPMS AP and database and concluded that the use of HPMS as tailored by TxDOT had been satisfactory.

Kansas

The Kansas DOT (KDOT) recently undertook an analysis to examine the appropriateness of the standards on which it established highway deficiencies and highway needs. The analysis was undertaken in conjunction with the development of a new state transportation plan. Kansas has many miles of routes classified as arterial, including numerous low volume roads. Using the then existing standards in needs analysis, the costs to improve this extensive mileage to these standards was more than what realistically would ever be available. Therefore, KDOT began a policy analysis to better understand the problem and to look at their options. Initially, they looked at a broader set of functional classifications than used previously. In effect, they subdivided the arterial system into several categories.

In actual practice, the percentage of roads falling into the different functional classes varies significantly from state to state and even between states with similar topography and highway systems. Many of the functional classifications were originally made at a time when the expectations of the systems were quite different. Following establishment of the broader set of classification standards, KDOT used the AP to examine the consequences of the modified standards. Their analyses looked at user costs, related to various funding levels and the modified standards. These analyses determined that user costs are "more than double . . . for the conventional functional classification . . . with the same funding level, the road user costs increased only slightly when the funds were allocated according to the State Transportation Plan classification and standards" (*11*, p. 12). KDOT has also used the HPMS AP in other policy applications. These included looking at a "maintenance only" funding policy and at the cost implications of deferring maintenance.

Arizona

The Arizona DOT (ADOT) reports that they are currently using the AP as part of the process to provide input to the Governor's Transportation Vision 21 Task Force. They are investigating two planning scenarios. The first will determine the costs of maintaining the highway system minimum tolerable conditions, whereas the second is estimating the costs of maintaining the system at acceptable conditions. For each of the scenarios ADOT staff specified the parameters of the condition level.

North Carolina

The North Carolina DOT (NCDOT) undertook an HPMS AP analysis of highway needs along with an assessment of future highway conditions and performance resulting from alternative funding and policy scenarios. In an analysis similar to that required in many zero-based budget reviews and strategic planning analyses, NCDOT staff used the HPMS AP capabilities to simulate the system performance that would result from seven different program funding levels. The specified funding levels were 0, 10, 40, 60, 70, 80, and 100 percent of current funding. For each funding level, composite safety, service, and condition indices were developed, as well as a combined index.

The analyses were conducted for each highway functional class to facilitate the evaluation of the program consequences of the funding levels on different functional categories. NCDOT also used the BNIP in a parallel exercise for the bridge program. NCDOT staff concluded that the HPMS AP and the BNIP ". . . can provide an informational support basis to help management evaluate policy, analyze needs, develop improvement programs, and allocate money to maintain optimally the North Carolina highway and bridge systems" (*11*, p. 6).

Michigan

MDOT has used the AP as a part of its ongoing statewide planning program. MDOT has traditionally used their own needs process for estimating highway system deficiencies and the cost of eliminating them. The HPMS AP has been used as a benchmark or independent source for determining highway pavement and congestion needs.

Nevada

The Nevada DOT has made use of the HPMS AP mainframe version on many occasions. Since converting to microcomputer operations their use has not been as extensive, although they intend to start again. The Nevada DOT has included looking at (1) the types of improvement specified in the AP results for the various system and project categories and (2) the AP investment levels by category as an aid in formulating their state highway program.

Georgia

The Georgia DOT reports having used the AP once during the past 5 years for internal planning studies. Based on that experience, the department intends to begin using it every 2 years as a part of their ongoing statewide planning process.

CHAPTER FOUR

AIR QUALITY CONFORMITY

BACKGROUND

The use of HPMS-derived VMT estimates for air quality conformity analysis in nonattainment and maintenance areas is based on federal policy established following enactment of the CAA Amendments in 1990 and ISTEA. The Environmental Protection Agency, in consultation with the U.S. DOT, published VMT Forecasting and Tracking Guidance in 1992, in response to a CAA requirement (*12*). This guidance addresses how to forecast and track VMT and requires the use of HPMS-derived travel estimates, unless the agency responsible for demonstrating conformity can show that it has a better method available. This policy was established because HPMS proved to be the only statistically based VMT estimation procedure available on a national basis.

At the time the guidance was issued many MPOs had never made count-based estimates of VMT for their study areas because it was not essential for their purposes. They had less expensive methods, such as screen line counts, for validating travel models that could then be used to estimate VMT.

Each state has for many years prepared annual VMT estimates based partly on the HPMS (for that part of the system covered by the HPMS) and partly on other methods for that part of the system not covered by HPMS (generally roads functionally classified as rural minor collector and local). These estimates are reported annually in the FHWA publication *Highway Statistics* (*4*). The FHWA, the Federal Transit Administration, and the Environmental Protection Agency established HPMS-based VMT estimates as the preferred approach, because these estimates had a long history, were statistically based, were controlled in a national system of total VMT estimation, and had been published for many years. MPOs have the option of using an alternate method if they demonstrate that it is superior to HPMS-based estimates.

A review of the responses to the HPMS reassessment questionnaires by states and MPOs and interviews with many federal, state, and MPO officials did not provide a clear understanding of practice with respect to the use of VMT in air quality conformity analysis. Within a single state some MPOs reported full satisfaction with HPMS-based VMT estimates for travel model validation and conformity analysis. Others reported no confidence in the estimates and cited the use of an alternate procedure. The alternate procedure used in lieu of HPMS most often involves either (1) a region-wide estimate of VMT based on coverage counts instead of the HPMS random sample or (2) a travel model-derived estimate with the base year travel model having been rigorously validated.

State responses to questions regarding the use of the HPMS-based VMT estimates for conformity analysis also showed inconsistencies between opinion and practice. These results are, perhaps, not surprising given the complexity of this topic. First, it must be recognized that the HPMS system is designed primarily to yield statistically valid state estimates of specific highway system parameters, including VMT. Although consideration is given to metropolitan areas of over 200,000 population in the sample design, transportation system parameters will always be more accurate at the state level than at the metropolitan level. Second, the accuracy required for air quality analysis strains the requirements of the transportation planning process at all levels.

Today's urban transportation planning models were designed to determine if added lanes are needed on a highway (plus or minus 2,000 vehicles per hour, the normal capacity of a freeway lane) or to make similar decisions with respect to transit. In conformity analysis the models are required to evaluate the pollution burden consequences of all transportation improvements, as well as the impact of various air pollution reduction strategies (known as transportation control measures). These strategies include measures such as carpool promotion or no-drive days, the magnitude of and the results of which are generally small and extremely difficult to estimate. Individual control measures are often designed to reduce area-wide travel by less than 1 percent. Nevertheless, the HPMS has some benchmarking role in almost all nonattainment areas. Most commonly it is used to establish the base year VMT estimate, which serves as a benchmark for the travel model base year estimate. HPMS-based travel forecasts are less likely to be used in air quality analyses because they result from a growth factor applied to each sample highway section. Typically, only one growth factor per section is used for each forecast period. The series of models used for forecasting in metropolitan travel analysis are much more dynamic and transportation-system and land-use sensitive than the HPMS. MPOs evaluate mode, system, and operational changes on a frequent basis. Land-use forecasts by MPOs are generally based on zoning, known development proposals, and growth trends, and are generally varied based on the nature of transportation system proposals.

Significantly, there is a "partnering" that frequently takes place relating to the HPMS use of MPO travel forecasts to develop the growth factors for the HPMS sample highway sections. Because MPOs have extensive experience in estimating traffic on specific facilities under a range of assumptions, there is a compelling logic to having MPOs develop HPMS growth factors.

ILLINOIS

When the Chicago metropolitan area experienced difficulty in demonstrating air quality conformity in the early 1990s, the region's VMT estimates were called into question by federal review agencies. As a result, a detailed study of VMT estimation was undertaken by the Chicago Area Transportation Study (CATS), the region's MPO, in cooperation with the Illinois DOT and with the assistance of a consultant, Wilbur Smith and Associates. The study looked at the three sources of VMT estimates for the region. These were the HPMS, the Illinois Roadway Information System (IRIS) method, and the CATS travel model estimates. The study identified differences between the sources in system coverage, treatment of local roads, and approaches to estimating growth. The VMT estimates based on the HPMS and the IRIS approaches were more consistent than those of the CATS approach. This is not surprising because the HPMS and IRIS are developed from the same database. The CATS VMT estimates differed from the HPMS and IRIS primarily in the estimated rate of VMT growth. The CATS models showed a lower growth rate than either the HPMS or IRIS. The consultant has recommended, and Illinois DOT accepted, a series of improvements to their HPMS and IRIS procedures, mainly concerning keeping the HPMS sample up-to-date by adjusting it as traffic patterns change, particularly those associated with suburban development.

Conversations with transportation analysts and federal officials associated with conformity analysis in other non-attainment areas indicate that the Chicago area is not unique. Chicago officials have studied their problem in more depth and proposed a solution that will allow more confidence in the VMT estimates developed by the HPMS and IRIS. Once there is more confidence in the measured VMT, a determination can be made about the adequacy of the VMT estimates developed using the CATS models. This effort represents a good first step in the cooperative efforts to improve the air quality conformity process in the Chicago area.

CHAPTER FIVE

APPLICATIONS INVOLVING NEW TECHNOLOGY

Virtually all the positive partnering experiences of states and MPOs make use of new technology. The most advanced experiences are in states with data management systems that are accessible to MPOs electronically, either directly or through the periodic provision of data files on disks. The FHWA has made a number of data files available on the World Wide Web at http://www.fhwa.dot.gov/ohim/. The FHWA site also has links to most state DOT sites, many of which contain transportation data files or have links to data files. The FHWA site also has links to the U.S. DOT and to the Bureau of Transportation Statistics sites (http://www.bts.gov/). The Bureau of Transportation Statistics site, currently being upgraded, will contain a wealth of transportation information as well as links to a great number of additional transportation sources.

At the same time, it is significant that the ability to share transportation system information among the federal government, states, MPOs, and local governments is occurring concurrently with the ability of anyone with a computer and a modem to access most or key components of the same information.

GEOGRAPHIC INFORMATION AND GLOBAL POSITIONING SYSTEMS

For many years the HPMS product or output was a series of tables, charts, and graphs. With the advent of the GIS, states and the FHWA began to introduce a spatial dimension to all highway-planning activities, including the HPMS. These occur at two levels. Most basically, the GIS is used to provide geographic visualization to a data set, that is, it is mapped. In more advanced applications the GIS is used as an integrating technology, allowing all data with a common geography to be brought together for analysis. Beginning in 1992, the FHWA embarked on an effort to create a digital database representing the National Highway System, and the remaining rural arterials and urban principal arterials. The resultant product is called the National Highway Planning Network (NHPN).

The most common method used by states to identify the geographic location of their state highway system is a Linear Referencing System (LRS). The LRS, in effect, gives each highway section an address that allows it to be located. For FHWA purposes each NHS section is uniquely located on the NHPN. The common data fields that permit the linkage of HPMS sections to the NHPN are county code, inventory route number, inventory subroute number, and beginning and ending milepoints. The states use many different LRSs, but it has been possible to accommodate all of them in the NHPN.

In response to questions on the reassessment questionnaires regarding the potential of new technologies to improve the HPMS system, most states and MPOs expressed a desire to see more use made of GIS and GPS technology. Many respondents indicated that their sample sections were being geocoded in a manner that allowed them to plot the sections on their highway system maps using available GIS software. Clearly, practice is changing rapidly as a number of respondents indicated that they were currently involved in enhancing their GIS capability or upgrading their data files into data management systems.

The HPMS strategic reassessment included a review of required section identification attributes, including those used by the FHWA in linear referencing. The HPMS Steering Committee did not recommend any changes with respect to geographic referencing, concluding that the current identification scheme is functioning satisfactorily.

The Arizona DOT (ADOT) was mentioned frequently in conversations with transportation planners as the state that was perhaps the leader in the application and integration of GIS and GPS technology into transportation planning. A series of phone conversations with ADOT officials revealed that they have purchased two GPR devices, which are capable of specifying a point on the ground within an accuracy of ±1.5 m. Their current program involves using the GPR devices to determine the centerline location of the state highway system. Local governments providing traffic counts to ADOT on roads not on the state highway system are being asked to provide the same centerline location accuracy, if they have a program capable of delivering it. Local governments in Arizona have used consultants to provide GPS services.

The ADOT GPS program has multiple goals. Most importantly, they are significantly improving the accuracy of their base maps. Current base maps have evolved from state surveys and U.S. Geological Survey base maps and have been supplemented in recent years by Bureau of the Census TIGER (*T*opologically *I*ntegrated *G*eographic *E*ncoding and *R*eferencing system; a digital database of geographic features covering the entire United States) files. In the worst cases the accuracy of the current georeferencing is ±400 ft. Thus, in some instances, the accuracy has been improved by a factor of 40. The geographic location of ADOT'S highway system inventory data is specified using a linear referencing system. The GPS program, as part of the centerline location program, is locating every mile post and other LRS control point within the ±1.5 m accuracy standard.

Arizona also has a video-referencing program for their highway system. It is thus possible for staff to look at the video image of any highway section without leaving the office. Cross sections, signs, drainage, accident locations, and pavement types can be identified and the precise location determined. ADOT has checked the accuracy of its GPS measurements against carefully measured benchmarks and determined that even at 55-mph vehicle operation the specified accuracy is obtained.

ADOT is moving to a full GIS platform with its highway system data. This is an excellent example of where the HPMS data collection is benefiting from a general upgrading of highway planning technology. In the process, the costs of collecting and maintaining HPMS data will be reduced and its accuracy improved. Its availability on a GIS platform should increase its availability within ADOT and increase the possibility of sharing the data with external partners.

In conjunction with this synthesis, Transportation Research Board (TRB) staff queried the TRB Committee on Spatial Data and Information Science and the TRB Committee on Statewide Data and Information Systems, seeking further insights into the current relationship between the GIS and the HPMS. A number of useful responses were received.

- A representative of an Arizona MPO reported that ADOT has a program called the Arizona Transportation Information System, designed to facilitate HPMS reporting by local governments. It includes the application of ArcView, a commercial software package, to facilitate the use of the ADOT GIS base map as an aid in locating sections and determining section characteristics. The MPO reports that they are not using the Arizona Transportation Information System in their transportation planning, because at this time their own base maps are more current and more accurate.
- A Michigan MPO reports that they have invested a considerable amount of time in developing a prototype three county HPMS GIS database. Four years of HPMS data have been incorporated into the database. All files are in TRANSCAD (a commercial software package) file format, and include a number of additional geographic identifiers.

Several other state DOTs reported on their database and GIS advances. Commercial software packages are in common use. The Oracle system for databases, Integraph, and Arcinfo for the GIS were cited in addition to those previously mentioned.

Perhaps the most interesting comments came from a representative of the private sector, who noted that states have aggressively opposed any national or federal location standards. He argued that intelligent transportation services will converge on a common location standard determined by the marketplace and that states would begin to gravitate toward the marketplace standard. He stated that when a critical mass of states have moved to a common base, the FHWA would have the opportunity to change the HPMS location standards. Clearly there is a great need for a common reference system with the growing use of inexpensive in-vehicle positioning technology. All automakers have georeference-based products available, with new ones coming on the market. The issue is how and when to achieve it.

One report cited the use of a GPS to monitor highway system performance in the Boston area. This involved an instrumented vehicle monitored as it travels through the highway network. Using GPS tracking, the speed and distance traveled are determined, thereby providing a snapshot of relative congestion on the system.

INTELLIGENT TRANSPORTATION SYSTEMS

The continued growth and expansion of ITSs throughout the United States has meant the installation of literally thousands of loop detectors. Loop detectors are wire loops placed in grooves cut in the pavement. When attached to a monitor loop detectors have the ability to measure traffic volume, and when combined with a second detector, the ability to measure speed and estimate traffic density. Detectors are being installed for many different specific applications, but virtually all may be linked with a transmitter to send the data they are monitoring to computers at central control stations. Most applications of ITSs are designed to operate on a real-time basis. The data gathering mechanisms are monitored and data transmitted continually. Virtually all ITS applications monitor traffic volumes, the most expensive component of HPMS monitoring. Traffic is also the most variable element of the HPMS monitoring system, changing throughout the day and night, by day of the week, and tending to increase over time. ITS applications are somewhat oriented to freeways, the most difficult highways to monitor.

The wealth of information collected on highway system operations can only be shared if data coordinating mechanisms are in place and if top management of the agencies responsible for system operations and those responsible for system planning agree to work together. The case studies specifically identified only one direct instance of data sharing, although, no doubt, there are many more. This single instance occurred in Pennsylvania, where MPOs are allowed to connect monitors to the PennDOT loop detectors on freeways in order to monitor volumes. Where direct transmission of volume data to centralized traffic control centers occurs, the sharing of traffic data can be further simplified.

Although the sharing of traffic volumes from loop detectors has been described, it is only the tip of the ITS iceberg. Toll roads in particular are bringing online an array of monitoring devices that greatly increase the ability to monitor travel. Weigh-in-motion systems are evolving and have greatly increased the amount and quality of truck classification information.

One of the problems of ITSs is that the amount of data collected can be overwhelming, particularly for those with modest and periodic needs.

CONGESTION MANAGEMENT SYSTEMS

The requirement that CMSs be in place in all metropolitan areas of more than 200,000 population originated with ISTEA in 1991. There had been an earlier requirement in California law that formed the basis for the federal provision. ISTEA required that all construction of new freeway capacity be based on a CMS. Although the CMS programs were under development throughout the country, Congress had received many complaints that the provisions were onerous and a burden on states and MPOs, particularly in rural mountain and farm states. As a result, in the National Highway System Act of 1995, Congress removed the blanket CMS requirement, but left it in place for all nonattainment areas of over 200,000.

The HPMS reassessment questionnaires did not reveal any consistent pattern of use of HPMS data in the CMS process. Clearly, congestion management requires knowledge of traffic volumes on some kind of systematic basis. The HPMS, with its grounding in a random sample of highway sections, cannot form the sole basis for CMS data collection. Where the HPMS is part of a data management system it helps support all traffic data needs. Additionally, the HPMS data can be used in other types of applications because of its ability to provide a benchmarking measure.

The Texas Transportation Institute (TTI) at Texas A&M University has for more than 15 years undertaken research and reported on urban congestion throughout the country. This work is based entirely on HPMS data. The press eagerly awaits each annual report by the TTI team. The reports are now embargoed for release at a specified time to ensure fairness in publication. The TTI reports rank each major metropolitan area on the severity of its congestion. Newspapers in the areas indicating the worst congestion or indicating a worsening of congestion give front-page coverage to the TTI report.

The TTI researchers have demonstrated the ability of the HPMS database to provide an index of relative urban congestion in U.S. metropolitan areas. Thus, metropolitan areas that apply congestion management strategies such as promotion of carpooling, vanpooling, and transit can use their HPMS data as a bottom line measure of whether the strategies are actually affecting congestion on a system-wide basis (*13,14*).

CHAPTER SIX

OTHER HPMS APPLICATIONS

SAFETY

The literature search conducted employing the TRIS system revealed significant use of the term HPMS relative to safety. Indeed, safety applications can be considered major data sharing practices related to the HPMS program. This is because all crash rate reporting requires a measure of exposure to provide a basis for calculating crash rates used for making safety comparisons. For example, fatal crashes are generally reported on the basis of deaths per 100 million vehicle miles. Roadway type, vehicle type, sex and age of driver, etc., typically stratify crash rates. The HPMS system is used to establish miles of roadway by functional classification, truck VMT, as well as all measures of automobile VMT. Thus, the HPMS program plays a key roll in the provision of safety statistics. The HPMS reassessment has provided some relief with respect to the reporting of crash information through HPMS, recognizing that crash information is also reported to the National Highway Traffic Safety Administration through the Fatal Accident Reporting System and the Highway Safety Information System. The FHWA will eliminate the reporting of fatal and injury crash data now provided by the states on a summary basis by functional system. Nevertheless, the HPMS remains of major importance as a basis for estimating the various exposure measures noted above for calculating crash rates.

PAVEMENT MANAGEMENT

A number of references in the TRIS search and their bibliographies showed that there was considerable interest in the HPMS database as a pavement research tool in the late 1980s and early 1990s. The more than 100,000 HPMS sample sections with their 30-year history of monitored pavement condition proved a valuable resource for pavement research. A number of researchers developed HPMS-based pavement performance curves for use in early pavement management applications (*15*).

From their inception, the AP models have evaluated pavement conditions of the sample sections and made improvement determinations as a basis for determining needs in each of the biennial reports to Congress. The AP therefore might be thought of as a forerunner of the many current pavement management models.

A close examination of the pavement research literature shows, however, that the HPMS data set has been replaced as a pavement research tool by the data collected by the Strategic Highway Research Program. In addition, the vast increase in the use of pavement management systems has begun to make available a rich source of pavement condition data.

The emergence of pavement management systems has created an opportunity to reduce the costs of collecting pavement condition data for the HPMS by using the pavement management system data in lieu of data collected solely for the HPMS. A variation of this practice reported by some states is to use a contractor collecting pavement management data to monitor HPMS sections while they are in the field monitoring pavement management systems.

BENCHMARKING

A 1995 Advisory Commission on Intergovernmental Relations report, which looked at the performance-based approaches of 13 federal agencies, characterized the FHWA HPMS process as the most comprehensive of the systems examined. The Advisory Commission on Intergovernmental Relations study also found that no agency has a longer or better record of reporting performance to Congress than the FHWA (*3*, p. 4). The HPMS process preceded by 25 years the 1993 Government Performance and Results Act, which requires performance reporting by all federal agencies. This law requires every federal agency to establish a system for monitoring the results or effectiveness of the federal investment in terms of outcome measures. The DOT has reported biennially to Congress since the HPMS was established. This long series of reports has resulted in a continuing dialog between the executive and legislative branches on the adequacy of federal transportation resources and the effectiveness of the program.

In parallel with the broad mandate of the Government Performance and Results Act there has been an evolution in government management practices, which has resulted in an emphasis on strategic planning and performance-based management. These management approaches place an emphasis on measurement of outputs and outcomes. Benchmarking is the term usually applied to the quantified tracking of key parameters relating to program performance.

Asset management is a newer approach to the management of infrastructure and is being widely applied in both the private and public sectors. Asset management also requires benchmarking to ensure that assets are being maintained at desired levels.

The case studies of HPMS applications did not reveal significant direct use of the HPMS in state program management activities. The use of VMT trends, which are derived from the HPMS, is widespread. The highway condition data, however, are not often used at the state level. Where condition data are used, it is in those states where the AP and HERS are a part of their policy planning functions.

There is a significant opportunity for greatly increased use of HPMS data, AP, and HERS in all states that have adopted performance-based management approaches that incorporate benchmarking of program performance.

THE ROAD INFORMATION PROGRAM

Sharing and partnering within the HPMS program are most often thought of as occurring within the public sector. There are, however, other major HPMS applications that do not fit into this category.

One major user of HPMS statistics is The Road Information Program (TRIP), an organization that conducts education programs for the highway industry. As their name infers, TRIP provides highway-related information, mostly in the form of press releases. They are active in individual states when highway-funding issues are being debated in state legislatures and at the national level when Congress considers national transportation legislation. TRIP depends very heavily on data from DOT biennial reports to Congress and from special analyses conducted using HPMS data. Over a period of years every state legislator and member of Congress is made aware of the condition and performance of their state's and the nation's highway system. All of these statistically based arguments are derived from HPMS data.

The TRIP organization makes use of HPMS results because the data are available to any individual researcher or organization requesting them since they are produced at public expense. Additionally, the TRIP program results in significant and effective use of the HPMS product through its press releases and services to journalists needing road information.

PRIVATE SECTOR INVOLVEMENT

There is not extensive private sector involvement in the HPMS process; however, the potential exists. The New York State DOT (NYDOT) has experienced differences in VMT forecasts made using different data sets and different methodologies. The HPMS sample sections, along with their assigned growth factors, were the principal source of data for one estimate. To help resolve the differences and in particular to help resolve questions regarding travel growth, NYDOT has purchased county level commercial data and forecasts from the WEFA Group. Woods & Poole Economics provides a similar product. The commercial forecasts are not VMT forecasts, but growth estimates based on demographic and economic models. Growth is expressed in terms of population, households by income, and employment by industry. The estimates serve as another form of benchmarking. When two estimates or forecasts differ it is extremely helpful to have a third estimate to help determine where the problem lies. Given the high correlation between VMT and the economy, demographic and economic benchmarks that are external to the HPMS process could prove helpful to other states.

Some states and MPOs use private contractors for traffic counting. Although the practice is limited, the potential exists for contractors to find multiple users for count information and thus bring down collection costs.

CHAPTER SEVEN

CONCLUSIONS

The time of this synthesis was advantageous, following as it did the 1997–1998 HPMS reassessment. More significantly, the entire field of data management is currently undergoing rapid change as indicated by the following:

- Individual databases are being consolidated into data management systems.
- GISs are gaining near universal use when data fields have an associated geographic location.
- Agencies at all levels of government are applying strategic planning and performance-based management principles to their organizations and programs.
- Intelligent Transportation System applications are resulting in a significant increase in the number of continuous traffic monitoring devices.
- Asset management concepts are increasingly applied to infrastructure systems.
- Benchmarking is a cornerstone of strategic planning, performance-based management, and asset management. (The HPMS is by its very nature a benchmarking system.)

All of these technology and management dynamics are increasing the need and opportunity for data partnerships. They are also greatly increasing the potential benefits.

Other findings to facilitate partnering in the collection and use of HPMS data include the following. The need to:

- Establish training for states and MPOs on how to estimate the accuracy of statistics resulting from state or regional application of the HPMS, including procedures on how to determine the number of additional sample sections needed to increase the accuracy of specific statistics for state or regional applications. Combine the analytical process (AP) and the Highway Economic Requirements System (HERS) models into a single, user-friendly microcomputer analysis program.
- Expand training opportunities to cover the use of the combined analytical programs; that is, AP and HERS.
- Use HPMS data and the analytical models more broadly, given the HPMS reassessment decision to maintain each state as a basic sampling unit and the successful experiences of states using HPMS analysis tools. Potential applications include benchmarking for strategic planning, performance management, and asset management; corridor planning; the development of state plans; as well as the more traditional policy and planning analysis.
- Have the MPOs provide the growth factors for the sampled highway sections whenever the HPMS data or process is used to estimate future conditions on highway sections within MPO planning boundaries.
- Establish data coordinating committees for each state and MPO, with representation from all those agencies at the state, metropolitan, or local level, which are involved in the collection of transportation system data.
- Make national and state HPMS data sets accessible on Internet web sites as soon as the edited data becomes available.
- Incorporate HPMS data into broader data management systems whenever possible.
- Provide state and MPO planners with access to highway operations data available electronically through the application of Intelligent Transportation System technology.
- Ensure that potential users of the HPMS database are aware of its availability and possible applications.

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ABBREVIATIONS AND ACRONYMS

AASHTO—American Association of State Highway and Transportation Officials
AMPO—Association of Metropolitan Planning Organizations
AP—analytical process

BNIP—Bridge Needs and Investment Process
BTS—Bureau of Transportation Statistics

CAA—Clean Air Act
Caltrans—California Department of Transportation
CATS—Chicago Area Transportation Study
CMS—Congestion Management Systems

DOT—Department of Transportation

EPA—Environmental Protection Agency

FARS—Fatality Analysis Reporting System
FHWA—Federal Highway Administration
FTA—Federal Transit Administration

GIS—Geographic Information Systems
GPRA—Government Performance and Results Act
GPS—Global Positioning System

HERS—Highway Economic Requirements System
HPMS—Highway Performance Monitoring System
HSIS—Highway Safety Information System

IRI—International Roughness Index
ISTEA—Intermodal Surface Transportation Efficiency Act of 1991
ITS—Intelligent Transportation Systems

LRS—Linear Referencing System

MPO—Metropolitan Planning Organization

NAAQS—National Ambient Air Quality Standards
NCHRP—National Cooperative Highway Research Program
NHS—National Highway System
NHPN—National Highway Planning Network
NHTSA—National Highway Traffic Safety Administration

PL funds—federal-aid metropolitan transportation planning funds
PSR—present serviceability rating

RHMS—Regional Highway Monitoring System
RMS—Roadway Management System

SCAG—Southern California Association of Governments
SCOP—Standing Committee on Planning
SHRP—Strategic Highway Research Program
SPR—state planning and research

TEA-21—Transportation Equity Act for the 21st Century
TRB—Transportation Research Board
TRIP—The Road Information Program
TRIS—Transportation Research Information Services

USGS—United States Geological Survey

VMT—vehicle miles of travel

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