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Information Assets to Support Transportation Decision Making

Report of a Peer Exchange of State Transportation Organizations

April 17–18, 2007
Kansas City, Kansas

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Joseph L. Schofer
Northwestern University

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Preface

Data and information help to fuel decision making. As transportation choices become more complex, the challenge to supply useful, timely, and understandable data and analyses to inform transportation choices becomes even greater. At the same time, budget pressures can make it difficult to sustain essential data programs.

In this context, the AASHTO Standing Committee on Planning (SCOP) invited the Transportation Research Board (TRB) to bring together a small group of public agency transportation professionals to share experiences and exchange ideas on the effective use of data and ways to secure it for the management of transportation systems. This peer exchange fits neatly into the activities of the SCOP Data Subcommittee, which has the continuing responsibility to track transportation data practices and resources and to encourage innovation in data programs.

The exchange was also an integral part of the TRB effort to assess the state of transportation data and information and to explore ways that agencies can treat data as one of the key assets of the transportation system itself. This perspective is important because of the role that data and information play in guiding informed transportation choices and because it reminds us that, like other assets, data must be managed and supported to ensure availability when we need it.

The peer exchange was hosted by the Kansas Department of Transportation (DOT) and supported by the U.S. DOT Research and Innovative Technology Administration (RITA).

Participants in this peer exchange shared a variety of ideas that can provide a foundation for sustaining transportation data programs and ensuring that they remain responsive to user needs. Those ideas are summarized in this circular. Thanks go to Joseph L. Schofer of Northwestern University for summarizing the peer exchange and preparing this report.

—Deb Miller
Secretary, Kansas Department of Transportation
Chair, AASHTO Standing Committee on Planning

Summary

Participants in this peer exchange identified and discussed actions that could assist in ensuring the availability of data needed for effective transportation decision making:

- Institutionalizing data as a transportation asset by aligning information programs with organizational goals and articulating the value of data to decision making; communicating opportunities and limitations of data assets to managers and decision makers; and providing easy access to data and metadata to describe it.
- Enhancing data and information programs by developing data business plans as dynamic organizing frameworks; linking data systems to organizational goals; defining responsibilities, boundaries, and flows and providing a basis for setting data investment priorities; strengthening data programs for performance measurement by standardizing definitions, reporting practices, and linear referencing systems (LRS) to support integration across agencies, network components, and jurisdictions; conducting benchmarking analyses within and among states using national databases; and using data for outcome analyses to understand effectiveness of actions.
- Developing data producer and information technology (IT) competencies that include organizational knowledge; strategic thinking; openness to new data uses, applications, and technologies; team building, networking, and negotiating skills; technical skills to accommodate emerging technology and information management solutions; and the capability to conduct more sophisticated data analyses.

Peer participants discussed three opportunity areas for national efforts to advance transportation data systems, including initiatives by the federal government, AASHTO, TRB, and TRB's cooperative research programs:

- Conduct synthesis studies to document innovative data practices, including data business plan development processes; protocols and management systems for sharing data within and between agencies; data reporting strategies and technologies; and studies of the uses and importance of national data bases [National Household Travel Survey, Commodity Flow Survey (CFS), census including Census Transportation Planning Products (CTPP), and others].
- Development of new data tools, such as analysis and forecasting methods to support transportation decisions; practical methods to calculate return on investments (ROI) for all transportation improvements; techniques to identify and quantify the risks and benefits of alternative investment scenarios; and advanced tools for integrating real-time traffic data with transportation management and planning functions.
- Identification of effective designs for cooperative and collaborative interagency decisions on selection, sharing, and application of multiple data sources for decision making.

Introduction

Objectives and Process

This report is part of an ongoing TRB effort to assess the ability of data to support effective transportation decision making, to identify gaps in those data and the processes for collecting, analyzing, and disseminating them, and to identify actions to close those gaps. An underlying premise of this effort is that data and the information produced from it are essential assets of transportation systems. As a transportation asset, data requires resources—planning effort, money, and time—to ensure its timely availability for decision support.

This report summarizes discussions at a peer exchange of state department of transportation representatives and other professionals, focused on data and information uses, management strategies, needs, and gaps in their organizations. The objectives of this peer exchange were to

- Examine the role of data and information in transportation decision making;
- Identify unmet and emerging information resources, gaps, and opportunities;
- Discuss important data, access and analysis improvements for information resource programs; and
- Suggest strategies for the transportation community to implement those improvements.

In advance of the peer exchange, participants were asked to contribute one or more cases in which data made a difference in the management and functioning of their transportation systems, that is, where the availability of appropriate data made a decision possible or better and led to better results than might have been obtained if the needed data were not available. This exercise was intended to focus the thinking of participants on the value of data as a transportation asset, as well as to extend the understanding of the applications of data for transportation management.

Ten state DOTs were represented at the peer exchange: Florida, Kansas, Maryland, Michigan, Minnesota, New Mexico, Nevada, Vermont, Virginia, and Washington. Also present were participants from two metropolitan planning organizations (MPOs)—the Mid-America Regional Council (Kansas City) and the Regional Transportation Commission of Southern Nevada (Las Vegas)—and from AASHTO, FHWA, RITA, and the Bureau of Transportation Statistics.

The exchange itself was a mixture of plenary and breakout discussions. It began with an overview of past work on this project and a summary of the data use examples supplied by participants. The discussion then explored the most important decisions made by transportation agencies, data users, and their needs, issues, and trends in data availability, data gaps, and ways to improve data resources for DOTs. This report, prepared by the author and reviewed by the planning committee for accuracy, follows that agenda, summarizes the previous work, describes the peer examples of data success stories, and then presents the major themes discussed in the peer exchange. Promising directions for enhancing transportation data systems are then outlined, followed by more specific action ideas for advancing the field in these directions.

Background

Previous Work

When Congress enacted SAFETEA-LU (the Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users) in 2005, it mandated a comprehensive assessment of transportation data needs. TRB began a volunteer effort to get a quick start on the data needs assessment and to engage its technical committees in the process. When funding for the mandated policy study did not materialize, the TRB effort was continued and expanded with modest support from RITA.

The first step in the TRB activity was to invite its 200 standing committees to discuss and report unmet or poorly met transportation data needs. In the spring of 2006, committee members from 144 committees identified more than 650 transportation needs, ranging from very specific data elements or classes of elements to ideas for analyzing, archiving, and communicating information derived from data analyses. The submittals were analyzed, organized, and presented to a workshop of TRB committee chairs in July 2006. That workshop led to some targeted interviews with transportation policy makers to gain their perspectives on the value and limitations of transportation data. The results of these activities are reported in *Transportation Research Circular E-C109: Transportation Information Assets and Impacts* (*1*) and briefly summarized here.

Both providers and users recognized the value that data—and in its processed form, information—add to decisions, clarify problems, identify better solutions, support informed choices, and (sometimes) reduce the effects of raw politics on decisions. On the basis of examples and reports, it is apparent that timely, focused data do make a difference in the decision process. Particularly high value is placed on data describing the current state of transportation systems—condition, performance, and utilization—because current measures are often believed to be more relevant and reliable than forecasts.

Other key observations follow:

- Data are a transportation asset. Data are a key asset for planning, building, and operating transportation systems, public and private. Transportation requires resources that can produce commensurate returns on data investments. Transportation managers need to plan for and allocate resources to collect and maintain databases to support transportation decision making.
- Decisions are the product. The fundamental use of data and information is to support transportation decision making. Therefore, data must be understood and acted on by the ultimate users, decision makers, and the public. Understanding user needs is a key element in any data program.
- Sharing data extends its value. It is efficient to share data among users; data collected in one place can help identify problems and anticipate outcomes in other settings. National data can support local decisions, and local data sometimes guide national policy. Sharing is facilitated by archiving data, making it readily available, and documenting sources, limitations, and formats.
- Sustained data programs ensure timely response to decisions. Decisions proceed with or without information support. Therefore it is desirable to have data in the bank when a decision

is about to be made. This emphasizes the need for ongoing data collection and archiving programs at both national and local levels.

- Technology presents new opportunities. Advances in data collection technologies, including real-time vehicle and shipment tracking and infrastructure component monitoring, Internet-based survey methods, video imaging, and cellular phone–based data collection are making it easier to collect better data about transportation and travel. These innovations can improve decision support, but it is important to avoid swamping the decision process with data. Concerns about personal and business privacy must also be addressed.
- Analysis tools must keep up with the needs. Efficient and effective data collection and the analysis tasks necessary to convert data to useful information for decision support and presentation require appropriate tools and procedures. There is considerable need for developing, improving, and implementing more responsive analysis methods and models.

REFERENCE

1. Schofer, J. L., T. Lomax, T. Palmerlee, J. Zmud. *Transportation Research Circular E-C109: Transportation Information Assets and Impacts.* TRB, National Research Council, Washington, D.C., December 2006. http://onlinepubs.trb.org/onlinepubs/circulars/ec109.pdf.

Where Data Made a Difference

Innovative Data Applications from Peers

Participants in the peer exchange submitted 23 examples of cases where data contributed to making a decision feasible or in some way better. Of course, neither the agencies participating in this peer exchange nor the examples that they submitted can be considered representative of national trends and priorities. Participants were selected and self-selected because of their particular awareness of and interest in data applications and needs. Still, the examples that they provided do suggest important dimensions of data value.

The examples, summarized in Table 1, were classified in six categories. The most commonly reported application (15 cases) was the use of inventory and condition data for problem identification and resource allocation. Measures included physical conditions (e.g., pavement roughness), presence of features (e.g., guard rails), design characteristics [e.g., stopping sight distance, bike lanes, Americans with Disabilities Act (ADA) compliance], and performance measures (e.g., crash rates, real time traffic conditions). These data were used for data-driven resource allocation, deploying funds solely or largely on the basis of an objective measure of condition or system performance.

TABLE 1 Data Application Examples Contributed by Peer Participants

Topic and Decision	Data Types	Innovation	State
Safety: update stopping sight distance measures	Condition inventory	Replacement of manual surveys with GPS-based data from pavement management data	Kansas
ADA compliance of sidewalks, priority setting	Condition inventory	Inventory using GPS for location tracking and GIS for quality assurance	Maryland
Safety: problem identification, priority setting	Condition inventory	Integration and sharing of data from many sources to ensure consistency, support fact-based decisions	Michigan
Safety: guardrail investment decisions	Condition inventory	Central inventory of guardrail using GPS location for systematic basis for decisions, post-implementation performance assessment	Michigan
Pavement management: multiple jurisdiction condition database	Condition inventory	Development of pavement deterioration curves based on design and type	Michigan
Investment programming: condition-performance database to support STIP[a]	Condition inventory	Integrated state database on system performance and condition	Minnesota
System maintenance: objective data to support maintenance decisions	Condition inventory	Performance measures and targets to identify needs and priorities	Minnesota

(continued)

TABLE 1 (*continued*) **Data Application Examples Contributed by Peer Participants**

Topic and Decision	Data Types	Innovation	State
Safety: data to support investments in median guardrail	Condition inventory	Analysis of median-crossing crash data to assess guardrail effectiveness and identify problem locations	Minnesota
Safety: systematic data to identify problems and solutions	Condition inventory	Crash database to identify hazardous locations and countermeasures	New Mexico
Bicycle investments: support for on-street bicycle facility program decisions	Condition inventory	Analysis of existing visual street image data to measure curb lane characteristics	Las Vegas MPO
Safety: pedestrian crash countermeasure deployment decisions	Condition inventory	Detailed GIS-based pedestrian crash database	Las Vegas MPO
Reinvestment programming: support for needs based budgeting decisions	Condition inventory	Data on system condition and unit replacement costs	Virginia
Safety: needs identification and project selection	Condition inventory	Integrated crash and road condition data base	Virginia
Operations management: diagnosing operations problems using real time data	Condition inventory	Analysis of archived real-time data to identify problems and solutions	Virginia
Asset management: decision support for VTrans[b] and Legislature	Condition inventory	Asset management database using statutory performance measures to guide resource allocation	Vermont
Project management: data to assure decision makers and public project responsibility, accountability, and progress	Project monitoring, managing	Integrated project database providing multiple "dashboard" views of status and progress[c]	Virginia
Project management: support project managers with consistent, comprehensive view of status	Project monitoring, managing	Integrated project manager is shared, central warehouse for project information, with progress data flowing automatically to it	Virginia
Project management: coordinate multiagency clearance for all ground-disturbing activities of DOT	Project monitoring, managing	Comprehensive Environmental Data and Reporting System stores and shares data on relevant projects	Virginia

(continued on next page)

TABLE 1 (*continued*) **Data Application Examples Contributed by Peer Participants**

Topic and Decision	Data Types	Innovation	State
Project scoping: comprehensive information on project issues for engineers and planners	General project planning	Database housing of all project information to support more informed project scoping	Minnesota
Project scoping: assembling information to produce more accurate early cost estimates	General project planning	Integrated roadway information database describing physical conditions	New Mexico
Personnel management: decision support to retain technical personnel with competitive salaries	Bench marking	Database integrating salary patterns for comparable positions in the state and nation	Maryland
Traveler (customer) support	Real-time traveler information	Assembly and organization of current and new real-time condition information to support customer needs	Kansas
Economic impact of investments: support legislative decisions with estimates of program impacts	Program impact assessment	Collection and analysis of data to show economic impacts of investment and disinvestment in highway capacity	Florida

[a] State Transportation Improvement Program
[b] Vermont Agency of Transportation
[c] http://www.virginiadot.org/info/ctb-qtrlyrpt.asp (June 29, 2007)
GPS: Global Positioning System; GIS: geographic information system

Three submissions were examples of data used to monitor and manage transportation projects, both to support agency managers and to provide accountability to the public and to other, higher-level decision makers. Data included project progress as well as environmental measures. In one case, project status data were organized into a data dashboard to facilitate understanding by decision makers.

In two examples data were used for more general project planning, before implementation, to support project scoping and management and to inform the public.

One example was submitted for each of three other data applications: bench marking to assess agency performance; providing real-time traffic measures to support customer travel decisions; and program impact assessment, using before and after data to understand the relationships between transportation investments and economic development.

All applications submitted are examples of value to the originating agencies. Each illustrates the use of objective measures of transportation system status to support resource allocation, management decisions, customer decisions, and accountability. Together they emphasize the high value of objective local condition and status measures for management.

In contrast, no examples of forecasting were presented. During the peer exchange, although the usefulness of forecasts became clear, the reluctance of decision makers to rely on models was a contradictory theme, motivated by concerns about model complexity and obscurity and the risk of forecasting errors.

The data application examples relied completely on local or state data, with no apparent use of national databases. Together the data application patterns in this small sample underscore the key decision value of timely data describing current system conditions and performance. The points of value reflected in these examples include

- Multiple uses of the same data to achieve several objectives efficiently;
- The sharing of data across units in an agency and across agencies to support integrated and consistent decision making;
- The fusion (integration) of data from different sources to produce more useful information; and
- The high value of spatially referenced data, achieved in the collection process by GPS location fixing, and in analysis and presentation through the use of GIS tools.

Themes from Peer Exchange Discussions

Participants in the peer exchange examined data issues from the perspective of users and providers and discussed both strategic and more specific data needs and ways to meet them. This summary of key themes begins with a discussion of the relationship between data users and providers, followed by more specific data needs and actions to meet them. It concludes with a description of the data business plan, one important step that the participants identified for building transportation data programs.

MEETING THE NEEDS OF DATA USERS

The value of data lies in use. In a transportation organization, data are used for decision support—identifying problems and solutions, selecting preferred actions, and monitoring and managing outcomes—as well as system performance, costs, and impacts. It is important for data providers to have effective working relationships with data users so that user needs are clearly understood and well supported and so that users recognize the costs and limitations of the data elements they use. While it is common for suppliers to receive and respond to requests for data, it is desirable for them to become proactive, anticipating needs as or before they arise, building ongoing data systems to provide regular reports to customers, and helping users articulate unmet and emerging data needs.

Data needs will vary with the user. While the underlying data source may be the same, planners, designers, managers, agency leadership, and elected officials are likely to require information in different forms (e.g., tables, text, graphs, charts, and visualizations) and aggregations. Quantitative data on pavement condition may satisfy the needs of maintenance managers, but decision makers and the public may be better served by before–after photographs of pavement distress. The need for metadata—descriptions of the primary data and its limitations—will also vary with users. For example, limited coverage of crash data on minor roads could lead decision makers to overlook problems or overstate the worth of proposed solutions, if they are not made aware of data gaps.

Technical data providers can develop an understanding about the markets for their data and the needs of the various users through formal interactions and routine requests and responses. Developing and maintaining an understanding of user data needs is an ongoing and evolving function of the transportation data program. This suggests that successful transportation data programs will not be solely IT functions. Instead they must be driven by an understanding of the technical and substantive information needs of the community of data users inside and beyond the transportation agency.

Peer participants discussed the strong correlation between data quality and data use: better-quality data are likely to be better utilized and higher levels of use lead to data improvements. Well-used data commonly get more attention and care from the providers and more consistent resource support from decision makers (users). This is a market test for data: what survives and thrives is what customers want and use.

DATA NEEDS AND GAPS

Peer participants identified a broad variety of transportation data needs, including the following specific gaps.

Asset Management Data

Asset management, ensuring that transportation system assets are in place, in good condition, and functioning as required, is a fundamental data application. Decisions include problem identification, selection of solutions, resource allocation within programs, and budgeting choices at higher levels. This process should be based on timely data describing system and component attributes (what is where), condition, and performance. Asset management decisions made with poor data may be unnecessarily influenced by outdated, historic spending trends or political factors independent from objective measures of need.

Data needs—data gaps—include having timely (reasonably current), accurate, and location-specific measures and having consistent data across the transportation network (across jurisdictions and functional classifications). Automated remote monitoring and data logging can be economical and reliable methods for collecting data on infrastructure condition, system utilization, and loads (weights, weather). GPS and GIS technologies are becoming common as effective tools for establishing precise locations of components (e.g., bridges) and events (e.g., crashes). Of course, converting older, less precise, and nongraphic databases to these modern methods can be a significant task. Integrating asset condition data across jurisdictions, important for consistent end-to-end user service, may require breaking long-established interagency barriers.

Safety

Data needs for decisions about transportation safety enhancements have similar dimensions. Safety actions are logically driven by crash data, and accuracy and comprehensiveness are particularly important attributes for supporting choices that will lead to real reductions in crashes and crash severity. Accuracy needs include both reliable measures of the circumstances and location of crashes. Here, too, GPS and GIS are important tools for safety data collection, analysis, and presentation.

Because crash data are collected by local agencies and used for decision making at other levels of government, there is a special need to ensure consistency in data elements and the methods for measuring them (standardization). Because numerous factors contribute to crash risks, it is important to include contextual variables in crash databases. As in the case of asset management, the ability to integrate data across levels and jurisdictions is essential for supporting informed allocation of safety resources.

Important values can be gained from linking crash data with neighborhood demographics to understand who is involved in crashes and how to design the most effective countermeasures for different demographic (ethnicity, gender, age) groups.

Archiving and disseminating crash records gathered over extended time periods support informed problem identification. Early trend spotting can identify emerging problems before they become serious. Maintaining data on crashes, roadway characteristics, and context can also provide a basis for evaluating the impacts of countermeasures. This is at once important, for such outcome assessments provide an objective basis for selecting countermeasures in the future, and difficult, because it requires that roadway characteristic and countermeasure data be merged with crash records.

Freight Flows

Freight data are important for supporting decisions about congestion management, facility design, and economic development. There is demand for increased geographic (origin–destination and route) detail from data users, which conflicts with concerns about disclosure of proprietary information coming from carriers and shippers, as well as raising costs because of the need to collect larger and more detailed samples. Most freight data originates in the CFS conducted as a part of the economic census, but decision makers typically see information enhanced through analysis and supplemented with data from other sources, including proprietary and locally collected data. Thus, although it is critically important, the CFS is often invisible to users. That invisibility lessens support for resources to sustain it.

Peer participants cited the need to understand the business models of shippers and carriers, which would support interpreting the patterns observed in freight data. This is also an implicit expression of the need to forecast—to predict what will occur to freight flows if infrastructure, service, prices, or other characteristics are changed, as a result of either actions or inaction.

Traffic Operations

Real-time traffic flow data are used for operations management, and customers—travelers—have come to expect such from transportation agencies for trip planning. Archived traffic measures are useful for identifying trends and spotting emerging problems to support investment planning and decision making. Technology has evolved to support automated data collection and dissemination—right to the users' pocket. The sheer magnitude of real-time data streams demands thoughtful decisions about what to collect, how to analyze it, and what to archive for future studies.

Crosscutting Issues

Peer participants identified a number of data needs that cut across substantive application areas:

- Data for before-and-after analyses are essential for evaluating the effectiveness of transportation system changes, for example, crash countermeasures, as well as operational changes, pricing and regulations, but it is not common for agencies to collect such data. It can be difficult to justify resources to collect data after interventions, to spend money when presumably the problem has been solved. It is especially hard to find resources for controlled experiments, where data must be collected at sites where no intervention occurs, but controlled experiments can provide the most reliable information on outcomes of system changes.

One outcome of before-and-after studies is information on ROI associated with system changes. ROI estimates are particularly useful for supporting future investment decisions. Locally developed estimates often carry greater weight than values found in the literature based on studies in other places.

- Transportation systems, their operations, and their impacts are inherently spatial. Where something occurs is important for planning, management, and decision making. In almost every context there is a desire for increased spatial (location) detail. GPS and GIS provide effective support for spatially referenced data collection, analysis, and presentation. The challenges include implementing these tools and adding detailed spatial referencing to existing data sets and future data collection programs.
- While specific agencies have responsibilities for particular service area or regions, the transportation system and its users function on an interconnected, multijurisdictional network. Spillovers in operations and impacts occur between system elements almost without restriction. Many peer exchange participants pointed out the need to gather consistent data across jurisdictions to provide a basis for true network management.
- Some applications require that data be merged or fused from several sources to produce useful information: data on crashes, roadway characteristics, and demographics or on roadway design elements and natural habitats. This requires a common referencing system, typically geographic or linear referencing for roadways, as well as coordination across separate databases to assure availability and compatibility.
- Peer participants described data sharing between different users as an efficient way to meet user needs: collect it once and use it many times. They recognized that data were more easily shared within the transportation community than across functional boundaries (e.g., between transportation, police, security, or environmental agencies). Data sharing is not easy because the resources—money and skilled personnel—are not always equally available across jurisdictions. It is logical for public entities to focus limited resources on data that seem most salient to their own operations; this focus sometimes leads to myopic data collection programs. Even where data programs are mandated (e.g., FHWA’s Highway Performance Monitoring System) there is resistance to data collection burdens when the need for the data is neither well understood nor locally salient.

An organized approach to data programs—under a data business plan—should take advantage of opportunities for data sharing, recognizing that delivered data products will likely need to be tuned to the needs of the different users.

- Although many data users, and some data providers, report no use of national databases, national sources often underlie state and local data products. Regional agencies such as MPOs often rely on the Nationwide Personal Transportation Survey (NPTS) for benchmarking and default model parameters. Most freight data used at the state and regional levels has its origins in the CFS, even though users may not be aware of this. CTPP is a common data source for agencies at all levels. This is underscored by the decision by AASHTO to acquire these data for its members. And national datasets can be used to support recommendations and advocacy for national policy initiatives. Thus, despite their lack of visibility, national data sources provide substantial value to transportation decision making.
- Trend analysis is an important use of data of all types. Trends can give early warning of emerging needs, problems, and opportunities. Applications include travel demand by location and mode (e.g., growth in transit usage as energy prices rise), traveler demographics (e.g., travel patterns of recent immigrants), energy supply and prices, location trends, work trip travel patterns (e.g., telecommuting), and vehicle fleet mix. Ongoing national data programs may prove especially valuable for detecting national trends to alert state and local agencies of impending changes. Trend spotting is a continuing responsibility of the transportation data program,

producing a consistent view of recent and likely future changes in important variables and factors.

These and other crosscutting issues underscore the importance of a systematic, integrated approach to the transportation data program, focused on the fundamental goals of the agency and designed to meet the diverse needs of decision makers and system users.

MANAGING DATA AS A TRANSPORTATION ASSET: THE DATA BUSINESS PLAN

As key assets of the transportation system, it was generally recognized that data and data programs should be driven by the goals of the transportation agency, including

1. Safety,
2. Mobility,
3. Assurance of capacity and congestion reduction,
4. System preservation,
5. Equity in the distribution of services,
6. Economic development, and
7. Environmental stewardship.

These goals support customer needs and satisfaction where customers are users and residents, now and in the future, as represented by elected and appointed decision makers.

The data business plan provides a framework for managing data assets, for assuring sufficient, timely, quality data to support decisions as they arise, without overinvesting so that the enterprise becomes data rich and information poor. The point is to support informed choices, not to overwhelm decision makers with data. By tying the data program to the business purposes and functions of the transportation enterprise, priorities for data investments should become both clearer and more logical; this in turn should make data investment decisions more responsive to the need.

Data business plans are becoming important, structural elements of the strategy of transportation organizations, and some states represented at the peer exchange either have developed or are developing such plans. Florida has identified information, resource, and technology needs associated with new intermodal system requirements. Kansas has data business plans that bring functional area and IT specialists together to find the best ways to provide data and information throughout the agency. Virginia and Michigan have begun work on plans to meet current and future transportation information needs. Washington created a data council that brings together business area and information technology staff to discuss information needs, issues and strategies.

Data business plans match decision making needs to specific data elements, recognizing differing needs across users, decisions, and program elements. They identify overlapping needs and opportunities for sharing and applying the same data over several or many users, although perhaps in different formats or based on different analyses. Common data business plan elements include

- Data mapping, tracing data flows for key business decision-making processes to identify specific users and their information requirements.
- Assembling inventories of available data resources.
- Identifying information gaps and priorities for investments in improved data systems.
- Assigning roles and responsibilities for collecting, archiving, analyzing, providing, and reporting information—including agency agreements on data owners, stewards, and reporting assignments. Arrangements with those outside the transportation enterprise pose special challenges.
- Defining governance relationships for operating data programs and selecting and implementing IT projects.
- Exploring technology needs and data management architectures for meeting information requirements.
- Defining protocols for reaching consensus across jurisdictions on data sharing and methods for reducing data redundancies, enhancing data integrity, and improving staff efficiencies.
- Identifying resource needs for data programs, including personnel, technology, and system costs for data collection and maintenance, and for implementation of system upgrades.
- Documenting information security policies, data access rules, and data sharing protocols.

Directions to More Effective Transportation Data Systems

Participants wrapped up the peer exchange with discussions of ways to resolve some of the issues outline above. Discussions included the points below.[1]

INSTITUTIONALIZING DATA AS A TRANSPORTATION ASSET

Effective communication, collaboration, and coordination between data users, producers, and information system professionals are keys to managing data as an asset. Actions that can build stronger data producer–consumer relationships within transportation agencies include

- Aligning information programs with strategic organizational goals and the context of business decisions—the business plan;
- Identifying and articulating the value of data and information to decision making, and finding effective ways to convey and display the power of information;
- Effectively communicating opportunities and limitations of data assets to managers, decision makers and IT personnel, using meta-data to describe data sources, quality, currency, and reliability;
- Providing easy access to data and clear linkages to contacts that can provide additional detail; and
- Broadly sharing information on technology improvements that may have value to others across the organization.

These actions can lead also to some tensions and challenges. For example, data producers and providers may resist sharing information without knowing who will use it or how it will be used, and they may insist on reporting its qualifications and limitations. But data users may not always be visible, and they will usually wish to avoid excess detail on the origins, production processes, and other technical issues associated with shared data.

There can be tensions between IT units and enterprise business areas over roles and responsibilities, data system and application standards, and IT project development processes. For example, data users sometimes suggest that too much IT oversight can stifle data and information system innovations or drive them undercover. IT offices wish to prevent uninformed technology investment decisions because they have the potential to raise subsequent network and system support issues. Some states have dealt with these tensions by establishing enterprisewide or even governmentwide data units that move strategic data decisions to the top management of the agency.

From a practical standpoint, relationships seem to thrive best in environments where there is more communication, flexibility, and focus on meeting business needs of the transportation agency.

STRATEGIES FOR ENHANCING DATA AND INFORMATION PROGRAMS

With increasing competition in transportation agencies for people and dollars, maintaining and sustaining support for robust data programs can be challenging. Following are some techniques for enhancing overall transportation data and information programs.

Data Business Plans

The data business plan is the organizing framework for transportation data programs. It links data systems to organizational goals; defines responsibilities, boundaries, and flows; and provides a basis for setting investment priorities for data programs. The development of a data business plan provides a context for linking provider and users so that data needs can be met effectively and efficiently. And because the needs for data are ever changing, data business plans must adapt to keep up with market demand, the challenges facing the transportation systems, and the opportunities presented by emerging technologies. This demands an ongoing, dynamic data-planning process that regularly brings users and providers together to review, adapt, and advance the enterprise data program.

Strengthening Data Programs to Support Performance Measurement

As transportation agencies implement performance measurement programs, there is growing interest in going beyond the identification of data for specific measures and metrics to provide for more

- Standardized data definitions, reporting practices, data management methods, and LRS to support integration of data across agencies, network components, and jurisdictional boundaries.
- Benchmarking and comparative analyses within and among states and other agencies. National databases can be particularly useful in supporting comparisons across states and against national averages.
- Outcome (before–after) analyses to understand effectiveness of actions, e.g., crash countermeasure evaluations to support safety management plans.

Staffing and Human Resource Enhancements

The knowledge, skills, and capabilities of data producers, providers, and analysts are critical to managing data as a transportation asset. As decisions and uses of information become increasingly complex and interrelated, there is a growing need for data producer and information technology competencies that emphasize

- Organizational knowledge of agency goals, objectives, business processes, information uses, and functional responsibilities.
- Strategic thinking that encourages broader views of enterprise information needs and the relationships between the data and the systems and processes needed to support decisions.
- Flexibility and openness to new data uses, applications, and technologies. This includes being open to publicly produced and privately purchased data products.

- Team building, networking, and negotiating skills that foster effective collaboration with internal and external partners on data collection, analysis, and the applications and systems to stream, report, display, and share information.
- Technical skills to accommodate emerging technology and information management solutions, including expertise in GIS, visualization, and other advanced reporting techniques.
- The capability to conduct more sophisticated data analyses. Decision makers and other data users rely on analysts for broader, more comprehensive views of how transportation systems and components are performing—or are likely to perform. For example, understanding where crashes are occurring is important, but linking crashes, traffic and roadway characteristics, adjacent land uses, demographics, and other factors is essential for understanding causality and identifying effective solutions.

To provide these broader data integration and analysis capabilities, a new kind of enterprise data architect professional may become important to transportation agencies. Such data architects would be responsible for looking out across agency silos to identify opportunities for linking data and applications to meet the information needs of multiple business areas, finding ways to permit data to be entered once and used often throughout the organization.

Advancing data programs in transportation agencies is likely to require the development of new job descriptions that specify this evolving skill set.

NOTE

1. This and the following section are based substantially on the notes provided by Jonette Kreideweis of Minnesota DOT.

Next Steps for Transportation Data Asset Management

Peer participants discussed opportunities for national efforts to advance the use and effectiveness of transportation data systems. These included potential initiatives that might be undertaken by the federal government, AASHTO, TRB, and its cooperative research programs. Three areas are outlined below.

SYNTHESIS STUDIES

Documenting innovative data practices would provide guidance for improving transportation data and decision support systems at all levels of decision making. Promising targets for syntheses of successful data practices under one of the cooperative research programs include

- Data business plan development processes, including criteria for and examples of successful plans;
- Business arrangements and protocols for sharing data within and between agencies;
- Data mining and analysis methods and products;
- Interoperable data management systems that support data integration and sharing;
- Data reporting strategies, including best practices from communications and marketing fields for delivering useful information to decision makers: this effort should explore technologies for delivering information using graphics, simulation, visualization, and animation; and
- Tracing and assessment of uses of national databases (NPTS, CFS, Census including CTPP, and others), determined through data mapping, to assess the value of these sources.

RESEARCH AND DEVELOPMENT OF TOOLS AND METHODS

There is a need for research, development, and dissemination of better tools for data analysis for supporting transportation decisions. This work could be supported through the TRB-managed cooperative research programs, Strategic Highway Research Program II, and by AASHTO to produce AASHTOWare products. Examples of needed work include

- Enhanced predictive tools to forecast system requirements and performance levels;
- Practical methods to calculate ROIs for the full spectrum of transportation improvements, from new construction to rehabilitation and maintenance to crash countermeasures;
- Improved techniques to identify, characterize, and quantify the risks and benefits of alternative investment scenarios; and
- Advanced tools for analyzing, visualizing, and integrating real-time traffic data with agency management and planning functions.

Success in these and other research areas will be critically dependent on good data sources describing outcomes associated with planned and unplanned changes in transportation systems and the variables affecting them. These data sources will come in the form of before–after studies, data archived over extended periods to capture important trends, highly detailed data revealing behaviors and causality, and data integrated from multiple sources to model complex processes. Such data captured, archived, and made available now will build a foundation for better decision support in the future.

INSTITUTIONAL ARRANGEMENTS

Because of the substantive necessity and efficiency advantages of sharing data across transportation (and other) agencies, it will be important to facilitate and enhance institutional collaborations. Work is needed to identify effective designs for cooperative and collaborative institutional arrangements among transportation agencies. Topics to be addressed include

- Examples of successful practices for reaching interagency agreements on joint data programs and sharing data and procedures,
- Ways to secure buy-in to use specific data sources (such as national data), and
- Effective mechanisms (guidelines, agreements, statutes, or regulations) to facilitate interagency data and procedural consistency.

Achieving such agreements could produce efficiencies in data collection and entry efforts, reduce the potential for conflicting results, and allow partners to communicate more effectively on performance, conditions, needs, and options. Institutional arrangements could be addressed through best practices research or through targeted peer exchanges sponsored by organizations such as AASHTO.

Closure

This peer exchange demonstrated, through example and discussion, the importance of data in the management of the transportation enterprise. An effective data system, producing timely, responsive, and understandable data and analyses for decision support, can provide an informed basis for those decisions and thus can improve the effectiveness and efficiency of the transportation system itself. All of this requires thoughtful, balanced development and management of data as an asset of transportation systems.

Peer participants reported much progress and many achievements, while identifying promising opportunities for near-term enhancement of transportation data systems. It will be useful to continue this dialog through future peer exchanges, as well as through explicit consideration of data needs in the general technical activities of TRB, AASHTO, and other professional forums for transportation discussions.

APPENDIX

Participants in the Peer Exchange

Antonio Abeyta
Administrative/Operations Manager
Data Acquisition and Reporting Section
New Mexico Department of Transportation

Thomas Jeffery Bolle
Director
Government, International, and Public Affairs
Research and Innovative Technology Administration

Aaron Butters
Manager
Systems Analysis and Program Development
Washington State Department of Transportation

Kent Cooper
Assistant Director
Planning and Research
Nevada Department of Transportation

Douglas Couto
Agency Services Information Officer
Michigan State University

Barry Driscoll
Senior Policy Analyst
Planning Division
Vermont Agency of Transportation

Jerry Duke
Assistant Planning Manager
Southern Nevada Regional Transportation Commission

James Hubbell
Transportation Planner
Mid-America Regional Council (Kansas)

June Jones
Survey Statistician
Bureau of Transportation Statistics

Anthony R. Kane
Director
Engineering and Technical Services
American Association of State Highway and Transportation Officials

Ron Kaufman
Chief
Bureau of Public Involvement
Kansas Department of Transportation

Jonette Kreideweis
Director
Office of Transportation Data and Analysis
Minnesota Department of Transportation

David Lee
Administrator
Statewide Planning and Policy Analysis
Florida Department of Transportation

Suellen Markley
Federal Program Consultant
Kansas Department of Transportation

Deb Miller
Secretary
Kansas Department of Transportation

Rick Miller
Assistant Geotechnical Engineer
Kansas Department of Transportation

Elaine Murakami
Community Planner
Federal Highway Administration

Janet Oakley
Director
Policy and Government Relations
American Association of State Highway and Transportation Officials

Patricia Oliver-Wright
Manager
Statewide Planning Section
New Mexico Department of Transportation

Thomas Palmerlee
Senior Program Officer
Transportation Research Board

Thomas Jeffery Price
Assistant Director
Operations Planning Division
Virginia Department of Transportation

Murali Rao
Information Technology Director
Virginia Department of Transportation

Angela Rouelle
Manager
Application Development IT
Vermont Agency of Transportation

Joseph L. Schofer
Professor
Northwestern University

Douglas Simmons
Deputy Administrator/Chief Engineer
Planning and Engineering
Maryland State Highway Administration

Dennis Slimmer
Assistant to the Planning Director
Kansas Department of Transportation

Ronald Vibbert
Manager
Asset Management Section
Michigan Department of Transportation

Johanna Zmud
President
NuStats, LLC

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