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Federal Highway Administration

4TH Integrated Transportation Management Systems (ITMS) Conference

ITMS: A Key Strategy to Optimize Surface Transportation System Performance

Conference Proceedings

July 15-18, 2001
Newark, New Jersey

Sponsored by

Transportation Research Board
Federal Highway Administration

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Institute of Transportation Engineers
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16. Abstract

This report documents the proceedings from the 4th Integrated Transportation Management Systems (ITMS) Conference, ITMS: A Key Strategy to Optimize Surface Transportation System Performance, held in Newark, New Jersey on July 15-18, 2001. The Conference was sponsored by the Transportation Research Board (TRB) and the Federal Highway Administration (FHWA), in cooperation with the Institute of Transportation Engineers (ITE), ITS America, and the American Association of State Highway and Transportation Officials (AASHTO). The purpose of the Conference was to identify potential initiatives and opportunities to help advance the state-of-the-art in planning, designing, deploying, operating, and evaluating ITMS. These proceedings will be used by the sponsoring groups to help advance all aspects of ITMS.

These proceedings summarize the presentations from the general sessions and the breakout sessions. The main topics covered by speakers in the sessions are highlighted. Subject areas addressed in the session include defining ITMS, planning and designing ITMS, institutional barriers and opportunities, performance monitoring, management and operations, and traffic management strategies and operational plans. The major issues and research initiatives discussed in the breakout sessions are summarized. The list of Conference attendees is also provided.

The seven white papers prepared to help frame key issues and opportunities associated with ITMS are summarized in the general sessions. The full white papers are provided in a separate document, *4th Integrated Management Systems Conference: White Papers* (EDL Document Number 13482) and are available on the Internet at www.tmcite.org.

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ITMS: A Key Strategy to Optimize Surface Transportation System Performance

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Conference Proceedings

Editor

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4th Integrated Transportation Management Systems (ITMS) Conference
ITMS: A Key Strategy to Optimize Surface Transportation System Performance

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Table of Contents

Conference Overview
Katherine F. Turnbull, Texas Transportation Institute; Walter Kraft, Parsons Brinckerhoff; and Jon Obenberger, Federal Highway Administration 1
Opening Session – Welcome and Background
Conference Welcome – Walter Kraft 9
Defining Intelligent Transportation Management Systems – Tom Urbanik 10
Importance and Role of ITMS to Optimize Performance – Christine Johnson 12

Plenary Session – Strategies to Successfully Plan, Develop, and Sustain ITMS
Institutional Challenges, Barriers, and Opportunities – Louis Neudorff 17
Planning and Designing ITMS: Technical Integration – Jim Kerr 18
Operational Programs, Strategic Plans, and Support Services: Procedural Integration – Wayne Berman 20

Plenary Session – Optimizing Performance: Managing and Operating ITMS
Managing and Operating ITMS: Policies, Procedures, Funding, and Staffing Issues – Walter Kraft 23
Traffic Management Strategies and Operational Plans – Les Kelman 24
Monitoring and Evaluating Performance: Programs, Methodologies, and Measures – Vince Pearce 26

Plenary Sessions – Initiatives Identified to Overcome Gaps in Practice and Improve the State-of-the-Art: Summary of Breakout Session Results
Institutional Challenges, Barriers, and Opportunities: Institutional Integration – Ron Sonntag 29
Strategies to Plan and Design for ITMS: Technical Integration – Alan Clelland 31
Operational Programs, Strategic Plans, and Support Services: Procedural Integration – Les Jacobson 33
Managing and Operating ITMS: Policies, Procedures, Funding, and Staffing Issues – John Collura 35
Traffic Management Strategies and Operational Plans – Larry Head 37
Monitoring and Evaluating Performance: Programs, Methodologies, and Measures – Darcy Bullock 39

Closing Session – Opportunities to Advance the State-of-the-Practice with ITMS
Common ITMS Themes, Priorities, and Directions – Vince Pearce 41
National Dialog on Transportation Operations: Status Report and Future Directions – Frank Francois 42
ITMS Needs and the TRB/ITE National Operations Research Agenda – Phil Tarnoff 46

Opportunities for Improvement: From Needs and Issues to Action Plans – Jeff Lindley 48

Appendix A–Break Group Summaries 51

Appendix B–List of Participants 55

Conference Overview

Katherine F. Turnbull, Texas Transportation Institute
Walter Kraft, Parsons Brinckerhoff
Jon Obenberger, Federal Highway Administration

The 4th Integrated Transportation Management Systems (ITMS) Conference was held in Newark, New Jersey on July 15-18, 2001. The conference was sponsored by the Transportation Research Board (TRB) of the National Research Council and the Federal Highway Administration (FHWA), in cooperation with the Institute of Transportation Engineers (ITE), ITS America, and the American Association of State Highway and Transportation Officials (AASHTO).

ITMS focuses on enhancing the operation of the surface transportation system through the use of advanced technologies for automated, real-time sharing information and the coordinated management activities of transportation agencies. These agencies and systems provide for the management and operation of a variety of transportation facilities and functions, including freeways, arterial streets, transit, toll facilities, emergency services, and information services.

The first ITMS Conference was held in Newport Beach, California in 1992. The ITMS concept was relatively new at that time, as intelligent transportation systems (ITS) were just beginning to be tested and deployed in many areas. The conference established a dialog among transportation professionals on ITMS and identified research and outreach activities to help facilitate the deployment of ITMS.

Conferences in Seattle in 1995 and Boston in 1996 further advanced the ITMS concept and expanded the partnership network to include emergency management services and information services. Recent activities, including the National Dialog on Transportation Operations, the National ITS Architecture, and ITS deployments throughout the country, continue to focus attention on the role ITMS can play in helping manage travel and provide mobility in congested corridors.

The goal of the Fourth ITMS Conference was to identify potential initiatives and opportunities to advance the state-of-the-art related to planning, designing, deploying, operating, and evaluating ITMS. To accomplish this goal the conference included both general sessions and breakout sessions organized around seven white papers prepared specifically for the conference. Participants in the breakout groups identified issues, opportunities, and research initiatives associated with ITMS.

The results from the conference, as summarized in these proceedings, combined with other efforts underway at the national, state, and local levels, provide an opportunity for all interests to develop a vibrant, ongoing research and deployment program to advance the state-of-the-art in planning, designing, deploying, operating, and evaluating ITMS.

Seven resource papers were developed specifically for the conference to help establish a common base for discussion. The resource papers were available prior to the conference on the Transportation Management Center Internet site (www.tmcite.org). The papers are also

provided in a separate document as part of these proceedings. The white papers and authors were:

- Definition of ITMS – Thomas Urbanik II;
- Planning for Operations – Wayne Berman;
- Institutional Challenges, Barriers, and Opportunities: Institutional Integration – Louis Neudorff;
- Strategies to Design ITMS – Jim Kerr;
- Managing and Operating Integrated Transportation Management Systems: Policies, Procedures, Funding, and Staffing Issues – Walter Kraft;
- Traffic Management Strategies and Operational Plans – Les Kelman; and
- Performance Measurement and Integrated Transportation Management Systems - A Traffic Operations Perspective – John Wolf.

The breakout groups were organized around the major topics addressed in the white papers. These topics included planning for operations, institutional challenges and opportunities, designing ITMS, managing and operating ITMS, traffic management strategies and operational plans, and performance measures.

Participants in each breakout group addressed a set of common topics. Participants discussed the major issues associated with the white paper and identified research initiatives to address those issues. A facilitator, recorder, and note taker assisted each group. The white paper authors attended the breakout sessions to provide additional assistance. The major results from the breakout groups were presented at one of the two closing general sessions.

A number of common themes emerged from the discussions in the breakout groups. As summarized next, these themes focus on making operations a priority, institutional coordination and cooperation, training and education needs, technical guidance, and performance measures and evaluations.

- The need for transportation agencies to focus on operations as a core mission was identified as a key element. Changing the mindset of these agencies from construction to operations is not an easy process, but is critical to the success of ITMS.

- Institutional issues are frequently more of a stumbling block than technical issues. Interagency coordination and cooperation is key to ITMS. Developing multi-agency partnerships, bridging institutional gaps, and establishing new institutional arrangements are all needed to maximize ITMS.

- Project champions with the authority, ability, and credibility to influence decisions are needed within all agencies and groups. Outreach to policy makers is a key part of building support and champions at the political level.

- Training, education, and staffing needs are critical to ITMS. Emphasis should be placed on recruiting, retaining, training, retraining, and cross-training personnel at all levels. Educational materials are needed for undergraduate and graduate courses, as well as on-the-job training.

- The need for technical guidance and best practice examples on a number of topics was identified as a priority. For example, the need for technical guidance on issues relating to planning, designing, maintaining, and sharing information via different interfaces among different systems was cited.

- Performance measures and evaluations are needed to document the benefits of ITMS. Common definitions, performance measures, and monitoring and evaluation techniques should be developed for ITMS. Ongoing monitoring and evaluation programs should be conducted.

In addition to these crosscutting major themes, participants in the breakout groups identified a number of other issues, opportunities, and research needs. The major research initiatives emerging from the breakout group discussions are summarized below.

Institutional Challenges, Barriers, and Opportunities: Institutional Integration

There was general agreement among the two breakout groups that the institutional issues associated with ITMS are frequently more difficult to address than the technical issues. There was also a general consensus that most of the institutional issues identified are not new. Further, many are not unique to ITMS. Institutional issues are likely to occur with any project involving more than one agency or jurisdiction. The multimodal, multi-jurisdictional, and multi-agency nature of ITMS increases the potential for possible institution conflicts. Key research initiatives included:

- Stakeholder Involvement. Develop and distribute information and briefing materials on ITMS for use by transportation professionals in presentations to the public and to elected officials.

- Institutional Inertia. Conduct research documenting case studies of good examples addressing institutional issues with ITMS and techniques that have worked with other ITS and transportation projects.

- Rethinking the Core Mission of Departments of Transportation. Conduct research on how to help facilitate a change in thinking from a focus on construction to a focus on operations at state departments of transportation, including case studies of good examples of organizational change.

- Agency Operating Cultures. Prepare a synthesis of successful and unsuccessful practices related to cross-agency coordination activities, including research identifying cultural differences.

- Strategic Planning Process for ITS. Conduct research on case studies of good examples of ITS strategic plans, the process used to develop these plans, and how these plans have helped address institutional issues.

- Performance Measures. Conduct research to identify and recommend a standard set of comprehensive performance measures for ITMS.

Strategies to Plan and Design for ITMS: Technical Integration

Key technical integration issues identified by participants in these groups included use of the systems engineering model, interoperability, planning for deployment, systems architecture, inter-agency groups, security, education, and programming. The systems engineering process was identified as the key technical issue, education and training was identified as an ongoing concern, and intra-agency groups was noted as an emerging issue. The groups identified the link between institutional and technical issues, noting that institutional concerns frequently influence the technical elements of a project.

- Use of the Systems Engineering Model. Conduct research to develop tools and techniques for applying the system engineering approach to ITMS.

- Interoperability. Conduct research to develop a framework for interoperability, including developing a standard definition for interoperability.

- Planning for Development. A number of research initiatives were identified relating to planning for ITMS development that would culminate in the development of guidelines for ITMS project planning.

- System Architecture Development. Conduct research to develop and provide guidance on how to translate Strategic Plans/Early Deployment Plans (SP/EDP) into design guidelines, how to include requirements for system architecture-based standards in requests for proposals (RFPs), how to define communication interfaces for new and legacy systems, and how to design an architecture that ensures sustainability and migration strategies.

- Security. Conduct research on possible procedures for identifying risks, including threat analysis and appropriate level of defense.

- Education. Develop and provide education and training in the basics of ITMS to improve base-level knowledge, including integration issues.

Operational Programs, Strategic Plans, and Support Services: Procedural Integration

Issues identified by participants in these two groups related to operational programs, strategic plans, and support services included a lack of understanding of operations and integration, poor communication among agencies, a lack of common measurable goals, a lack of project champions, inadequate funding, the unavailability of analysis tools, and education and training needs. There was agreement that the results from this conference should be used to build on, and enhance current activities.

- Outreach and Inreach. Recommended activities include conducting research examining good examples of operational programs and strategic plans, establishing a national peer network on ITMS to help facilitate the sharing of information, and establishing a program on a national level to recognize good examples of procedural integration.

- Analysis Tools. Conduct research to develop appropriate analysis and planning tools and techniques for ITMS.

- Regional and Program Structures. Conduct research examining the influence of different regional structures and various program structures on operations and ITMS planning.

- Staffing. Conduct research on the staffing, training, and educational needs associated with ITMS procedural integration, and identifing the skills sets needed by personnel at different levels.

- Successful Operational Planning. Conduct research examining and documenting good case study examples of successful operational and ITMS planning efforts.

- Quantify Benefits of Integration. Research is needed to analyze the benefits from integration and ITMS.

- University Curriculum. The results of the research projects described above should be used to develop and distribute course materials on ITMS procedural integration for undergraduate and graduate students.

Managing and Operating ITMS: Policies, Procedures, Funding, and Staffing Issues

These two breakout groups discussed the need for policies, procedures, funding, and trained staff associated with managing and operating ITMS. The groups also discussed the relationship of these topics to other issues associated with ITMS. There was agreement that these four general topic areas are critical to ITMS. Research initiatives to help address these issues focus on developing model policies and procedures, examining alternative funding scenarios, and developing needed education and training programs.

- Policies. Conduct research identifying the policies needed to support all phases of planning, designing, deploying, and operating ITMS.

- Procedures. Conduce research to identify the management and operations procedures needed with ITMS.

- Cost of Management and Operations. Conduct research analyzing the cost of different approaches to management and operations.

- Education and Training. Conduct research examining the education needs and requirements for ITMS operators, including the development of job specifications.

- Best Practices for Partnership Agreements. Conduct research examining alternative multi-agency and public/private partnership agreements with ITMS projects.

Traffic Management Strategies and Operational Plans

These two breakout groups discussed traffic management strategies and operational plans. A number of strategies for dealing with the identified issues were also discussed. These strategies included space allocation, such as alternative use of lanes for bus and parking, and time allocation, such as pedestrian and transit priority at certain times of the day. Pricing strategies were also identified as potential approaches. The need for

advanced operations plans for special events, parades, filming, and construction activities was discussed. The differences and similarities among applications for freeways and urban arterials were identified.

- Market Research on Strategies to Influence Travel Demand. Conduct market research on strategies that influence travel demand, and initiate specific applied research and demonstration projects based on the results.

- Arterial Incident Detection and Management. Conduct research on techniques, strategies, and technologies that can be used for incident detection and management on arterial streets.

- Development of Incentives for Integration. Conduct research examining the potential use of incentives for integrating operations and ITMS.

- Risks and Liabilities of ITMS. Conduct research exploring the risks and the liabilities associated with ITMS.

- Identify and Develop Disruption Management Tools. Conduct research exploring the use of disruption management tools with operations.

Monitoring and Evaluating Performance: Programs, Methodologies, and Measures

There was general agreement among participants in these breakout groups that performance measures are essential and that monitoring and evaluating ITMS should be an ongoing process. Participants noted that the goals of performance measures are usually not clearly defined. The need to develop an appropriate balance between analytical and qualitative measure of effectiveness was also discussed.

Other issues discussed by the group included data quality, data quantity, organization and institutional concerns, and different perceptions of system operations. There was general agreement that a common set of definitions and performance measures should be developed for ITMS projects.

- Evaluation Guidance. Conduct a major research initiative to develop guidance for establishing and maintaining an ITMS evaluation program.

- Data Consistency Guidance. Conduct research to develop guidance on data consistency. This guidance should include precise definitions of data requirements, national uniform data collection methods necessary for benchmarking operations between locations, uniform standard of accuracy, and uniform levels of detail.

- Defining Customer Expectations. Conduct research defining the customers for various types of information and what their needs are. Possible customers might include planning staff, operations staff, travelers, transit operators, transit users, and policy makers.

These research initiatives will be used by TRB, FHWA, ITE, ITS America, AASHTO, and other groups as part of the ongoing effort to advance the state-of-the-art in planning, designing, deploying, operating, and evaluating ITMS.

It is anticipated that the Conference Planning Committee and the TRB, ITE, ITS America, and AASHTO Committees will follow up with more specific activities. These actions include planning for future ITMS conferences, further defining the identified issues and research initiatives, developing a comprehensive research and deployment initiative, engaging key stakeholders, and building support at the federal, state, regional, and local levels for ITMS.

Opening Session – Welcome and Background

Pete Briglia, Washington State Department of Transportation – Presiding

Conference Welcome

Walter Kraft
PB Farradyne
Conference Planning Committee Co-Chair

It is a pleasure to welcome you to the Fourth Integrated Transportation Management Systems (ITMS) Conference. I am proud to announce that we have a little over 150 attendees from the United States, Canada, Japan, and the Netherlands. Within the U.S., we have representatives from 26 states and the District of Columbia.

The first ITMS Conference was held in Newport Beach, California almost 10 years ago. ITMS was a somewhat revolutionary concept at that time. In fact, it might have been a little ahead of its time because opportunities for integration were limited.

The potential to integrate various elements of the transportation system is much greater today from both a technical and an institutional perspective. Further, the ITMS concept is in line with the activities of the National Steering Committee on Operations being furthered by the Federal Highway Administration. This effort focuses on making all elements of the systems work better individually and better together.

The idea for this conference emerged from discussions at recent meetings of the Transportation Research Board (TRB) Freeway Operations and Signal Systems Committees. Other groups and organizations were brought in to help with the planning process.

The conference is being sponsored by the Transportation Research Board (TRB) and the Federal Highway Administration (FHWA), in cooperation with the Institute of Transportation Engineers (ITE), the Intelligent Transportation Systems (ITS) America, and the American Association of State Highway and Transportation Officials (AASHTO).

The TRB Freeway Operations, Signal Systems, and Transportation Systems Management Committees were actively involved in planning the conference. The ITE ITS Council, the ITS America Advanced Transportation Management Systems (ATMS) Committee, and the AASHTO Advanced Transportation Systems Subcommittee also helped organize the conference.

I would like to thank Lou Neudorff, co-chair of the Conference Planning Committee, and all the Committee members for the outstanding job they did organizing the conference. These committee members include Vince Pearce – Program, Bahman Izadmehr – Registration and Publicity, Robert Reiss – Hospitality, James Paral – Hotel, and Jon Obenberger, William Stoeckert, and Edwin Roberts who provided ongoing advice.

I would also like to recognize the special efforts of the white paper authors – Tom Urbanik, Lou Neudorff, Jim Kerr, Wayne Berman, Les Kelman, and John Wolf. All of the authors did a great job capturing the key issues and opportunities associated with their topics. I hope you had a chance to read the white papers, which have been posted on the ITE Internet site.

The white papers will be presented in sessions this afternoon and tomorrow morning. The white papers also provide the focus for the two breakout sessions. We hope that you will learn from the speakers and that you will actively participate in the breakout sessions.

The results from the conference will be used by TRB, FHWA, and other agencies, organizations, and groups to help define future research initiatives, projects, and activities related to advancing ITMS.

Again, welcome to the conference. Please remember that this is your conference; make the most of it by actively participating. I hope you have a productive and enjoyable two days.

Defining Intelligent Transportation Management Systems

Tom Urbanik
Texas Transportation Institute

It is a pleasure to participate in the opening session of this conference. I have been involved in the previous conferences, and it is good to see the continued interest in ITMS. I want to stress that the opinions expressed in the white paper and in this presentation reflect my views and are not those of any institution.

It is important to start with a common understanding of ITMS. The TRB Freeway Operations Committee has defined ITMS as follows. "An ITMS provides for automated, real-time sharing of information between ITS-based systems and the coordination of management activities between agencies, thereby enhancing system interoperability and enabling an areawide view of the transportation network."

This definition provides a comprehensive overview of ITMS. A simpler definition is that ITMS is a transportation system operating from the customers or travelers point of view as if under single ownership and management.

We are all aware of the problems associated with non-integrated arterial streets, freeways, and roadways. Multi-jurisdictional, multi-agency, and multi-disciplinary institutional frameworks are barriers to better integration in most areas.

Many of the ideas and concepts associated with ITMS are not new. The potential now exists, however, for a new vision of management and operations. Enabling technologies are now available to help bridge the institutional seams. A National ITS Architecture and standards to facilitate the exchange of information necessary for seamless operation of the surface transportation system is emerging. While the institutional structure in this country is not going to change overnight, by thinking differently we can begin to provide the customer with what they need and want.

Thinking differently should start with a policy-based approach. We need to do a better job of listening to policy makers and the public. Traditionally, operations has tended to focus on vehicles. Policy-based operations focuses on providing priority to different user groups.

It is also important to remember that each area has unique features and institutional arrangements. What works in one region may not be appropriate in another area. We need to understand the unique elements and the policy settings of different regions.

Signal timing provides a good example of how priority can be given to different user groups and vehicles. Railroads now have priority at signalized intersections, followed by emergency vehicles. Some areas are also giving priority to transit vehicles. It might be appropriate to consider giving trucks a priority to address the pavement deterioration they cause at intersections and to keep them from being the first vehicle at the stop bar.

An intersection with a railroad grade crossing in College Station, Texas provides an example of how ITMS could benefit different user groups. A major rail line runs through the Texas A&M University campus and trains have a major influence on traffic in the area, including disrupting the normal traffic signal cycle. The intersection is also a major fire response route, so the potential exists that a train will delay a fire truck or an ambulance. The operations of this intersection could be enhanced by ITMS to the benefit of all user groups.

A truly integrated system will encompass all elements and all modes. When someone calls 911 we will know where the call came from, and we will know where all the fire trucks and emergency response vehicles are. In many fire dispatch operations today, it is possible for a fire truck to be parked in front of a fire and to have another rig assigned because it is from the closest dispatching station.

Numerous benefits can be realized from ITMS. Benefits include more efficient use of the transportation system, improved safety, more reliable system performance, and improved customer satisfaction. These benefits in turn can lead to political and public policy support.

It is hard to identify many of the costs associated with ITMS. Further, cost savings or benefits do not always accrue to funding agencies. There is a need to develop better techniques for estimating the benefits and costs of ITMS. We must develop a political constituency to help ensure support for funding implementation and ongoing operating costs.

I think we are making progress, but it is not a fast process. We are at the beginning of a long road. We should not get frustrated, however, as the elements needed for successful systems are beginning to fall into place. For example, the National ITS Architecture and various standards are important steps in the development of an integrated system. Further, agencies are implementing projects that can become part of a comprehensive system.

There are numerous obstacles to full deployment and operation of ITMS. These obstacles include fear of change, fear of failure, lack of a broad understanding of ITMS, and institutional, funding, and personnel issues. The best way to address institutional issues is to try to do something rather than just studying potential problems. Although funding continues to be a limiting factor, financing for ITMS is being addressed. The need for quality personnel may be the biggest problem to overcome.

There are a number of things that need to be done to continue to help advance ITMS. These activities include promoting the concept, building a political constituency, building support for funding, and documenting successes. Stories of how ITMS has been used to benefit travelers are needed.

What can you do? Become a champion. Multiple champions in all agencies and modes are needed. Second, you can help reach across institutional seams to build bridges with all groups involved in ITMS.

I look forward to participating in the conference and exchanging ideas on how to help advance ITMS. Thank you.

Importance and Role of ITMS to Optimize Performance

Christine Johnson
Federal Highway Administration

It is a privilege to be invited to speak at this conference. Many of the conference participants can truly be counted among the visionary fathers of ITMS. Your voices, papers, risk taking activities, and innovative practices have been carefully guiding the surface transportation industry through a fundamental transformation. It has been slow in coming, but as I will elaborate on more later in this presentation, I think we are now at a final frontier.

Others of you are too young to realize the foundation of change that underpins your job in transportation operations centers and ITMS. For you the world began with the ITS effort, or freeway management programs. Nevertheless, you are at the leading edge of a fundamental transformation of our industry.

The comment in Tom Urbanik's paper suggesting most transportation agencies are organized to solve problems of the last century are appropriate. When we had few roads and most were not paved, we needed to develop a system to construct roads. Operations and maintenance, while necessary, was clearly not the mission during those days. The problems of the 21st Century are clearly different. We have lots of roads, but they are not all operating well. From my perspective the transportation operations centers of today are forging the transportation missions and organizations of the 21st Century.

We have come a long way over the last decade in developing the underpinnings necessary for integrated transportation management. These underpinnings include the Traffic Operations Program to Improve Capacity and Safety (TOPICS) program, transportation systems management (TSM), freeway management, and ITS architecture and standards.

We have elements of ITS being deployed in numerous jurisdictions. For example, there are some 50 traffic operations centers, over 300 traveler information systems, 75 percent of toll roads in this country have electronic toll collection, and 25 percent of large transit systems have automatic vehicle locations (AVL) systems.

We have made real strides in developing a system architecture, standards, and policies to underpin the integration of these technologies. The addition of the 511 national traveler information telephone number available directly to the public has introduced a consumer pull for integration of travel information. I think consumers will push for more integrated travel information systems in the future. Even with these advancements, however, there is ample evidence that we still have a long way to go to realize a fully- integrated system.

Perhaps the most glaring evidence is the "congestion ahead" or worse "have a nice day" signs on variable message signs that has become

the Secretary of Transportation's symbol of what is not working in our management of the system. I believe these overhead message signs tell us a great deal about what still needs to be accomplished.

Part of the reason we have these messages that are less than informative is that we still do not have enough surveillance data. ITS deployment can be characterized not as a national, or even in most cases a regional system, but as spots of development. For example, in 1990, approximately six percent of the major road system in this country was instrumented. By 1999, some 22 percent of the systems was instrumented. We have a long way to go if that rate is maintained. Further, only 10 metro areas had completed enough of a system to estimate system-wide reliability measures.

It would appear that the demand for cheap, relatively ubiquitous and relatively uniform "content" or data, otherwise known as ITS infrastructure has become relatively acute. A lot of people and groups need uniform data.

The military is trying to reduce deployment time from 17 power projection platforms across the country from 60 days to 72 hours – that requires, among other things, total visibility of the transportation system performance.

The emergency management community is looking at coastal evacuation needs. They need total visibility as well as system management capability over long distances. Weather response teams need greatly improved sensing capability and system visibility if they are to respond with precision to prevent total system shutdown in ice and snow storms.

Our national parks are now turning to traffic management to preserve these precious resources – they too need data way down stream of the park entrance to be effective. Our public safety and medical communities increasingly cannot afford less than precision response to a traffic incident.

Thus, there are many groups that cannot move forward to solve their problems without more information about the transportation system. It is important to stress that just getting more data, or making each of our individual management activities smarter will not achieve ITMS.

We remain, in large, a project-driven culture, with project-driven policies and project-driven legislation. As a result, we have managed to get some 2,200 overhead message signs up and numerous traffic operations centers – before we had sufficient content to truly make them useful. Signs and buildings were projects that could be designed and built, and they fit the existing culture.

The problem is, they have to be operated, which stretches the underpinning organizational fabric of the highway culture. It is like asking the construction company that built the shopping center to now turn around and run it. That company probably is not organized, staffed or even financed in a way that would allow it to do that. In many – but I hasten to add not all – instances, neither are we. Institutional transformation will be essential.

It is telling that the Federal Highway Administration (FHWA) makes a detailed report to Congress on the condition of the Nation's pavement and it's bridges, but that report says

relatively little on how well the system performs in terms of serving the customer on a daily basis. Part of the reason is that while we have numerous measures of highway infrastructure condition, we have relatively few measures of system performance.

Another telling symptom is the challenge we have seen in getting the right players together to develop ITS architectures and 511 services. In many urban and rural areas there is no planning forum that routinely draws the operators – police, parking, traffic, transit, roadway, trucking, special events, and other groups – together on a weekly or even monthly basis to discuss and plan for upcoming construction, weather, and special events, and to fine tune responses to the truly unexpected incident.

There is no institutionalized planning process for operating the system – the way we developed the "3C" process for capital investments. The result is no one is accountable for the way the system operates today. Who do you call to complain to if you had a miserable commute or who gets fired if the system routinely breaks down?

There are times when we do an outstanding job of operating the system, especially during special events such as the Olympics, major sporting events, and major cultural activities. We bring all the parties to the table and plan for operations during the special event. In many cases, the mayor, governor, or other elected official has instilled a real sense of accountability for ensuring that the transportation system operates well during the event. Often an effort is made to over communicate with the public during these activities. Our challenge is to sustain that kind of special event effort on an everyday basis.

We have found there are five elements necessary to achieve this peak performance. These elements are over and above the outstanding technical practice of freeway or arterial management. These elements are 1) having the ITS infrastructure in place; 2) having institutional integrated planning execution and accountability that is institutionalized and not at a one-time event; 3) having established and agreed upon performance measures to help hold agencies accountable for their performance; 4) maintaining ongoing communication with the customer; and 5) spending the resources necessary to make it work. It is important to remember that operations is not a low-cost alternative to capacity expansion any more than system preservation is.

There are major policy, technical, and cultural changes, which require fundamental research, organizational, and legislative change. To make those kind of fundamental changes, we have to have what I call an authorizing environment. This authorizing environment must contain a wide community of people who recognize a need to change and who generally agree on the parameters of that change.

To help achieve an authorizing environment for change, we have launched the National Dialogue on Operations. The Dialog is intended to help develop technical and policy agendas, and to take on the difficult issues of cultural change. The National Dialogue on Operations involves a number of activities including association focus groups and working groups, regional meetings, and e-dialogue. These activities are developing agendas asking the questions of what is required to take on the operations mission as though every day were a special event. Issues being addressed include funding, legislation, research,

tools, and other concerns. An Operations Summit is being held in October 2001 in Washington, D.C. to help bring together all of these activities.

I would like to close with a few of my own observations on the federal reauthorization process. As we move into reauthorization, I believe two issues are critically important to advancing the vision of Integrated Transportation Systems Management. These issues are data and institutional reform.

Related to data, I think we need to move from spots of data to a nationwide availability of cheap, integratable, data on system performance, weather, and other key parameters. To that end we have put a draft together to define a set of minimum requirements that might become part of the definition of a functionally sufficient highway or bridge. Your input on this draft is needed.

Now, in thinking how to actually achieve this information structure, I do not think we should focus on the old style massive public works project carried out by the public sector. It is my own belief that the only way to accomplish our goals is with a genuine national public/private partnership – meaning shared risk, shared benefit, and shared contribution.

Institutional reform is an even bigger challenge. Let me challenge your thinking with this concept. The structure of Title 23 – which governs much of the national highway policy – can be described as organized and funded by functional class, with key elements of operations and systems preservation appended.

Perhaps it is time to rethink the mission and the underpinning policy and define three missions in our legislative structure and base funding on these categories. The three missions are construction, systems preservation, and operations or systems management. Each of these categories have their own planning processes, unique to that function, and their own financing structures.

Thank you again for the opportunity to speak to you today. I hope you have a very productive conference and I look forward to seeing the outcome of your discussions.

Plenary Session – Strategies to Successfully Plan, Develop, and Sustain ITMS

Jeff Lindley, Federal Highway Administration – Presiding

Wayne Berman, Jeff Lindley, Louis Neudorff, and Jim Kerr

Institutional Challenges, Barriers, and Opportunities

Louis Neudorff
Seimens-Gardner Transportation Systems

I am pleased to have the opportunity to talk this morning about institutional challenges, barriers, and opportunities with ITMS. More information on this topic is provided in the white paper.

An important first step toward institutional integration is for agencies and stakeholders to reach agreement on the ITMS concept and the potential benefits from ITMS. Other important steps are to define ITMS functionality, architecture, and the roles and responsibilities of the various agencies and groups. It is also critical for agencies to commit the necessary resources to implement, operate, and maintain ITMS.

Institutional issues may emerge within individual agencies and among agencies. Many transportation agencies are moving from a focus on infrastructure investments to a concentration on management and operations. There is also a greater focus on identifying and satisfying customer needs. Further, additional agencies are involved in operations, including enforcement, emergency services, MPOs, and private groups.

Other institutional challenges include enlightened self-interest by agencies; legal constraints related to funding; interagency control of devices such as variable message signs; and intra-agency issues relating to roles and responsibilities for different functions and facilities.

A number of approaches can be taken to address institutional challenges. Examples of possible ways to overcome institutional issues include adopting a regional ITS architecture, developing ITMS stakeholders and champions, undertaking outreach and inreach activities, promoting human relations efforts, and developing public/private partnerships.

A regional ITS architecture can be looked at as a framework for ITMS. The FHWA rule and Federal Transit Authority (FTA) policy that became effective April 8, 2001 states that "ITS projects shall conform to the National ITS Architecture and standards." Conformance means "using the National ITS Architecture to develop a regional architecture, and the subsequent adherence of all ITS projects to that regional ITS architecture."

There are a number of elements that should be included in any regional ITS architecture. First, it should contain a description of the region. Second, participating agencies and other stakeholder groups should be identified. Third, the operational concept should be identified including the roles and responsibilities of participating agencies. Fourth, there should be agreement among agencies on operational elements such as interoperability and standards. Fifth, the system functional requirements should be outlined. Sixth, the interface requirements and information exchanges with the existing and the planned system should be identified. Finally, the sequence of projects required for implementation should be provided.

The development of a regional ITS architecture should be consistent with processes for statewide and metropolitan transportation planning. The process requires both technical and institutional integration. The development of a regional ITS architecture is potentially a useful mechanism for bringing together all operating agencies and entities.

Stakeholder involvement should focus on including all groups involved in surface transportation. Be inclusive, not exclusive and include ITMS dissenters in the process. Identify champions to lead the ITMS effort. There should be champions from each key agency or discipline. Also, think about minimizing new committees or meetings.

Outreach, education, and inreach are key parts of the consensus building process. These activities help agency personnel understand and buy into ITMS concepts and benefits. Efforts should focus on all levels of an organization, including senior management. Training courses, workshops, interviews, fact sheets, brochures, and other techniques may all be used. Human relations activities may include personal communications and other efforts. Approaches should be open and honest, respectful of individual agency missions and personnel, and flexible.

The development of formal written elements of ITMS should be undertaken in a well thought out and thorough manner. Public/private partnerships are also a key to ITMS. ITMS deployment and operations will likely involve private entities. The allocations of responsibilities and risks between public and private entities will be critical. Contracting and financing mechanisms and ownership issues will need to be addressed as part of the process.

I look forward to a productive discussion on institutional challenges, barriers, and opportunities in the breakout sessions. Thank you.

Planning and Designing ITMS: Technical Integration

Jim Kerr
NET Corporation

I would like to focus my comments on the strategies that can be used to successfully design and implement ITMS. Initially, ITMS focused primarily on integrating freeway management and traffic management systems. The ITMS concept has expanded over the years. Today, we think of ITMS in the "all modes/all roads" context. Obviously, this approach is more complex, with more technical and institutional issues to be addressed.

My comments will focus on activities related to designing and implementing ITMS. Major

elements of the process include the scoping phase, the deployment planning phase, the design phase, and the implementation phase. More detailed information on the activities associated with each of these phases is provided in the white paper.

The scoping phase focuses on identifying how and where ITMS fits into the overall regional ITS integration effort. Four general scenarios are likely for ITMS efforts. These four scenarios are the development of a single stand alone project, the development of an incremental element of a larger ITS vision, the development of an overall architecture with the implementation of an initial project, and ITMS as one part of a comprehensive intermodal, inter-jurisdictional ITS system.

The *Showcase* project in southern California is used in the paper to illustrate one example of the third approach to designing and implementing ITMS. This project focuses on the development of an overall architecture with a limited initial deployment. *Showcase* can be thought of as the "enabler" for ITS in southern California. It focuses on designing and developing areawide integration technologies with intermodal management and information systems. The *Showcase* vison is to integrate all modes and roads into a "system of systems" that continually improves regional mobility. The foundation relies on the National Architecture, the center-to-center (C2C) standards, and peer-to-peer relationships between centers.

The first question that had to be addressed was how the *Showcase* project fit into the local institutional, planning, and operating setting. The conceptual model developed for the project associates the time frame of deployment on the x axis, with location of deployment on the y axis, and the technology component on the z axis. This conceptual model helped show how the project fit into other activities underway in the area.

Showcase concentrates on the first five years of deployment, with a focus on center-to-center integration. It was anticipated that the four regional ITS strategic plans would use the *Showcase* architecture, would continue to build the ITS infrastructure, and would move toward more complex integration activities.

Developing a clear vision of the project deployment is a critical first step in the deployment planning process. In the case of the *Showcase* project, we started by defining the key elements to be integrated. The first step was to link the existing traffic and transit operations centers together in an integrated environment. This approach represented a relatively non-threatening application for the local agencies, allowing a focus on the technical aspects of integration.

A number of approaches or processes may be used in the design stage. One common approach is the more traditional "waterfall" method that starts with user requirements and ends with final system implementation. Other steps in the process include developing system requirements, system architecture, detailed design, implementation, integration, and operations/maintenance.

Another approach is the spiral model, which assumes that requirements and technologies are constantly changing. The spiral model focuses on completing just enough of the requirements definition and the design to develop the first

application. Once that application is implemented and tested, further requirement definition and design is completed based on the experience of the first system.

Both approaches have advantages and disadvantages and each area should determine the design process they are most comfortable using. Regardless of the approach, a number of important design considerations should be addressed. These considerations include performance requirements relating to device control, data exchange, display requirements, fail-over requirements, technology specific throughputs, and deterministic/non-deterministic requirements. Maintainability is also a critical consideration.

There are a number of elements that are available to help move existing infrastructure and traffic management centers toward an integrated vision. The National Architecture provides a good basis for starting an integration process. Second, available standards such as the center-to-center standards, can be used. A range of implementation strategies can be developed to allow agencies to move slowly into integrated approaches.

In conclusion, it is important to first identify how the project fits into the overall ITS integration effort. Second, it is critical to have a clear vision for the development process. Third, areas should use the design process they feel most comfortable with. The technical and institutional issues associated with planning and designing ITMS can be addressed through an open and well thought out process.

Operational Programs, Strategic Plans, and Support Services: Procedural Integration

Wayne Berman
Federal Highway Administration

It is a pleasure to have the opportunity to talk about planning for operations at this conference. I think most people would agree that the goal of operations is to make the elements of the surface transportation system work better and work together. While it is important that the individual elements work well, it is even more important that they work together.

In planning for operations, it is important to ask the basic questions of what, why, who, and how. It is also critical to identify potential challenges, barriers, and issues, as well as opportunities and enablers.

Planning for operation is strategic thinking to shape, develop, manage, and evolve policies, programs, procedures, protocols, and projects to make the elements of the transportation system work better individually and together.

There are a number of guiding principles related to operations. First, it is based upon collaboration. Second, it is visionary, strategic, and continuous. Third, it ranges from solving problems to continuously improving performance. Fourth, it is based on meeting customer service and performance demands. Fifth, it accounts for policies and protocols. Finally, it distinguishes between operations and optional improvements.

Planning for operations is important for a number of reasons. There is a need to fully realize the benefits of complex and sophisticated ITS. There is a need to recognize strategic needs of operations. We can no longer just “set and

forget." Integration does not just happen, it must be planned. We have shown that it works well for special events, emergencies, reconstruction, and other activities. There is also a need to match resources to meet future investment capabilities.

While planning for operations should be part of the traditional "3C" planning process, it should be more than that. In a regional context it should include MPOs, regional transportation agencies, regional operating organizations, states, cities, counties, and transit agencies.

There are a few elements to consider in planning for operations. The methodology of the ITS National Architecture should be applied to help achieve collaboration and information sharing. The principles of asset management should be used to help achieve a strategic life-cycle approach. Performance measures should be applied to help achieve better customer service.

When planning for operations is done well, system management and operations strategies will influence decisions. A broader range of stakeholders will be at the table. Planning will consider the evolution and growth of better operations. Performance measures and life-cycle analysis will be aligned with the improvement program.

Planning for operations should also help reduce maintenance costs, result in more effective use of resources, align investments with resource allocation needs, and improve information sharing leading to system integration. Customer service needs are planned for rather than reacted to. There are greater levels of acceptability and accountability for performance measures.

There are a number of potential challenges and barriers to planning for operations. First, planning is often stuck in a project-based culture. Second, planning for operations is generally problem focused, reactionary, and ad hoc. Third, planning constituencies are different than operations constituencies. Fourth, fragmented ownership of systems can be problematic.

There are other possible issues and concerns with planning for operations. For example, operations personnel do not routinely talk with operations personnel from other agencies and operations personnel do not generally talk with planners. A forum for collaborating on operations is not the routine in most areas. Analysis tools are not available to help in the operations planning process. We should learn from the planning efforts undertaken for special events, emergencies, and other major activities.

There are numerous opportunities and enablers to help advance planning for operations. These include leadership, issues or threats, special events, public safety, traveler information, freight, economic development, access to jobs, funding needs, and major projects.

In closing, I think we have progressed to a point where operations is now a science – not just a tool. Operations is strategic thinking – not just problem solving. Better, more integrated operations demand better planning.

Thank you.

Plenary Session – Optimizing Performance: Managing and Operating ITMS

Tom Urbanik, University of Tennessee – Presiding

Les Kelman, Tom Urbanik, Vince Pearce, and Walter Kraft

Managing and Operating ITMS: Policies, Procedures, Funding, and Staffing Issues

Walter Kraft
PB Farradyne

It is a pleasure to talk about managing and operating ITMS. There has been a significant focus on management and operations over the past five years. I will focus my comments on defining the management and operations concept, and discussing related policies, procedures, funding, and staffing issues. More information on this topic is provided in the white paper.

The management and operations concept has been evolving over the past few years. A key element of this process was the change in terminology from operations and management to management and operations. It is important to understand the difference in these two approaches. Management relates to the allocation of resources. Operations relates to actions for proper functioning of the transportation system.

It is interesting to note that transportation comprises a larger percentage of household spending in some metropolitan areas than housing. This situation may result from people moving further out to avoid congestion and to obtain lower housing costs. I would suggest that this trend is not good and that it needs to be examined in more detail.

I would like to focus on the four basic management and operation elements of policies, procedures, funding, and staffing. Policies define the public interest and expectations. Policies can be further subdivided into partnerships and standards. Effective management and operations requires all types of partnerships. Public/public, public/private, and other partnerships are all needed to help advance management and operations.

Standards are needed to provide a common base for management and operations and to foster further systems integration. Developing standards takes time, but the investment is worth it. Issues that need to be addressed are who should be involved in standard development, who should be responsible for maintaining standards, what techniques can be used to help migrate from legacy standards to new standards, what are appropriate roles for federal agencies, and who makes the final decisions.

I have separated procedures into the two subcategories of general and specific. General procedures can be established to guide inter-jurisdictional committees, inter-agency

agreements, operating procedures, data collection and evaluation methods, and publicizing the benefits. Specific procedures may be needed for individual projects such as ramp closings, quick clearance, and pre-trip information.

Interagency agreements may take different forms. Agreements may be informal or formal. Informal understandings may be developed among staff at various agencies. Formal memorandums of understanding or contracts among agencies are often used. Formal documents usually take longer to develop and obtain agreement on. Formal agreements usually outline the roles and responsibilities of the different agencies. Informal agreements may work well, but staff turnover may cause problems in maintaining long-term relationships.

Regardless of the type of agreement, it is important to start early and to be inclusive rather than exclusive. Providing information to all groups on an ongoing basis is also a key element of good agreements. There is also a need to better document and publicize the benefits of management and operations.

Staffing for management and operations is a critical concern. Issues related to staffing include hiring, retaining, and cross training. Outsourcing to private firms or doing work in-house is an issue in many areas. There is a need to examine why people work for governmental agencies, possible outsourcing of some functions, and identifying personnel for cross training.

You will have the opportunity in the breakout sessions to discuss the issues identified in the white paper. The four issue areas of policies, procedures, funding, and staffing provide a focus for the management and operations breakout session.

In conclusion, there are many issues associated with advancing the management and operations concept. I think management and operations will be a major focus of transportation professionals as we continue to try to improve the transportation system.

We need to continue to work together to make management and operations work. We need to coordinate within and among agencies. I think we have a great start on advancing management and operations, but we have a long way to go to fully realize the benefits from management and operations.

Traffic Management Strategies and Operational Plans

Les Kelman
City of Toronto

It is a pleasure to talk about traffic management strategies and operational plans this morning. The white paper provides more detailed information, as well as examples from Toronto.

How do you respond when someone asks what you do at the office? Do you tell them you have a desk, a computer, a pencil, and a telephone or do you tell them the types of projects and activities you are working on? The same question can be asked with ITMS. Too often our response is that we have 46 closed circuit television cameras, 200 miles of fiber cable, and 18 changeable message signs, rather than what we do with these system elements. Another example might be a response that we have 1,850 traffic signals under system control.

What we do not say is that they are all fixed-time based on an eight- year old signal-timing plan.

Too often ITMS is described as technologies and component parts rather than focusing on what these elements do and how they are used. We are all guilty of this approach at times. There is a need to reorient our focus on the use and the benefits of ITMS.

We are all well aware of the transportation problems in urban areas. These problems include increasing demands on the transportation system and limited ability to expand the productivity of the system.

Demands are increasing from all user groups – general traffic, goods movement, transit, pedestrians, and cyclists. Further, not all of these groups are willing or able to share roadway space. At the same time, there are increased activity demands on the transportation system. These demands include construction and maintenance activities, special events, film industry activities, telecommunication industry activities, and emergency situations.

These concerns have focused attention on ways to better share space and time to improve productivity and safety. Traffic management strategies and operational plans have been developed to respond to these issues. Many of these approaches involve space or time allocation trade-offs.

Examples of space allocation trade-offs include HOV or bus lanes versus curb parking, bike lanes versus general traffic lanes, and sidewalk width versus road width. Examples of time allocation trade-offs include mainstream traffic versus pedestrian crossings, transit priority versus pedestrian delay at traffic signals, and road occupation for non-traffic purposes.

Traffic management strategies may be developed for many situations. For example, in Toronto we have traffic management plans for construction, filming activities, incident response, telecommunication industry efforts, and emergencies. We have operational plans for special events such as the Molson Indy Road Race, the Ride for Heart bicycle event, marathons, and Caribana.

A number of basic elements should be included in any traffic management strategy or plan. The basic steps should include information input, information processing, decision making, information output, and a performance assessment feed back loop. Traffic volumes and patterns represent a data input commonly used with traffic management plans. Integration issues associated with traffic volume data may include identifying all data sources available through the city, province, transit agency, and private groups; data sharing and data fusion; and establishing and maintaining a city-wide traffic volume data bank.

Potential data processing and decision making issues include multiple control centers, multiple command posts, and multiple dispatchers. Associated integration issues include control center operational protocols, shared data presentation and mapping, and shared operational plans. Techniques that may be used to disseminate information include telephones, Internet sites, media releases, and radio and television coverage. A key integration issue is agreeing on a single source of information dissemination to ensure consistency.

The performance assessment feedback loop is essential to build ongoing credibility for traffic management strategies and operational plans. The results of the performance assessment provide valuable information for agency staff, policy makers, and the public.

In summary, traffic management strategies and operational plans should focus on defining the problem, identifying appropriate response strategies and plans, developing integration and synergy among agencies and groups, and applying the appropriate technologies. It should not focus on technology in search of problems.

There is also a need to develop realistic public expectations. It may not be possible to eliminate all disruptions from a special event or other activity, or even to have minimum disruptions. It is possible, however, to have managed disruptions due to well-developed traffic management strategies and operational plans.

Monitoring and Evaluating Performance: Programs, Methodologies, and Measures

Vince Pearce
Federal Highway Administration

It is an honor to present the white paper on performance measurement and ITMS authored by John Wolf of the California Department of Transportation (Caltrans). John did an excellent job providing a traffic operations perspective on performance measures. He also prepared the slides and the notes for this presentation.

The first point John makes in the paper is that system management and performance are inseparable. Although measuring the performance of the highway system has always been important, the Intermodal Surface Transportation Efficiency Act (ISTEA), the California Transportation Plan of 1993, and Senate Bill 45 gave added importance to performance measurement in California.

The purpose of performance management is to establish a coordinated and cooperative process for consistent performance measurement throughout California. The focus is on developing indicators and measures to assess the performance of California's multi-modal transportation system to support informed transportation decisions by public officials, operators, service providers, and system users.

Four goals of performance management in California can be highlighted. The first goal is to understand the role the transportation system plays in society. The second goal is to focus on outcomes at the system level rather than on projects and processes. The third goal is to build transportation system relationships with clearly defined roles, adequate communication channels, and accountability at all levels. The fourth goal is to better illuminate and integrate transportation system impacts of non-transportation elements.

Developing performance measurement criteria or indicators is not an easy process. Indicators must be easy to use and simple to understand. Indicators must be measurable across all modes. Indicators must use existing data sources and conform to existing performance activities wherever and whenever possible.

It is important to present a realistic picture of performance measures. Performance monitoring is not a panacea, nor is it an isolated exercise. Further, performance monitoring does not usurp

the roles and responsibilities of the various agencies.

The Caltrans Traffic Operations Program developed a strategic plan in 1999, which embraced a performance-based transportation planning approach. The strategic plan, *Managing for Safety and Mobility*, appeared in the National Cooperative Highway Research Program (NCHRP) Report 446. The plan identified the need for multi-jurisdictional relationships similar to those used during the Los Angeles Olympics.

The plan also focused on the integration and coordination of various functions within the Department. The strategic plan represents the beginning of a process to institutionalize a system management approach to operations that is integrated across all functions. Caltrans is developing a Systems Management Strategy, called TOPS, based on system monitoring and evaluation. The strategy focuses on keeping the system in balance by management, operations, and adding capacity.

The results from performance monitoring can be used in a number of ways. Performance monitoring drives performance reporting, but it is also used for real-time operations and for planning system improvements. Performance monitoring can help integrated planning and operations. The results from the performance monitoring system can be used in analyzing current trends and in forecasting future trends.

The experience in California indicates a number of important points. First, the availability of accurate data is critical for performance monitoring. Second, integration across jurisdictional boundaries is challenging, but necessary. Third, performance measures must be tailored to the individual modes. Fourth, it is difficult to define broader societal goals in easily measured terms. Fifth, there is a great deal of difference between regions and been states. Finally, travelers are savvy, and we must continue to look for new ways to provide traveler information and services.

Finally, the California experience indicates that we cannot truly manage even a sub-system, such as a freeway, without integrating to a broader system level. It also suggests that we cannot manage and operate at a highly integrated systems level without a common performance language.

Plenary Session – Initiatives Identified to Overcome Gaps in Practice and Improve the State-of-the-Art: Summary of Break out Session Results

Jon Obenberger, Federal Highway Administration – Presiding

Les Jacobson, Larry Head, Alan Clelland, Jon Obenberger, Darcy Bullock, Ron Sonntag, and John Collura

Institutional Challenges, Barriers, and Opportunities: Institutional Integration

White Paper Author: Lou Neudorff, Seimens-Gardener Transportation Systems
Facilitator: Ron Sonntag, Marquette University
Recorder: Tip Franklin, Lockhead Martin
Note Taker: Lap Hoang, Florida Department of Transportation

The two breakout groups discussed the institutional challenges, barriers, and opportunities associated with developing, deploying, and operating ITMS. There was general agreement that the institutional issues associated with ITMS are frequently more difficult to address than the technical issues.

There was also a general consensus that most of the institutional issues identified were not new. Further, many are not unique to just ITMS. Institutional issues are likely to occur with any project involving more than one agency or jurisdiction. The multimodal, multi-jurisdictional, and multi-agency nature of ITMS increases the potential for possible institution conflicts.

The turnover in personnel at many agencies and organizations was identified as a contributing factor to some institutional issues. Changes in personnel often result in loss of momentum, the loss of institutional memory, and the need to reestablish relationships. Finally, participants agreed that there was a need for persistence in addressing institutional concerns.

Issues

- Human Relations. There are different perspectives among agencies, agency personnel, policy makers, and transportation professionals. There are differences among missions, goals, and objectives of the various agencies and groups involved in ITMS. In some cases, groups may be uncertain of the potential benefits of ITMS. Finally, changing personnel at agencies can cause loss of momentum and institutional memory. Turnover in personnel may also require re-establishing inter-agency relationships.

- Stakeholder Involvement. Often there is no up-front agreement on system needs and requirements. There is frequently a lack of

understanding of the resources and requirements needed to implement an ITS architecture.

- Institutional Inertia – Moving Projects from Construction to Operations. It is difficult to overcome the traditional mindset in many transportation agencies focusing on construction. There is a need to move toward an operations mindset within these agencies.

- Agency Operating Cultures. The operating cultures and philosophies are different among the various transportation and emergency agencies.

- Regionalization Issues. There is a need to realize that operations extends beyond agency boundaries. Further, possible duplication of services may be an issue in some areas.

- Strategic Planning Process for ITS. Operations, especially ITS operations, are usually not considered in the regional transportation planning process.

- Performance Measures Acceptance. Frequently there are no commonly agreed upon performance measures among agencies or at a regional level.

- Rethinking the Core Mission of Departments of Transportation. There is a need to recognize the importance of operations as the core mission of state and local transportation agencies.

Research Initiatives

- Stakeholder Involvement. Information and briefing materials on ITMS should be developed and distributed. These briefing materials would be of use to transportation professionals for presentations to the public and to elected officials. A related research project should develop guidance and tools to help transportation professionals understand and relate to elected officials and the political process.

- Institutional Inertia. Case studies of good examples addressing institutional issues with ITMS should be developed and distributed. Techniques that have worked with other ITS and transportation projects should be researched and included in the case study report.

- Rethinking the Core Mission of Departments of Transportation. There is a need for research on how to help facilitate a change in thinking from a focus on construction to a focus on operations at state departments of transportation. Case studies examining good examples of organizational change should be included in the study. Using the budgetary process to encourage this change to operations should be explored. Outreach is needed to obtain support from non-transportation organizations, such as the American Public Works Association, the National Association of County Engineers, and the National League of Cities. There is a need to support the AASHTO Organization Redefinition Study.

- Agency Operating Cultures. A synthesis of successful and unsuccessful practices related

to cross-agency coordination activities should be developed and distributed. Research identifying cultural differences among agencies and organizations and ways to bridge these differences should be part of this study.

- Regionalization Issues. Case studies documenting successes and failures relating to dealing with institutional issues on a regional basis should be developed and distributed.

- Strategic Planning Process for ITS. Case studies of good examples of ITS strategic plans, the process used to develop these plans, and how these plans have helped address institutional issues should be developed and distributed. This project should include research exploring alternative roles for MPOs. It should also identify possible techniques for using linkages to resource allocation documents, such as Transportation Improvement Plans (TIPs), to address institutional concerns.

- Performance Measures. Research should be conducted to identify and recommend a standard set of performance measures for ITMS. These measures should include system-wide and multi-level criteria that focus on the full system, subsystems, and tasks.

Strategies to Plan and Design for ITMS: Technical Integration

White Paper Author: Jim Kerr, NET
Facilitator: Alan Clelland, Siemens-Gardner Transportation Systems
Recorder: Phil Masters, NET
Note Taker: Mo Zarean, SAIC

These two breakout sessions focused on technical integration issues and opportunities associated with ITMS. There was a general consensus among participants on the major issue areas related to technical integration. There was also general agreement that these issues had significant scope for research initiatives.

The groups identified the link between institutional and technical issues, noting that institutional concerns frequently influence the technical elements of a project. The systems engineering process was identified as the key technical issue, education and training was identified as an ongoing concern, and intra-agency groups was noted as an emerging issue.

Issues

- Systems Engineering Model. Many transportation professionals are not aware of the systems engineering model. This approach has not be used extensively in transportation.

- Interoperability. Interoperability with ITMS is critical. Numerous technical and institutional issues must be addressed in the planning and design stages to ensure interoperability.

- Planning for Deployment. Numerous planning approaches may be used for

deploying ITMS. While each area should use a process that best matches the needs and institutional arrangements in the region, there are some basic elements that should be included in any planning effort.

- System Architecture. Developing a system architecture is a difficult process. The National ITS Architecture and standards provide a starting point.

- Intra-Agency Groups. The involvement of all appropriate agencies and groups is key to planning and designing ITMS. Multi-agency teams, coordinating groups, and technical working committees can all be used to help plan and design ITMS.
- Security. There are a number of security issues related to technical integration. Most of the concerns revolve around ensuring that the system is secure from non-authorized users.

- Education. Education and outreach activities are needed in planning and designing for ITMS. Different efforts should focus on policy and decision making groups, top agency personnel, agency technical staff, and the public.

- Programming. Programming knowledge and skills are critical to technical integration. Many agencies may not have individuals with expertise in these areas. Options for obtaining the needed skills include hiring new staff, contracting out, and sharing staff resources among agencies.

Research Initiatives

- Use of the Systems Engineering Model. Research is needed to develop tools and techniques for applying the system engineering approach to ITMS. This research should include how systems engineering can be scaled for smaller projects. Research is also needed to develop guidance on contracting methods to support the system engineering approach. This project should further develop guidance on the use of modeling for ITMS.

- Interoperability. Research is needed to develop a framework for interoperability. A first step in this effort would be to develop a standard definition for interoperability. It should also examine the use of Common Objective Request Broker Architecture (CORBA) and DATa EXchange (DATEX) with ITMS.

- Planning for Development. A number of research initiatives were identified relating to planning for ITMS development. These issues could be addressed in one large research project or a series of smaller initiatives.

  Develop and distribute an inventory of all existing "theory of operations" documents. Document the lessons learned and experiences from previous efforts with different contracting methods. Research management structures and identify those that maximize project and planning authority and accountability. Develop guidelines for project planning, that include integration and operations.

Develop cost benefit analysis tools and methods. Identify techniques to reduce deployment risk, including prototyping and proof-of-concept. Document case studies and lessons learned from previous efforts, identify the pitfalls and opportunities with various approaches.

Examine techniques to sustain ITMS through configuration management. Identify techniques to consider system operation in the design process. Identify methods to manage expectations.

- System Architecture Development. Develop and provide guidance on how to translate Strategic Plans/Early Deployment Plans (SP/EDP) into design guidelines. Develop and provide guidance on defining physical architecture from the logical architecture, which is the output of the National ITS Architecture. Develop and provide guidance on how to include requirements for system architecture-based standards in requests for proposals (RFPs). Develop and provide guidance for defining communication interfaces for new and legacy systems (systems of systems). Develop and provide guidance on designing an architecture that ensures sustainability and migration strategies.

- Intra-Agency Groups. Research enterprise WAN's and their application to ITMS. Identify education topics for information technology (IT) group. Identify techniques to embrace IT group and get them appropriately involved in ITMS. Examine methods to resolve IT product-based approach versus ITMS System Engineering approach.

- Security. Research possible procedures for identifying risks, including threat analysis and appropriate level of defense. Document and distribute case study examples addressing security concerns in planning and designing ITMS. Examine lessons that can be learned from other fields and applied to ITMS security issues.

- Education. Develop and provide education and training in the basics of ITMS to improve base-level knowledge, including integration issues, for transportation professionals. Develop and provide guidance on the knowledge level required for various staff positions and levels.

- Programming. Research and document ITMS benefits as an input to programming.

Operational Programs, Strategic Plans, and Support Services: Procedural Integration

White Paper Author: Wayne Berman, Federal Highway Administration
Facilitator: Les Jacobson, PB Farradyne
Recorder: Ed Roberts, New York Department of Transportation
Note Taker: Robert Bruce, EIS, Inc.

These two breakout sessions focused on the procedural integration issues. These issues included operational programs, strategic plans, and support services. Twelve general issue areas were identified by participants, along with research initiatives to help address these concerns.

The groups discussed activities currently underway that may help address many of these issues. These activities include the development

of the National ITS Architecture and standards, the Traffic Management Center Pooled-Fund Study, and the National Dialog on Operations. There was agreement that the results from this conference should be used to build on and enhance these activities. The need to agree on common terminology and to sustain collaboration were also discussed.

Issues

- Lack of Understanding of Integration. There is often a lack of understanding – both internally within an agency and externally with the public, decision-makers, media – concerning what integration is and what it is not.

- Lack of Communication Among Agencies. Most areas do not have logical forums for collaboration among agencies, especially related to operations and ITMS.
- Staffing Issues. Personnel concerns include a lack of trained staff, personnel turnover, training and cross training staff, and building internal expertise versus using consultants and contractors.

- Lack of Common, Measurable Goals. Most areas have not established common goals, objectives, and measures of effectiveness for ITMS, ITS, or operations.

- Need for Project Champions. Project champions for ITMS are often missing within agencies. Project champions with the authority, responsibility, credibility, and ability to influence decisions are needed within multiple agencies and organizations.

- Need to Share Successful Practices. Documentation of successful practices and case study examples is often missing.

- Lack of Understanding of Benefits. The possible benefits of ITMS are not well understood in many areas. The lack of evaluations and documentation of benefits is a concern.

- Lack of Analysis Tools. There are few analysis tools and techniques to help with ITMS planning.

- Need Improved Training and Education. A wide range of training and education on ITMS, ITS, and operations is needed at all levels.

- Funding Programs Do Not Support Integration. Existing programs and mechanisms at the federal, state, and local levels are not geared toward integration projects.

- Lack of Agreement on Concept of Operations. There is not a common definition of operations or a shared vision of management and operations in most areas and at the national level.

- Agencies not Committed to Integration and Operation. In many areas not all agencies are committed to focusing on operations.

Research Initiatives

- Outreach and Inreach. Research is needed examining good examples of operational programs and strategic plans. Case studies,

syntheses, and guidance should be developed and distributed.

- Analysis Tools. Research is needed to develop appropriate analysis and planning tools and techniques for ITMS. These planning techniques should be provided to technical personal through conferences, training sessions, CD ROMs, reports, and other techniques.

- Regional Structures. Research is needed examining the influence of different regional structures on operations and ITMS planning. Good case study examples of successful planning processes in different regional settings and with different regional institutional arrangements should be developed and distributed.

- Program Structures. Research is needed examining the different program structures that can be used with ITMS. Case study examples of successful programs structures should be developed and distributed.

- Establish a National Peer Network. As part of the outreach effort, a national peer network on ITMS should be established and maintained. This peer network would help facilitate the sharing of information, the distribution of reports, and the ongoing identification of key issues and concerns.

- Staffing. Research should be conducted on the staffing, training, and educational needs associated with ITMS procedural integration. Appropriate courses and training material should be developed. Research is also needed to identify the skills sets needed by personnel at different levels.

- Successful Operational Planning. Research is needed examining and documenting good case study examples of successful operational and ITMS planning efforts.

- National Recognition Program. Consideration should be given to establishing a program on a national level to recognize good examples of procedural integration. This program could be developed and maintained through an existing agency or organization.

- Quantify Benefits of Integration. Research is needed to analyze the benefits from integration and ITMS. The results of this assessment and case study examples of benefits should be documented and distributed.

- Impacts and Mitigation Techniques of Integration Activities. Research is needed to examine the potential impacts of integration efforts, and the mitigation technique that can be used to overcome these issues.

- University Curriculum. The results of the research projects described above should be used to develop and distribute course materials on ITMS procedural integration for undergraduate and graduate students.

Managing and Operating ITMS: Policies, Procedures, Funding, and Staffing Issues

White Paper Author: Walter Kraft, PB Farradyne

Facilitator: John Collura, Virginia Tech University

Recorder: Bill Stoeckert, Connecticut Department of Transportation

Note Taker: Ray Martinez, TRANSCOR

These two breakout groups discussed policy, procedural, funding, and staffing issues associated with managing and operating ITMS. The groups also discussed the relationship of these topics to other issues associated with ITMS.

There was agreement that these four general topic areas are critical to ITMS. There was further agreement on the major issues and research initiatives associated with each of these topics.

Issues

- Policies. Policies are needed on a number of topics associated with managing and operating ITMS. Policies are needed related to standards, strategic operation planning, procurement, partnerships, operations (i.e., for ramp metering and traffic signals), and land use and planning.

- Procedures. Common management and operations procedures are needed within a region and on a statewide and national basis. For example, common procedures are needed for closing one-way ramps, quick clearance, and pre-trip information. There is also a need to document these procedures in operating manuals and publicizing the benefits of common procedures. Inter-jurisdictional committees, inter-agency agreements, and internal agreements can all be used to help facilitate the development and use of common procedures.

- Funding. Numerous funding and financing issues were identified. These included identifying management and operations costs, life-cycle costs, and system replacement costs. The need to focus federal, state, and local funding on operations was also identified.

- Staffing. Three major issues related to staffing for ITMS were identified and discussed. These concerns were hiring and retraining personnel, the use of internal staff versus consultants or contractors, and the need for cross-training of personnel.

Research Initiatives

- Policies. Research is needed identifying the policies needed to support all phases of planning, designing, deploying, and operating ITMS. This research should include documenting case study examples of existing policies, as well as model policies that could be adapted to the needs of individual areas.

- Procedures. Research is needed to identify the management and operations procedures needed with ITMS. This research should include case study examples of common procedures, manuals, and inter-agency and inter-jurisdictional agreements. It should also include examples of general procedures, manuals, and agreements that can be modified and adopted for use in individual regions. The results of this research should be documented and distributed.

- Cost of Management and Operations. Research is needed to analyze the cost of different approaches to management and operations. This assessment should include examining the size and nature of different systems and how to improve operator productivity and effectiveness.

- Education and Training. Research is needed to examine the education needs and requirements for ITMS operators, including the development of job specifications.

- Best Practices for Partnership Agreements. Research is needed to examine alternative multi-agency and public/private partnership agreements with ITMS projects. The results of this analysis should be documented and distributed.

Traffic Management Strategies and Operational Plans

White Paper Author: Les Kelman, City of Toronto
Facilitator: Larry Head, Seimens-Gardner Transportation Systems
Recorder: Walter Dunn, Dunn & Associates
Note Taker: Bob Sheehan, ITS America

These two breakout groups discussed traffic management strategies and operational plans. The groups identified a number of common issues and research initiatives to help address these concerns.

A number of strategies for dealing with the identified issues were also discussed. These strategies included space allocation, such as alternative use of lanes for bus and parking, and time allocation, such as pedestrian and transit priority at certain times of the day. Pricing strategies were also identified as potential approaches. The need for advanced operations plans for special events, parades, filming, and construction activities was discussed. The differences and similarities among applications for freeways and urban arterials were identified.

There was agreement that performance assessment, with continuous improvement process and feedback loops were important. Sharing information and applying lessons learned from other locations, education and outreach activities, and developing and maintaining partnership with the media were also identified as important elements.

Issues

- ITMS Concepts versus "What They Do." Many agencies have trouble focusing on what equipment and techniques can do rather than just on the equipment itself.

- User Demands. Different user groups place different demands on the transportation system. The demands of the various groups are not all well known.

- Activity Demands. Different types of activities place different demands on the transportation system. These demands are often not known or well understood.

- Public Expectations. Little is known about what the traveling public really wants or expects related to operations, especially in the case of special events or activities.

- Funding. An issue in most areas is who pays for the management activities associated with

special events and activities. The ability to charge event or activity organizers is of interest to many public agencies.

- Lack of Organizational Structure in Many Areas. Most regions are not organized to deal with operations. In some cases there may be a need to formalize existing informal processes, to develop an operations process similar to the construction process, or to develop some other organizational structure to facilitate operations. It is also important for agencies to realize they are part of a larger regional system.

- Lack of Benchmarking of Impacts and Benefits. Information on the impacts and benefits of traffic management strategies is not available in many areas.

- Lack of Operations Mentality within the Budget and Policy Processes. Few areas have incorporated operations into the budgeting or the policy processes.

- Focus on Demand Side Not just Supply Side. Currently, most areas focus on the supply side of addressing operational issues. Influencing the demand side should also be explored.

- Staffing Limitations. Having adequate personnel – both in number and in capabilities – is often a problem in dealing with traffic management and operational strategies, especially with events and activities.

- Leverage Private Sector Capabilities. The ability and capability to involve private sector resources and personnel is an issue in many areas.

- Data Gathering Requirements for Shared Use. Few areas have established requirements or processes to share data and information among agencies. The sharing of information is critical to successful integration operations.

- Conflicting Technical and Political Goals. There may be conflicting goals between the technical level and the policy level.

- Productivity Rather than Capacity. Too often the focus is on capacity, which the public and policy makers do not understand, rather than on the productivity of the transportation system.

- Lack of Educating, Informing, and Communicating with Customers and Motorists. Many areas do not do a good job of providing information to the public.

Research Initiatives

- Market Research on Strategies to Influence Travel Demand. Market research is needed on strategies that influence travel demand. This research should examine the factors that influence travel decisions as well as possible strategies and techniques to alter travel behavior. Specific applied research and demonstration projects should be initiated based on the market research results. A best practice synthesis should also be developed highlighting examples of successful strategies to influence travel behavior.

- Arterial Incident Detection and Management. Research is needed on techniques, strategies, and technologies that can be used for incident detection and management on arterial streets. While research has focused on this area, much more needs to be done, especially given recent advancements in technology. This research should include the development and testing of new technologies and approaches, developing measures of effectiveness and evaluating the demonstrations and existing projects, summarizing best practice examples of current projects, and identifying promising strategies for future tests.

- Assessment of the Success of the Rational Architecture Process and the Regional Architecture Process in Accomplishing Integrated Systems. Research is needed examining the use of the rational architecture process and the regional architecture process with ITMS.

- Development of Incentives for Integration. Research is needed examining the potential use of incentives for integrating operations and ITMS. Examples of potential incentives include additional federal or state funding, higher project priority at the regional level, and higher levels of funding for operations.

- Risks and Liabilities of ITMS. Research is needed exploring the risks and the liabilities associated with ITMS. Examples of how these concerns have been or could be addressed should be included in this project, along with case study examples.

- Identify and Develop Disruption Management Tools. Research is needed to explore the use of disruption management tools with operations. This research should examine available tools and identify possible enhancements for application with ITMS.

Monitoring and Evaluating Performance: Programs, Methodologies, and Measures

White Paper Author: John Wolf, California Department of Transportation
Facilitator: Darcy Bullock, Purdue University
Recorder: Paul Olson, Federal Highway Administration
Note Taker: Kevin Balke, Texas Transportation Institute

These two groups discussed programs, methodologies, and measures for monitoring and evaluating ITMS. There was general agreement among participants that performance measures are essential and that monitoring and evaluating ITMS should be an ongoing process.

The groups also felt that the goals of performance measures are usually not clearly defined. The need to develop an appropriate balance between analytical and qualitative measure of effectiveness was also discussed. The use of different definitions for basic data elements, like incidents stop and start times, was discussed. There was general agreement that a common set of definitions and performance measures should be developed.

Issues

- Perception of System Operation. Different users may perceive different needs for system performance measures, implying different interpretations of the same measure. Some

type of formalized feedback mechanism to operators is needed.

- Relationship to Economy and Society. Performance measures should link to higher level goals for the area.
- Data Quality. Different users have different data quality requirements. For example, operations personnel may be able to tolerate lower quality data, while assessing the benefits of ITMS may require higher data quality. It is also not clear what is adequate resolution of data.
- Organizational Issues. Potential organizational issues related to data collection and information sharing include how frequently data collection and distribution should occur, who should have access to the information internally and externally, security concerns over who has access to what information, and transparency concerns.
- Data Quantity. ITMS generates a great deal of data, but data does not necessarily translate into information. A large amount of data maybe collected a few points, but not enough data may be collected throughout the system. The resources required to process voluminous data can often be great.

Research Initiatives

- Evaluation Guidance. Research is needed to develop and distribute guidance for establishing and maintaining an ITMS evaluation program. This guidance should include how to mainstream the process, (project planning process, agency level, institutionalize to be normal practice), how to use a separate and dedicated program (incremental improvement, program design), how to conduct periodic analysis (respond to ad hoc queries, timely reporting), and how to maintain independence and objectivity (third-party evaluators and qualified evaluators).
- Data Consistency Guidance. Research is needed to develop and distribute guidance on data consistency. This guidance should include precise definitions of data requirements. For example, different groups may define the start and the end of an incident differently. It should also outline national uniform data collection methods necessary for benchmarking operations between locations, uniform standard of accuracy, and uniform levels of detail. The project should examine the needed aggregation level (temporal and spatial) and how to collect all types of data, including information from police, fire, and emergency management agencies.
- Defining Customer Expectations. Research is needed to develop and distribute guidance on defining the customers for various types of information. This project should examine who the customer is and what they want. Possible customers might include planning staff, operations staff, travelers, transit operators, transit users, and policy makers. These groups probably have different information needs, level of detail, and data accuracy.
- Data Fusion. Research is needed examining data fusion issues. These issues include examining links between sources (i.e., police CAD, fire CAD, service patrol dispatch, etc.), how to take on a large project, and how to fuse data into information.

Closing Session – Opportunities to Advance the State-of-the-Practice with ITMS

Joe Stapleton, Georgia Department of Transportation – Presiding

Vince Pearce, Phil Tarnoff, Joe Stapleton, Frank Francois, and Jeff Lindley

Common ITMS Themes, Priorities, and Directions

Vince Pearce
Federal Highway Administration

I would like to highlight a few of the major themes, priorities, and directions that seemed to emerge from the discussions in the breakout sessions. There are a number of common elements that emerged from the breakout groups, speakers, and white papers.

First, there seems to be agreement that institutional issues represent one of our biggest challenges. Second, while we agree that operations needs to be a core mission, we also agree that it cannot stand alone. We need to work with other parts of our own agencies and with other agencies to be successful.

For the most part, we are still product- and project-focused. We need to shift to a management and operations focus. Staffing continues to be a major concern. Hiring, training, retaining, and retraining are all critical elements. Cooperation among agencies and within agencies is essential. Accurate data is also critical to advancing ITMS.

It takes a long time to achieve regional operations. We need to realize that success will not happen overnight. We need to establish responsibilities and accountability. Performance measures are one way to help establish agency responsibility and accountability. We need to manage the expectations of the public and policy makers. We need a perspective across modes and across the transportation network to deliver the mobility and service the public needs. We are also still talking within the profession – we need to outreach to other groups and agencies. Finally, most agree that performance measures are key to effective management and operations.

A number of common priorities emerged from the discussions. I have identified the following priorities that seem to reflect the comments in the breakout sessions. First, enabling current staff through the use of advanced technologies, tools, and training should be a priority. Second, developing partnerships, especially with planning departments and agencies, should be higher priority. Third, we need to focus more on the public and elected and appointed decision makers as our audience. Fourth, consistency is needed in terms of

common definitions, standards, and other elements.

Fifth, we need to do a better job of demonstrating and documenting the benefits of ITMS. Sixth, we need to continue to find and foster champions for ITMS and management and operations. Seventh, funding will always be a priority. We need to mainstream funding for ITMS. Finally, I think we all agree that there is a lot more we need to know on many topics and issues. Ongoing research is critical to helping answer these questions.

Finally, I would like to highlight a few common elements related to future directions. There seems to be agreement that we are moving toward mainstreaming ITMS. We have more people thinking about management and operations and there is a recognition that operations is essential. We need to continue to work to mainstream ITMS, however, and continue to promote management and operations. There is a greater realization that management and operations has to be considered on a regional basis. We are building the partnerships that are needed for integrated management and operations. Public/public, public/private, and private/private partnerships are all needed to advance an integrated approach. Finally, although we have more examples of integration, it is still not the norm in most areas.

In conclusion, I think most of us would agree that we are making progress in key areas. We still have a great deal to accomplish, however, before we have a truly integrated system.

National Dialog on Transportation Operations: Status Report and Future Directions

Frank Francois
Steering Committee Chair
National Dialog on Transportation Operations

Thank you. It is a pleasure to be with you to talk about the National Dialog on Transportation Operations and the National Steering Committee. My comments will focus on the background of the Committee and the Dialog, as well as the activities conducted to date.

The National Dialog on Transportation Operations was initiated by FHWA and ITE in 1999. The National Steering Committee was formed to help ensure that all groups and individuals with an interest in transportation at the national level were involved in the transportation operations dialog. The Committee is comprised of approximately 33 individuals, although the exact number varies. The focus and membership of the Committee reflects all modes, as well as public and private sector organizations. We are concerned about moving people and moving goods. We are also interested in the intermodal links between modes.

We are all well aware of the transportation problems in most urban areas. Between 1980 to 1990 vehicle miles of travel (VMT) increased by 72 percent, while road miles increased by only one percent. Some 46 percent of peak travel is now congested. Incidents and accidents further contribute to longer travel times and unreliable trips. Traffic congestion is on the radar screen of the American public.

FHWA conducted a national customer satisfaction survey in 2000. Comparing the results to those from a similar survey five years ago indicates the public perceives improvements in some areas. For example, public perception of visual appeal, bridge conditions, travel amenities, safety, and maintenance have improved. Traffic flow is at the same level as five years ago, however. Participants were also asked their opinion of how funding should be allocated for transportation improvements. Elements receiving the most support included resolving problems with traffic flow, improving safety, and enhancing work zone management. These elements were rated higher than projects to improve pavement conditions, bridges, and other infrastructure elements.

The Committee has conducted a number of activities over the past two years. The Committee sponsored a track on traffic operations at the April 2000 ITE meeting in Irvine, California. Six white papers were commissioned to help facilitate discussion at the conference. Topics addressed in the white papers included establishing the vision, building a constituency, developing benchmarks for system performance, identifying sources and levels of funding, facilitating institutional change, and setting a research agenda.

The next step undertaken by the Committee was to develop an Action Plan for the National Dialog. The action plan focuses on four major areas of outreach to other groups, operations programs, tools and applications, and a research agenda. The plan is available on the FHWA Internet site under the National Dialog on Transportation Operations. The Action Plan is constantly being updated.

The Committee also developed a vision statement, four goals, and 12 objectives to help guide its work. The vision the Committee developed is "managing and operating the existing transportation system so that its performance meets or exceeds customer expectation." The key word in the vision statement is customer; we are focusing on meeting the needs of the American public. Managing and operating also are key words.

The following four goals were identified to help measure performance toward accomplishing the vision. We will know we are successful when:

- customer surveys indicate consistently increasing satisfaction with the performance of the transportation system;

- the focus of decision makers and transportation agencies includes continuous performance based delivery of services in addition to implementation of individual projects;

- performance measures are in place that are understandable, measurable, and are used effectively in making decisions improving transportation systems performance; and

- managing and operating the transportation system are equal and integral parts of funding and staffing continuum that also includes planning, design, construction, and maintenance.

The Committee further developed 12 objectives. Many of these objectives address the elements discussed at this conference. The 12 objectives are:

- reduce congestion and improve safety on our area-wide metropolitan transportation systems and priority corridors;

- implementing and sustaining effective transportation operation centers;

- reducing delays and disruptions caused by incidents;

- minimizing the adverse effects of work zones, including duration, congestion, and safety;

- providing effective transportation prior to, during, and after emergencies and disasters;

- minimizing traffic tie-ups in conjunction with special events;

- reducing congestion and delay by regular retiming of traffic signals;

- providing accurate and timely information to travelers;

- improving the linkages between modes for passengers and freight;

- providing reliable and quick response mayday systems for travelers;

- reducing delays and increasing safety in the movement of goods; and

- providing timely and accurate roadway weather information.

The goals and objectives cover both highways and transit.

The Committee has been working on a number of activities this year. First, we are bringing additional public and private organizations into the process to expand the dialog to all interested groups. Second, we formed a new Executive Committee, that includes representatives from ITE, American Association of State Highway and Transportation Officials (AASHTO), American Public Transportation Association (ATPA), Association of Metropolitan Planning Organizations (AMPO), and ITS America, with Public Technology Incorporated (PTI) representing local governments. The electronic national dialog has been ongoing. I hope you are taking the time to read the messages on the electronic dialog and respond as you feel appropriate.

The Committee also sponsored five local dialog sessions in Philadelphia, Columbus, San Jose, Dallas, and New Orleans. These sessions were organized with the assistance of FHWA, FTA, ITE, AASHTO, ITS America, PTI, and AMPO. The sessions generated a great deal of useful and thoughtful information.

John Mason at Penn State has completed an initial summary of the barriers to successful management and operations identified at the sessions. Some of the most frequently cited barriers were the mindset of agencies focused on capital projects, the lack of a common regional vision, the multiplicity of public and private organizations with different and often competing responsibilities, the lack of a common understanding of the groups to be involved, the lack of agreement on who should take part in management and operations, the complexity of the planning process, the availability and eligibility of federal funds, the lack of public support for improvements that do not have immediate visible

benefits, fragmentation of operations activities among many agencies with no regional management and operation plan, and the lack of coordination between planners and operators.

A number of elements that appear to be key to successful management and operations programs were also identified. These elements include an agency cultural change from a project focus to an operations focus, collaborations and partnerships; improved funding availability, eligibility, and flexibility; a regional consensus on the importance of management and operations; continuous communication with the public and elected officials; and needed enabling legislation.

This month the Committee met to start the process of considering possible legislative recommendations. We are organizing a national meeting to refine the vision, objectives, possible activities, and areas of consideration for an operations program and supporting legislation. The meeting will be held in Columbia, Maryland, on October 16-18. Some 200 people have been invited to participate. Another set of white papers is being developed for the meeting.

Other organizations participating in the meeting include the American Public Works Association (APWA), The American Roads and Transportation Builders Association (ARTBA), American Traffic Safety Services Association (ATSSA), National Association of City Transportation Officials (NACTO) International City/County Managers Association (IC/CMA), National Association of County Engineers (NACE), National League of Cities (NLC), and the Freight Council.

Staff at both FHWA and ITE are supporting the activities of the Committee, as are staff from other organizations and volunteers. Work is underway on a public awareness campaign, a research agenda, reviews of existing management and operations success stories, publicizing the information, implementing a self-assessment process for agencies with management and operations responsibilities, continuing development of the ITS public safety program, and supporting continuous development and implementation of ITS technologies.

In conclusion, we know that full-time integrated operations cannot eliminate traffic congestion. It can, however, reduce delays, improve reliability, reduce fatalities and injuries, and restore a sense of control via better information to customers. Management and operations does not replace the need for new lanes and facilities, but it can enhance the operation of the roadway system for all user groups.

As we move forward, I would like to remind you that words are very important. Operation and maintenance are the old words, while management and operations are the new words. Management and operations reflects a new integrated approach. We also need to be careful how we use words like congestion relief, rather than congestion management. The bottom line is that while management and operations will not solve all our problems, it will help address the transportation problems we face throughout the country.

ITMS Needs and the TRB/ITE National Operations Research Agenda

Phil Tarnoff
University of Maryland

My presentation will cover four major topics. These are 1) background on the Transportation Research Board (TRB)/Institute of Transportation Engineers (ITE) National Operations Research Agenda; 2) recommended research; 3) observations on elements with this conference; and 4) a few final comments and conclusions.

The National Operations Research Agenda represents an attempt to define an agenda for operations research. Dennis Christiansen from the Texas Transportation Institute (TTI) and I co-chaired the effort to develop the research agenda.

The development of the agenda recognizes that research on operations is going on throughout the United States at universities, state agencies, businesses, and other groups. The agenda represents an attempt to coordinate these efforts, to make good use of scarce research funding, to help eliminate duplication of effort, and to focus on high priority topics.

The scope of the research agenda focuses on the application of techniques, both automated and manual, to facilitate the flow of vehicles, travelers, and goods. Facilitating flow includes reducing travel times, improving travel time predictability, and improving safety. Vehicles, travelers, and goods include cars, trucks, buses, and light rail; commuters, vacationers, and commercial operators; and asset tracking and intermodal transfers. The emphasis is on operations, not just ITS, and the scope emphasizes highway travel.

The TRB/ITE National Operations Research Agenda is being directed by a committee comprised of representatives from public agencies, universities, research organizations, consulting firms, and other groups. The committee was jointly established by TRB and ITE.

Since it's formation in December 1999, the committee has conducted a number of activities. First, a white paper was prepared highlighting major issues and concerns. A committee meeting was held in Washington, D.C. in March 2000 to establish common themes and priorities. Research issues were discussed at sessions at the ITE Transportation Operations Conference in Irvine, California in April 2000. Research topics were identified at ITE Annual Meeting sessions in Nashville, Tennessee in August 2000.

A final report containing the research agenda has been prepared. It will be published within the next few months. The report contains the following 15 major sections:

- Introduction;
- Discussion of the Problem;
- Research Needs and Payoffs;
- Overview of Ongoing Research
- Overview of Research Themes and Cross-cutting Issues;
- Customers, Customer Expectations, and Customer Needs;
- Maximizing Efficiency/minimizing Congestion;
- Information Needs and Requirements.
- Transportation Safety;
- Environmental Impacts;
- Intermodal Interfaces and Efficiency
- Research Program and Process;

- Potential High Priority Research Projects;
- Future Plans;
- Appendices.

Twelve high priority research projects have been identified. These 12 projects are as follows:

1) Identification of customer needs and expectations. This project will help define what people really expect from the transportation system. Much of the discussion in the breakout groups focused on this topic.

2) Defining the objectives of transportation operations, in terms of performance measures. The need for performance measures was discussed at this conference.

3) Transportation and supply chain management. This project will focus on goods movement and supply chain management. While this topic was not discussed extensively at this conference, it has been identified as a priority at other conferences and meetings.

4) Incidents. ITMS and incident management has been discussed at this conference.

5) Historical data for travel time prediction. This research topic focuses on predicting travel times based on historical data and current data.

6) Pricing. This project will examine the use of pricing to influence demand.

7) Intensive traffic control for saturated settings. This project will examine creative approaches to addressing congestion at saturated intersections, freeway entrance ramps, and other facilities.

8) Innovative enforcement and incentive programs. This project will examine innovative approaches such as increasing speed limits slightly with photo enforcement and other such techniques.

9) Low cost traffic adaption signal technology.

10) System operations warrants.

11) Work zone management.

12) Air quality and transportation operations.

A few common themes seem to emerge from the discussion at this conference. There seemed to be a shared concern that management and operations and ITMS is not getting the attention or the respect it deserves. One of the key problems identified is the lack of funding, staffing, resources, organizations, and attention necessary to address critical transportation problems.

The recommendations made in the breakout groups reflect this problem. For example, recommendations address the need to focus more attention to operator training and certification, to examine funding alternatives, to evaluate external and internal benefits, to assess technical issues associated with integration and demand management, and to explore planning

tools, techniques, and procedures. Not all of these recommendations are appropriate for research. Further, not all of the recommendations are new. We have to be careful not to duplicate past efforts.

There are similarities in the issues discussed at this conference and the elements in the research agenda. These similarities include an emphasis on customer needs, performance measures and warrants, data dissemination and data fusion, demand-side techniques such as pricing and telecommuting, and privatization.

There are also some differences. Elements discussed at this conference that are not in the research agenda include research on the benefits of regionalization of systems and integration of multiple functions, operations planning, the technical aspects of interoperability, and policy issues related to organization and funding.

In closing, I would like to make a few final observations. First, I think some new and interesting ideas have been contributed during the development of the National Operations Research Agenda and the breakout sessions at this conference. I think there was greater emphasis at this conference on institutional issues while the National Research Agenda emphasizes technology. When defining research, it is difficult to avoid reinventing the wheel. Areas where this point applies include identifying benefits, developing more effective marketing, studying educational needs, and exploring management and operations costs.

Finally, we spend a good deal of time talking about the difference in the state-of-the-practice and the state-of-the-art. The problem could be in how we define the state-of-the-art. Maybe the state-of-the-art focuses on the wrong technologies, technologies that are too expensive, or technologies that are solving the wrong problems. We need to be sure we focus on the real issues and apply the most appropriate technologies.

Opportunities for Improvement: From Needs and Issues to Action Plans

Jeff Lindley
Federal Highway Administration

It is a pleasure to participate in the closing session this afternoon. Other speakers have done an excellent job of summarizing the main points from the conference and establishing links to the National Operations Dialog and the National Research Agenda.

I would like to thank all of you for participating in the conference. You have invested your time, your travel funds, and your ideas and intellectual energies to participate in the conference. Your efforts will help in moving the deployment and operation of ITMS forward. The results from the conference will be used by FHWA and other agencies.

I would also like to thank everyone who help organize all aspects of the conference. A number of people contributed significant time and energy to ensure a successful conference. I would especially like to recognize the efforts of Walter Kraft in leading the Conference Planning Committee.

I hope you will all stay involved in this process, as this is a process not just an event. FHWA is in a natural position to help facilitate and coordinate activities. FHWA will have a central role in helping advance many of the ideas

and recommendations emerging from the conference. We need your participation and the involvement of others to help move the process forward.

I would like to suggest five ways you can participate. First, you can join the electronic National Dialog if you are not already a member. You can visit the National Dialog Internet site and participate in the on-line discussions. The on-line discussions provide a great way to communicate both with your peers and with those outside the transportation profession. I encourage you to actively participate in the on-line dialog.

Second, join the ITE Transportation Management Center (TMC) Committee. You do not need to be an ITE member to participate in the activities of the committee. A key focus of the committee is to help facilitate communication in the TMC community. There is a Internet site and a list of services you can sign up for.

Third, join the TMC pooled fund study. While state departments of transportation have traditionally been the main participants in pooled fund studies, other agencies may participate. While helping fund the study is desired, especially when it comes to deciding on priorities and specific work tasks, it is possible to participate without being a funding partner.

Fourth, stay active in one of the sponsoring committees. The recommendations from this conference will be acted upon by TRB, ITE, and ITS America committees. So, stay active, involved, and in touch with what those committees are doing.

The FHWA Operations Internet site is a gateway to many of the sites discussed during the conference. The address for the site is www.ops.fhwa.dot.gov.

Fifth, you can become a champion for ITMS within your agency, firm, or organization. A champion needs to be an advocate for ITMS. You can also help bridge institutional issues. It takes two organizations to disagree to have an institutional issue, but a single agency or a single individual within an agency can start the process of bridging institutional issue. We do not have to solve all of the issues discussed at once. We can start small and build on our successes.

I hope you view this session as the beginning of a long partnership rather than the end of a conference. Your help is needed to help ensure that the ideas generated will be acted upon.

Appendix A–Breakout Group Summaries

Institutional Challenges, Barriers and Opportunities: Institutional Integration

Issues and Needs:

1. Human relations. Changes and turnover in personnel.
2. Operations culture and inertia for change is missing.
3. Regionalization. Operations and services extend beyond boundaries resulting in duplication or gaps in service.
4. Program and System Strategic Plans. Understanding the value, issues, and commitment of resources is missing to receive the support and resources necessary to develop the program and multi-years strategic system plans.
5. Operations, TMC's, traffic management, and operational strategies that are not integrated throughout agencies mission goals, objectives, strategies, performance measures, or decision making matrix.

Research Initiatives

1. Outreach and awareness material needed for all key decision making levels within an agency on the benefits and value of TMC's and operational strategies.
2. National legislation and programs needed to create inertia to influence change in agencies culture and strategic plans.
3. Strategic planning for TMC's and operations programs. Technical guidance and training is needed on the process, stakeholders, agreements, techniques, components, issues and level of effort to consider in developing and sustaining a multi-year strategic plan for TMC's or operations programs.

Strategies to Plan and Design for ITMS: Technical Integration

Issues and Needs:

1. System Engineering process is not used or understood by public agencies or interest involved with transportation operations.
2. Interoperability. Technical and institutional issues are not being addressed in the planning and design stages.
3. Training. Training and outreach in needed to develop and improve the capabilities of agency staff.
4. Software Programming. Agencies lack the basic skills or expertise necessary to develop and support systems, or interfaces to share information between systems.
5. Stakeholder involvement and commitment. Lack of up-front agreement on system needs, requirements, and commitment of resources.
6. Planning and design process and techniques are not well understood by individual common among agencies, or consistent nationally. Multi-agency teams or groups are needed to coordinate and address technical issues.

Research Initiatives:

1. Planning and design. Technical guidance and training is needed on the planning and design phases of the systems engineering process that is scaled to TMC's of various sizes.
2. Integration and interoperability. Technical guidance and training needed that provides a framework and process to achieve integration between communication interfaces and interoperability for different systems and devices. Specific initiatives should include but not be limited to: TMC Concept of Operations; TMC feasibility study and conceptual system design; TMC preliminary design; integration and interoperability (e.g., TMC to TMC, TMC to public safety, TMC to devices, device to device); configuration management; acceptance testing; migration strategies; security and risk analysis; and sample procurement techniques and specifications.

Operational Programs, Strategic Plans, and Support Service: Procedural Integration

Issues and Needs:

1. Operations Table. Required in regions to provide forum for interests to collaborate on TMC and other operations related issues.
2. Project champions. Champions needed within multiple agencies and organizations.
3. Understanding of benefits. Lack of understanding of the benefits, value of performing requires analysis, methodologies, and tools to assess TMC's, operational strategies, and integration.
4. Concept of operations. Common definition and shared mission needed within agencies, regions, and nationally.

Research Initiatives:

1. Operations Programs and Strategic Plans. Technical guidance needed on how to develop and sustain operations programs at a state, regional, or agency level. Other issues to be addressed include the program components, multi-year strategic plan, and related items.
2. Operation Table. Research and technical guidance needed on different operational or TMC focused regional organizations, structures, or processes.
3. National TMC Network. A national TMC network needs to be maintained to facilitate the sharing of information, reports, and identification of key issues.
4. National Recognition Program for organizations and individuals.
5. Benefits of TMC's, operational strategies, and integration. Additional information on benefits of TMC's needs to be collected and where gaps exist, operational tests required.

Managing and Operating ITMS: Policies, Procedures, Funding, and Staffing Issues

Issues and Needs:

1. Policies. Issues include standards, strategic planning for TMC's and operations, procurement, partnerships, operational strategies, and land use planning.

2. Procedures. Common procedures needed in operations manuals on an agency, regional, State, and national level. (e.g. quick-clearance of incidents, closing ramps, CMS operation, and reporting of traveltime).
3. Staffing. Issues include hiring and retaining personnel, internal vs. consultants, cost-training, staff development, and development of future staff.

Research Initiatives

1. Policies. Technical guidance and model policies needed to identify the policies to support all phases of planning, designing, deploying, and operating TMC's.
2. Procedures. Technical guidance needed related to the management and operation of TMC's (e.g. sample procedures, manuals, agreements).
3. Costs to Manage and Operate TMC's. Technical guidance needed or costs accounting for different operational strategies, provision of services, and systems.
4. Training. Programs, courses, curriculum, and technical guidance needed to support the development of sample position descriptions and other related items required to support positions at all levels within a TMC.
5. Partnership agreements (public-public and public private) procurement strategies, specification, and procedures.

Traffic Management Strategies and Operational Plans

Issues and Needs:

1. Benchmarking of impacts and benefits. Information on influence and benefits of TMC's, operational strategies, or control plans are not available in the many metropolitan areas or agencies.
2. Original structure of table. Support and facilitate operations across jurisdictional or system boundaries.
3. User and Activity demands. These demands of various groups are not all known or well understood.

4. Staffing Limitations. Adequate personnel in both number and capabilities for day- to-day activities and events.
5. Leverage Private Sector Capabilities. Ability and capability to involve private sector resources and personnel.
6. Data gathering and processing. Need for established requirements to collect, process, evaluate, and share information on roadway travel conditions.

Research Initiatives

1. Market research on strategies to influence travel demand.
2. Arterial traffic incident detection and management.
3. Incentives to accomplish integration.
4. Risks and liabilities associated with sharing information.

Monitoring and Evaluation Performance: Programs, Methodologies, and Measures

Issues and Needs:

1. Data Availability, Quality, and reliability. Users have different needs and practices for collecting, processing, and warehousing data.
2. Measures, evaluation methods, and tools. Not well understood or inconsistent practices exist.

Research Initiatives

3. Evaluation guidance. Technical guidance, training, and outreach needs to establish and support a continuous performance monitoring, evaluation, reporting techniques, and program.
4. Data consistency and fusion.
5. Define customer expectations and measures (e.g., information needs, level of detail, accuracy, etc.).
6. Technical Guidance to trace measures to region and or agency goals, objectives, operational strategies, and services provided .

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