TRB TRANSPORTATION RESEARCH BOARD
OF THE NATIONAL ACADEMIES

June 30, 2003

Mr. Jeffrey Paniati
Associate Administrator, Operations
Acting Director, ITS Joint Program Office
Federal Highway Administration
400 7th Street SW, Room 3401
Washington, D.C. 20590

Dear Mr. Paniati:

We are pleased to submit this letter report of the Committee on Developing a Regional Concept for Managing Surface Transportation Operations.

This Committee was convened by the Transportation Research Board (TRB) in response to a request from the Federal Highway Administration (FHWA). The roster of committee members is in Attachment A. The committee was charged with conducting a workshop to obtain stakeholder input on developing the Regional Concept of Operations approach. This approach provides a means for achieving an improved performance of the transportation system, including improved customer service and emergency response, on the basis of the shared vision of transportation systems operators and service providers in collaboration with public safety providers. Recommended actions that FHWA should take to facilitate the wide implementation of the Regional Concept of Operations approach were also requested, as well as recommendations on the elements that need to be considered in establishing a Regional Concept of Operations for transportation systems. This letter report presents the Committee's consensus findings and recommendations.

Activities

The Committee held its first meeting on December 13, 2002, at the National Academies facilities in Washington, D.C. The purpose of this meeting was to review recent activities in the area of regional transportation operations and to plan a workshop to generate input on the potential for broad application of the Regional Concept of Operations approach.

The workshop was held on February 24, 2003, at the National Academies facilities in Washington, D.C., with approximately 30 individuals attending. Stakeholder panels responded to a series of questions posed by the Committee and offered a range of perspectives, from those of interjurisdictional traffic management to emergency management and services, law enforcement, port operations, public transportation, systems engineering, and transportation planning. Following the panel discussions, the

entire group participated in an open dialogue to identify the issues to be considered in implementing the Regional Concept of Operations approach. The Committee then met in closed session on February 25, 2003, to consider the workshop discussions and prepare its recommendations to FHWA.

The Committee met again on April 7, 2003, to discuss a draft version of the letter report, which was then finalized through follow-up correspondence among the Committee members. In developing its findings and recommendations, the Committee drew on the workshop discussions, information gathered at its several meetings, articles in the technical literature, and the experience and expertise of individual Committee members. The workshop panelists and committee members focused attention on two FHWA documents:

- An FHWA-commissioned draft white paper entitled, "Regional Concepts for Transportation System Management and Operations," the February 6, 2003, draft of which is included in Attachment B[1]; and
- "Regional Transportation Operations Collaboration and Coordination—A Primer for Working Together to Improve Transportation Safety, Reliability, and Security," which was published by FHWA in 2002 and is available at www.itsdocs.fhwa.dot.gov/JPODOCS/REPTS_TE/13686.html.
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These documents are referred to as the "white paper" and the "primer," respectively, in this letter report.

Summary of Committee's Recommendations

It is clear from our deliberations that an essential key to success in improved customer services and emergency response lies in building and maintaining a multijurisdictional approach to fulfilling the real promise of operating regional transportation systems more effectively. A summary of the Committee's recommendations follows. The detailed recommendations are provided in Section 5 of this letter report.

A. The Committee's primary recommendation is that high priority be given to aggressively extend FHWA's recent efforts toward supporting improvement of regional[2] transportation operations.

The time is opportune to take steps to assist and enable the multijurisdictional and multifunctional agencies in all regions to work more effectively together. Specifically, FHWA should

[1] The February 2003 version of the FHWA-commissioned draft white paper "Regional Concepts for Transportation System Management and Operations" was used by the Committee in developing these recommendations. FHWA has since made significant revisions to this white paper.

[2] The term "region" or "regional" in this report includes both metropolitan areas and other multijurisdictional regions. For ease and consistency, the term "regional" is used.

- Convene a leadership coalition to provide continuing guidance and advice to FHWA on its transportation operations policies, programs, and initiatives;
- Provide national leadership and support in constituency building, outreach, and achieving consensus on the importance of regional collaboration and coordination for improved transportation operations;
- Make the case by demonstrating the value added to improving customer service and emergency response by regional collaboration over current practice;
- Develop and disseminate guidance;
- Offer education and training;
- Conduct related research; and
- Address funding needs.

B. FHWA should replace the term "Regional Concept of Operations" with "Regional Transportation Operations Strategy (RTOS)."

The phrase "concept of operations" has different meanings for various groups, such as police and public safety agencies, and the suggested replacement term more clearly conveys the FHWA's intent.[3]

C. FHWA should define the term "operations" for use in regional transportation operations activities according to the definition of the American Association of State Highway and Transportation Officials (AASHTO) that was developed through an 18-month effort with input from multiple constituency groups.

The remainder of this report is organized into the following sections:

1. Background
2. Stakeholder Workshop Results
3. Regional Transportation Operations Strategy
4. Findings
5. Recommendations
6. Closing Remarks

1. BACKGROUND

The challenges facing transportation agencies in metropolitan areas and other regions are well known: unacceptable and costly congestion, nonrecurring delays, increasing and changing travel demand (e.g., more freight movements for just-in-time delivery), reconstruction and maintenance of facilities under traffic, elevated security concerns, and

[3] The Committee recognizes that the term "concept of operations" has been used in FHWA literature and that it may be included in reauthorization legislation. If so, it may be appropriate to continue with the term "concept of operations," although the acronym "CONOPS" should be avoided. There is no difference in substance between the terms "Regional Concept of Operations" and "Regional Transportation Operations Strategy."

traffic incidents and emergencies, to name a few. Technological solutions have been developed and are being deployed to address these challenges, including tools directed to freeway and arterial operations, traffic incident management, emergency management, homeland security, congestion relief, work zone traffic management, traveler information services, response to weather and special events, electronic payment services, emergency management systems, motorist information systems, and intelligent transportation system (ITS) technologies. Unfortunately, these technological solutions (along with the routine operations to control traffic, such as signal timing) provide only part of the answer. Jurisdictionally fragmented regions and varying agency priorities pose major challenges to achieving the necessary level of consistent regional deployment and integrated operations that can fully capitalize on the potential of new technology and functional concepts.

A region typically includes numerous jurisdictions (towns, cities, counties, and states), each dealing with its own multifunctional responsibilities (e.g., passenger and freight transportation, safety, fire and other emergencies, law enforcement, and security). Because these functions also have regional importance, balancing the regional and local interests in a fair and effective way is essential to optimum transportation operations. At the same time, the priorities of the operating agencies that use the transportation systems—law enforcement, fire and rescue, emergency management, and regulatory functions—vary and require accommodation and reconciliation as mobility, safety, and other issues are addressed at the regional level.

In response to these challenges, state and local transportation agencies have taken on added responsibilities related to improving operation of existing facilities, in addition to their continuing role in building new facilities. Some regions have implemented innovative approaches for improving regional collaboration and coordination, for example:

- The Transportation Operations Coordinating Committee (TRANSCOM) was created in 1986 to facilitate regionwide coordination of construction projects in New York, New Jersey, and Connecticut. Since then, its role has expanded to include the distribution of traffic and incident information and the management of regional ITS programs. TRANSCOM's concept of operations is important to governing how the member agencies, as well as other agencies involved, interact with each other and share information.
- The Southern California ITS Priority Corridor management concept of operations was prepared to synthesize participant views on levels of interagency coordination and integration.
- The Maricopa Association of Governments in Phoenix, Arizona, has defined a Regional Concept of Transportation Operations as a "big picture" view of a region's desired state of transportation operations and management, with a cooperatively developed plan and institutional commitment to achieve that state.
- The Metropolitan Transportation Commission (MTC) in the San Francisco Bay Area's regional concept of operation focuses on freeway management in this

multijurisdictional region, where congestion and long daily commute trips through multiple jurisdictions are common and freeway expansion is unlikely.

FHWA, the Federal Transit Administration (FTA), and other government agencies and national associations—such as AASHTO, the Association of Metropolitan Planning Organizations (AMPO), the National League of Cities (NLC), the National Governors Association (NGA), and the National Association of City Transportation Officials (NACTO)—have a critical role in assisting states and regions in addressing the need for improved operations. Recent national initiatives include the following:

- The National Dialogue on Transportation Operations was initiated in 1999 by FHWA and the Institute of Transportation Engineers (ITE) and has provided support, substance, and tools to help raise consciousness of the role of management and operations.
- The Working Group on Linking Planning and Operations, sponsored by FHWA and FTA, identified ways in which transportation planning and transportation operations can be more effectively linked.
- A Regional Transportation Operations Conference was organized by a joint subcommittee of TRB and the Intelligent Transportation Society of America (ITS America) and held January 11–12, 2002, in Washington, D.C. It was co-sponsored by five national associations and the U.S. Department of Transportation (DOT).
- A National Conference on Traffic Incident Management was held in Irvine, California, in the spring of 2002 through the sponsorship of FHWA, AASHTO, ITS America, and TRB.
- AASHTO, ITS America, and TRB extensively reorganized their committee structures from 2000 to 2002 to support and lead efforts to move toward an operations orientation.

Additional details on initiatives are provided in Attachment D. In view of this background, as well as the current high level of interest in various regions, this is an opportune time to define the elements that should be included in a Regional Concept of Operations (hereinafter referred to as an RTOS) for transportation systems in a region and to identify the next steps to be taken at the national level to advance this approach to managing regional transportation system operations.

2. STAKEHOLDER WORKSHOP RESULTS[4]

The Committee sponsored a workshop on February 24, 2003, to receive input from various constituency groups and disciplines, including transportation management and systems engineering, regional planning, and public safety. Participants were drawn from the highway, transit, air, and water transportation modes with responsibilities for passenger travel and freight movements. The list of workshop panelists is shown in

[4] Consensus recommendations were neither solicited nor obtained at the workshop, in recognition that only the Committee is authorized to develop findings and recommendations.

Attachment A. The Committee is indebted to the workshop panelists for their high level of interest, outstanding participation, and invaluable comments and viewpoints. The panelists offered valuable insights to be considered by FHWA in its future work in this area, as well as suggestions for finalizing the FHWA draft white paper on "Regional Concepts of Operations for Transportation System Management and Operations." The following is a brief summary of the areas of the workshop discussion:

- Definition of a Regional Transportation Operations Strategy
  The definition provided in the FHWA draft white paper was generally acceptable to the workshop participants. A few areas identified for FHWA to consider in finalizing the definition include: (*a*) stressing outcomes rather than process, (*b*) placing emphasis on user perspectives rather than taking a top-down approach, (*c*) recognizing multimodal systems, and (*d*) varying roles and levels of responsibility among jurisdictions for different functions (e.g., traveler information). To provide a context for these areas, workshop participants deemed it important to place additional emphasis on the fact that an RTOS is only one part of a more comprehensive process. In this regard, the indication in the FHWA white paper and in the FHWA primer that RTOS is a document intended to serve as a tool was considered useful. A number of concerns surfaced on terminology, in particular on the terms "concept of operations" and "CONOPS." Use of terms that are more descriptive and easily understood by all constituency groups was suggested.

- Value Added by a Regional Transportation Operations Strategy Approach
  Workshop participants indicated that an RTOS approach would be beneficial in many regions, but only if the approach were to lead to actual improvements in operations rather than to creation of an exercise without real accomplishments. While not specifically stated, there appeared to be some doubts in this area, with participants underscoring the need to articulate clearly the potential for the RTOS approach to improve customer service and emergency response over existing practice. There was a desire for more scenario-based information to help the potential user understand the approach and its potential value. There was recognition of the significant challenge in achieving buy-in from the public safety community.

- Regional Transportation Operations Strategy Interest Areas
  The questions presented in the FHWA draft white paper on the areas of interest to be addressed in an RTOS were considered appropriate, although some concern was expressed by panelists that the white paper and the primer were not focused on a single audience. The questions in these documents seem to be posed both to those at a decision-making level who need to be convinced of this approach and also to those who would actually develop a regional RTOS. Separate documents for these two audiences would be useful.

Workshop participants viewed the federal role as critical in encouraging interjurisdictional operational initiatives, particularly on the part of state DOTs, which must play a central role in most regions. The need was identified to address the sharing of resources among jurisdictions to fund projects for the "regional good," with limited direct benefits to an individual jurisdiction. Panelists observed that relating an approach of regional collaboration and coordination to the existing regional planning process and ITS architecture efforts was important, but there was some concern about overstating the importance of ITS related to an RTOS. A major challenge that was not specifically addressed in the draft white paper was that of developing consensus among the law enforcement, fire and rescue, emergency management, and transportation communities.

- Credibility and Acceptability

  Specific steps needed for the RTOS approach to gain credibility and acceptance within the transportation and public safety communities were identified during the workshop.

3. REGIONAL TRANSPORTATION OPERATIONS STRATEGY

As previously noted, a number of regions have already established joint participation among multijurisdictional and multifunctional agencies in conducting regional transportation operations activities. While their specific approach and terminology may differ, these initiatives generally parallel the approach outlined in FHWA's "Regional Transportation Operations Collaboration and Coordination—A Primer for Working Together to Improve Transportation Safety, Reliability, and Security." As defined in this primer,

> Regional operations collaboration and coordination is a deliberate and sustained activity that takes place when transportation system, public safety, and emergency response providers work together at a regional level to solve operational problems, improve system performance, and communicate better with one another.

The primer identifies five elements that make up the regional collaboration and coordination approach: structure, process, products, resources, and performance. The third element—products—calls for a concept of operations to provide a regional strategy for achieving the shared vision of operators and service providers. The desired long-term outcome—the vision of a concept of operations—is that a forum (venue) be established for regional operations collaboration and coordination, in which owner–operators and service providers in a region commit to developing, maintaining, and utilizing a Regional Concept of Operations.

The FHWA primer and the draft white paper are a good starting point for developing a marketing vehicle for promoting the RTOS approach. However, there are some concerns

regarding terminology. Committee members and workshop panelists noted a number of terms that were unclear, duplicative, or potentially negative. Of particular note are the term "concept of operations" and the acronym "CONOPS." **The term "Regional Transportation Operations Strategy" is preferred over "Regional Concept of Operations."** The term "Regional Transportation Operations Strategy" is believed to be consistent with FHWA's intent and more conducive to wide acceptance and understanding. The Committee proposes that the FHWA's primer definition of Regional Concept of Operations remain the same but with the name changed as follows:

> Regional Transportation Operations Strategy (RTOS) is defined as a means for achieving an improved performance of the transportation system based on the shared vision of transportation systems operators and service providers in collaboration with public safety providers. It defines regional expectations (i.e., what is to be accomplished) over time, processes (i.e., how will it be accomplished), roles (i.e., who will do what), and resources (i.e., investments in time, money, staff, and equipment) for better operations and system performance. The strategy focuses in particular on how agencies and jurisdictions will work together to achieve improved regional levels of system performance and operations.

The term "operations" also has different meanings, especially to the workshop panelists who represented disciplines such as emergency services, law enforcement, and freight transportation. The Committee recommends that, rather than developing a new definition, FHWA define the term "operations" for use within the RTOS context according to the definition developed by AASHTO:

> Making the best use of the existing transportation system through provision of integrated systems and services that preserve and improve customer-related performance in anticipation of or in response to both recurring and non-recurring conditions. Operations includes a range of activities in both urban and rural environments, including: routine traffic and transit operations, public safety responses, incident management, snow and ice management, network/facility management, planned construction disruptions, and traveler/shipper information.

4. FINDINGS

After considering the stakeholder input, information presented in the FHWA draft white paper, and extensive Committee discussion, the Committee identified a number of overarching considerations for the advancement of an RTOS approach.

Opportunity

Regional collaboration and cooperation are essential to improving the performance of transportation systems in metropolitan areas, and the RTOS approach offers the opportunity for significant change and improvement over current practices in many regions. Transportation systems and the economies they serve are regional in nature; therefore, solutions that are regionally developed are needed.

While the need for regional solutions may be obvious, there are significant barriers and challenges to this approach. For example, there is a need to accommodate the varying missions and authorities of independent public safety and emergency management agencies within the context of the regional transportation operations. Also, the need for institutional and policy changes—state by state, region by region, and jurisdiction by jurisdiction—must be recognized along with the commitment and willingness to work more closely together across traditional jurisdictional barriers.

The satisfaction of interjurisdictional, interdisciplinary, multimodal, and cross-functional interests constitutes a daunting goal, but one that can be accomplished. Transportation security, safety, and congestion mitigation can be significant motivating issues in accomplishing this goal. This is an area where there is great potential to do better.

Context

An RTOS must take place in an institutional context that considers structure, process, products (including the RTOS), resources, and performance, such as described in the FHWA primer, "Regional Transportation Operations Collaborations and Coordination." Each region is unique in its jurisdictional make-up, system characteristics (including mode mix), and other factors that need to be considered in developing an RTOS.

Further, there is no single beginning point for initiating the development of an RTOS. It can occur at various points within the regional transportation operations process. For example, it may be best to introduce an RTOS approach in a region to deal with a single function, such as emergency response, rather than attempting to introduce RTOS by developing an all-encompassing strategy. Similarly, introducing the RTOS approach to deal with a major project may provide the best opportunity to develop support for the RTOS. A more comprehensive RTOS can evolve from these types of specific applications.

Real benefits can result from an RTOS approach, and the identification, documentation, and dissemination of actual examples should make a convincing case for regions to adopt this approach. Input from regions with existing RTOS-type initiatives can provide substantial evidence of the value of an RTOS approach. A clear and convincing response is needed to the comment, "We are already doing this." The case can be made that in an environment of constrained resources and congested transportation systems, following a jointly developed regional approach for addressing operational issues is often more

expedient than current practice and can also be cost-effective through sharing of resources.

While a convincing case can and should be made, it must be recognized that it requires a certain leap of faith for regions to accept that the RTOS approach will actually produce what is intuitively logical: that the system will operate more efficiently and better meet mobility objectives. It must also be recognized that the benefits will not materialize immediately and the initial costs may (but not necessarily) be somewhat higher than current practice. Reinforcement is needed though actions that can and should be taken now, as detailed in the section on recommendations below.

In addition to the benefits outlined in the draft white paper, the Committee identified the following service improvements to the customer that could be realized through an RTOS approach:

- Reduced delay and improved travel-time reliability for passenger and freight movements in the face of crashes, breakdowns, HAZMAT spill, weather, and other contingencies;
- Concentration of regional traffic on regional roadways, thereby reducing demand and improving safety on local roads and streets;
- Consistent transit fare policies and schedules;
- Seamless modal transfers for both passengers and freight;
- Improved safety on major regional facilities;
- Fewer adverse effects from work zones and routine maintenance;
- Improved traffic operations during major emergencies (e.g., terrorist attacks and natural disasters) and special events;
- Increased reliability and faster response times from emergency services providers; and
- More consistent, timely, and accurate weather and travel information for travelers.

Outcomes

The focus of an RTOS should be on outcomes, rather than process. Each region is different in its jurisdictional make-up and the level to which it is currently involved in RTOS-type efforts. Therefore, stressing the outcomes and potential benefits, rather than detailing a rigid process with a single-model approach, will more likely lead to a region's acceptance of the RTOS approach. However, a generic description of the process is a key aspect of an RTOS, in that it guides the region in developing its own approach toward reaching the desired outcomes.

Performance

Establishing objectives and performance measures at the regional level is critical to assessing progress toward goals and achieving those goals. Performance measures should be regionally driven and prioritized and at the same time be sensitive to concerns at the national level (e.g., defense and security) and at the individual jurisdictional level (e.g., funding, resources, and competing demands). While federally mandated measures are not appropriate in view of the unique differences among regions, the identification of

types of measures with illustrative examples of their implementation would be useful to a region in selecting and quantifying its own measures. Federal incentives (e.g., funding) would be helpful in stimulating development of performance measures.

Leadership

Leadership is needed at all levels—federal, state, regional, and local. Leadership from FHWA, FTA, and other federal agencies is especially critical at the present time as the RTOS approach is being developed and marketed nationally. At the regional level, the successful initiatives now in place typically resulted from the dedicated championing efforts of a single individual. Identifying and working with champions within the region are critical to advancing the RTOS approach, and it should be recognized that these champions might come from transportation agencies, metropolitan planning organizations, regional planning and implementation offices, emergency service providers, or others.

Accountability

A case can be made that an RTOS affords the opportunity to enhance institutional accountability and structural reform for the performance of the transportation system. In effect, an RTOS can provide a greater comfort level for embracing accountability.

5. RECOMMENDATIONS

As requested, the Committee on Developing a Regional Concept for Managing Surface Transportation Operations offers recommendations to the FHWA on the development of a regional concept of operations approach. These recommendations are the culmination of careful deliberations by the Committee following review of background information, resource materials, and the workshop panel discussions. The Committee recommendations are as follows:

A. High priority should be given by FHWA to aggressively extend its recent efforts toward supporting improvement of regional transportation operations.

The National Dialogue on Transportation Operations; the national forums that have been held by FHWA, TRB, ITE, and others; and the guidance provided in FHWA's primer, "Regional Transportation Operations Collaboration and Coordination," have built an excellent foundation for moving forward. In view of this recent national momentum and some noteworthy state-of-the-practice transportation operations initiatives in place in several regions of the United States, the time is opportune to take steps to assist and enable the multijurisdictional and multifunctional agencies in all regions to work together more effectively.

Wide application of an RTOS is needed to fully realize its potential to improve regional transportation operations. Actions need to be taken now at the national level to obtain acceptance of the RTOS approach and the commitment of a given region to adopt an

RTOS approach. The objective is to move each region up the state-of-the-practice curve while recognizing that each region is starting from a different point on the curve.

FHWA should provide leadership and initiatives to accomplish the following recommended action steps:

- **Convene a leadership coalition to provide continuing guidance and advice to FHWA on its transportation operations programs and initiatives.**

  FHWA needs to continue to convene the key stakeholders in regional operations, including members of the public safety community, to draw on their recent positive experience and encounters with challenges to improving regional operations.

- **Provide national leadership in constituency building, outreach, and achieving consensus on the importance of regional collaboration and coordination for improved transportation operations.**

  FHWA should seek buy-in, co-ownership, and assistance from key constituencies in the further development of the RTOS approach. Outreach should be initiated to national associations representing regional and local stakeholders and to other organizations that have a stake and interest in regional operations. Examples of such organizations are AASHTO, AMPO, NLC, the American Public Works Association (APWA), FHWA, the Public Safety Advisory Group (PSAG), the International Association of Chiefs of Police (IACP), NGA, NACTO, and the U.S. Conference of Mayors. Importantly, parallel outreach and consensus building must take place with the users of the regional transportation system, such as police and fire chiefs associations and other agencies.

  Leaders and champions of an RSTO approach should be identified and supported, both from within FHWA and FTA ("ambassadors" from the regional offices) and from the local jurisdictions in the region. These champions may come from the transportation agencies or other service providers.

- **Make the case by demonstrating the value added by the RSTO approach over current practice.**

  The case should be made for the RTOS approach by identifying, documenting, and then disseminating information on the value added from an RTOS approach over current practice. The white paper and fourth section of this letter report describe potential benefits that can be a starting point for a presentation of a convincing case that depicts the value added by an RTOS. Specific, quantitative (where possible) examples from existing RTOS-type applications would be most useful for this purpose.

Providing a clear context for the audience is critical in these documents. For example, when finalized, the white paper should clearly indicate the relation of an RTOS to the overall context of regional planning and operations.

- **Develop and disseminate guidance.**

  Elements should be identified that need to be addressed in an RTOS, providing a starting point from which a more detailed template should be developed and disseminated to individual regions (see Attachment C).

  A package of tools should be developed that would include marketing aids for use by regional champions, to gain support for the approach, to develop an RTOS, and to guide implementation.

  Demonstration and pilot projects should be fostered. This approach is considered to be one of the most effective means of obtaining buy-in.

- **Offer education and training.**

  Education and training programs should be developed and implemented. The value added from an RTOS approach needs to be made known to top officials at all levels of government, and the staff of regional agencies should be trained in the development and implementation of this approach. The Committee understands that a training package is being developed for the "Regional Transportation Operations Collaboration and Coordination" primer. This is an excellent first step. If the revised white paper is to be used for marketing purposes, incorporating the suggestions from the Committee and workshop participants is also recommended.

  As FHWA has done so effectively in other areas, peer-to-peer exchanges should be developed to assist regions in implementing an RTOS approach. In addition, arrangements should be made for groups and teams of experts to visit regions that seek assistance in developing an RTOS.

- **Conduct related research.**

  While the other recommended actions can proceed immediately, there is also a need for research to provide products to assist regions in developing their RTOS approaches. For example, research to develop guidance on the development of performance measures would be useful.

- **Address funding needs.**

  Inevitably, regions moving ahead on enhanced operations strategies will raise the issue of funding. While it is acknowledged that considerable

improvement in regional cooperation and coordination can be achieved with minimal cost, the reality is that providing incentives and seed money will make a real difference in the willingness and enthusiasm of regions to develop meaningful collaborative programs. During the upcoming reauthorization period for Transportation Equity Act for the 21st Century, every opportunity should be taken to encourage improved regional operations, with a view to strengthening the requirements in the subsequent reauthorization in 2009.

B. FHWA should replace the term "Concept of Operations" with "Regional Transportation Operations Strategy."

As noted by the workshop participants, the term "concept of operations" has different meanings for various groups, such as for police and public safety, and may receive a negative reaction from certain groups. The recommended replacement term more clearly conveys the meaning because it relates to regional transportation operations. The recommended change is solely one of terminology; there is no change in definition or intent.

C. FHWA should define the term "operations" for use in regional transportation operations activities according to the AASHTO definition, as shown in the third section of this letter report.

The AASHTO definition was developed through an 18-month effort with input from multiple constituency groups.

6. CLOSING REMARKS

On behalf of the Committee, I want to express our appreciation for the opportunity to assist FHWA in this important initiative. We would like to thank all those who contributed to this project, especially the workshop participants. The assistance of Wayne Berman of FHWA is particularly appreciated.

The committee applauds the FHWA initiatives to raise the consciousness of the importance of operations in addressing the pressing demands and challenges now facing transportation agencies in all metropolitan areas. These demands will only become more severe if not addressed more effectively in the near future. We would welcome the opportunity, should the need develop, to further assist FHWA in reaching this goal.

Sincerely yours,

John Mason
Chair
Committee on Developing a Regional Concept
for Managing Surface Transportation Operations

ATTACHMENTS

A. Committee Roster and Listing of Workshop Panelists
B. FHWA White Paper: Regional Concepts of Operations for Transportation System Management and Operations, Discussion Draft 2.1, February 6, 2003
C. Elements to be Considered by a Region in Establishing an RTOS
D. Additional Background

ATTACHMENT A

Committee Roster

Chair

John Mason
Science Applications International Corporation (SAIC)

Members

Thomas R. Buick
Maricopa County, Arizona

Andrea d'Amato
City of Boston Transportation Department

Matthew L. Edelman
Transportation Operations Coordinating Committee (TRANSCOM)

David S. Ekern
American Association of State Highway and Transportation Officials (AASHTO)

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Jonathan L. Gifford
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Emil J. Wolanin
Montgomery County, Maryland, Department of Public Works and Transportation

Staff:

Mark R. Norman
Director of Technical Activities, TRB

Richard Cunard
Traffic Operations Engineer, TRB

Rosa Allen
Administrative Associate, TRB

Robert Spicher
Consultant

February 24 Workshop Panelists

- Panel 1. Transportation Management & Systems Engineering Perspectives
  - Interjurisdictional Transportation Management Centers (Martin Knopp*, Director of ITS, Salt Lake City, Utah; and Thomas Buick, Maricopa County, AZ Department of Transportation)
  - Systems Engineering (Philip Tarnoff, University of Maryland)
- Panel 2: Regional Planning & Transit Perspectives
  - Regional Planning (G. Alexander Taft*, Executive Director, Association of Metropolitan Planning Organizations; and Sarath Joshua, ITS and Program Safety Manager, Maricopa Association of Governments)
  - Public Transportation (William Millar, President, American Public Transit Association; and Rollo Axton, General Manager, Greater Richmond Transit Company)
- Panel 3: Public Safety Perspectives
  - Law Enforcement (Colonel Richard J. Rappoport*, Chief of Police, City of Fairfax, VA; and Timothy Schoch, Deputy Program Manager of Cincinnati Advanced Regional Traffic Interactive Traffic Management Center)
  - Fire/EMS (Gordon Aoyagi, Fire Administrator, Montgomery County, MD)
  - Incident Management (John Corbin, Freeway Operations Engineer, Wisconsin DOT)
- Panel 4: Ports & Freight Perspectives
  - Intermodal (Tina Casgar*, Executive Director, FIRE)
  - Ports (Jeannie G. Beckett, Senior Director-Inland Transportation, Port of Tacoma, WA)
  - Airports (James Wilding, President & Chief Executive Officer, Metropolitan Washington Airports Authority)

*Panel discussion leaders

ATTACHMENT B

FHWA White Paper
Regional Concepts of Operations for Transportation System Management and Operations

Discussion Draft 2.1
February 6, 2003*

Preface

This paper presents the idea of a Regional Concept of Operations as strategic management tool used to guide the expectations for how actions and activities of regional significance must be developed and operated to ensure the safety, reliability, and security of the transportation system. These regional operations actions and activities may include, for example, traffic incident management, emergency management, homeland security, congestion relief, work zone traffic management, traveler information services, response to weather and special events, and electronic payment services. In each case, for these actions and activities to be effective and beneficial to those that use or depend upon the transportation system and services, agencies and jurisdictions must collaborate and coordinate to define a shared set of expectations that cross-traditional boundaries.

The important point of the Regional Concept of Operations is that it focuses attention and direction on a three to five-year "shared set of expectations" for how future operations will look and perform. This "shared set of expectations" is prepared collaboratively among transportation operators, public safety officials, and service providers with the support and buy-in of the transportation planning agencies. An important part of the Regional Concept of Operations is also framing how agencies (especially transportation and public safety) and jurisdictions will work together to accomplish the "shared set of expectations" for future operations. The Regional Concept of Operations goes beyond just defining a set of projects to resolve or remedy existing operational problem areas. It sets forth a strategy to achieve transportation operations and performance goals that may include policies, programs, protocols, procedures, and projects.

The idea of a Regional Concept of Operations builds upon the work of the National Dialogue on Transportation Operations, work conducted by ITS America and the Transportation Research Board regarding regional operating organizations, FHWA work on planning for operations and recent publication of the document entitled "Regional Operations Collaboration And Coordination – A Primer for Working Together to Improve Transportation Safety, Reliability, and Security."

This idea first came to light during discussions of an FHWA-FTA sponsored working group on "Linking Planning and Operations" in 2001. That Working Group noted the importance of having a formalized and sustained activity between operators and service providers, in metropolitan areas regarding regional operations policies and projects. The Working Group also noted that where this operations collaboration and coordination

* This February 2003 version of the FHWA-commissioned draft white paper "Regional Concepts for Transportation System Management and Operations" was used by the committee in developing these recommendations. FHWA has since made significant revisions to this white paper.

takes place, institutionally, is not the question. What gets done is the important challenge. Wherever it occurs, the regional operations collaboration and coordination activity must be linked to the metropolitan transportation planning and decision-making process governed by Federal law.

This is a discussion draft, presenting a number of thoughts to help frame and further define a Regional Concept of Operations. It is anticipated that through review, comment and discussion by practitioners and experts with subsequent iterative revisions and additions, a consensus model, set of benefits, and methodology for Regional Concept of Operations development and use will emerge.

This draft has been generated in consultation with Transportation Research Board's steering committee formed to consider Developing a Regional Concept for Managing Surface Transportation. It has been prepared as a resource document for use at a workshop organized by that committee scheduled for February 24, 2003 to explore the definition, use and value of a Regional Concept of Operations. It is expected that this draft will then undergo substantial revision. Further review and comment by other organizations and individuals is then anticipated.

What Is a Regional Concept of Operations?

Generically, a concept of operations or conops may be defined as a user oriented document that describes a system's operational characteristics from the user's viewpoint. A system is defined as a group of people, objects, and procedures constituted to achieve defined objectives of some operational role by performing specified functions.

Applied to transportation management and operations, a Regional Concept of Operations is therefore a regional strategy for achieving a shared "set of expectations" of operations and delivery of services to be provided by a regional transportation system. It is a primary product of regional operations collaboration and coordination.

A Regional Concept of Operations incorporates an "operations" set of expectations created by system operators and managers and shared by transportation and public safety policy officials, executives and policy boards. It literally states at a broad conceptual level, regional expectations over time (what is to be accomplished), processes (how it will be accomplished), and required means or resources (investments in time, money, staff, facilities and equipment). It also addresses how agencies and jurisdictions work together to achieve better system performance and operations.

The Regional Concept of Operations combines the range of plans, processes, data, and analyses through which performance expectations will be accomplished. It describes current arrangements and projected improvements to the "system" that are used to manage transportation facilities and services in the region. This system is made up of relationships, communications capabilities, procedural protocols, information sharing arrangements, interagency mutual aid agreements, technical information gathering, processing, and dissemination systems (hardware and software).

- The Regional Concept of Operations should serve as a primary reference document for achieving consensus on regional operations actions and activities. It is intended to assure that transportation system operations will reflect the needs and expectations of all of the regional stakeholders. It should serve as a bridge between non-technical officials, executives, various stakeholders and the public, and the system developers and

operations professionals. It serves as a key source document describing user needs, expectations and requirements for operations designers, engineers and developers. It is a dynamic document to be lived by and revised as systems mature and new needs emerge. It should be maintained under configuration control and should be subject to scheduled maintenance and reconsideration.

In order to be of any real value, the Regional Concept of Operations must be created and owned by the transportation professionals responsible for managing and operating the regional transportation system. Development and use of a Regional Concept of Operations should be a significant activity focus for Regional Operations Collaboration and Coordination. Work to-date has emphasized how regions need to organize; i.e., the need for a "table". Development of the Regional Concept of Operations provides an activity focus for those assembled around that table.

Benefits

Benefits that are projected from the development and use of a Regional Concept of Operations include:

- Acceleration and increased effectiveness in realization of the benefits associated with transportation management and operations including:
  - Reduced traffic congestion
  - Improved incident response
  - Effective emergency response and evacuation
  - Better information to travelers
- Avoidance by various transportation and public safety jurisdictions, agencies, departments and other entities of duplicative and/or conflicting efforts.
- Clarification of expectations and intent so that parties who may take actions that could affect transportation management and operations are aware of potential consequences.
- Clarification of expectations for system performance, functionality and use that will help avoid cost change orders as systems are designed, deployed and operated.
- Improved accountability and control for the various activities and functions being undertaken in transportation management and operations.
- Prioritization of efforts and investments to activities and functions that will make the greatest impact in community benefit.

Background

- The last several years has seen the emergence of managing and operating our transportation systems as a key concept for focus and activity in the twenty-first century. This has emphasized transportation system management and operations to address congestion and respond to incidents and emergencies. Work associated with advancement of this trend has included:

- FHWA's creation of the Office of Operations

- Discussion and policy recommendations emerging from the National Dialogue on Operations
- Recognition of the emergence of regional operating partnerships for regional operations and ITS deployment
- Major organizational shifts in State DOT's and transportation associations (e.g. AASHTO, ITE, TRB) to provide more focus on system management and operations issues
- Experience in operations and ITS deployment in metropolitan areas such as New York, San Francisco, Los Angeles and Phoenix.
- An operational concept requirement for Regional ITS System Architecture development
- Publication of *Regional Transportation Operations Collaboration and Coordination – A Primer for Working Together to Improve Transportation Safety, Reliability, and Security* by FHWA.

Concept of Operations and Systems Engineering

The idea of a Regional Concept of Operations is founded on the principles behind concept of operations in systems engineering. As defined from a systems engineering perspective, a concept of operations (ConOps) is a user-oriented document that describes system characteristics of the to-be-delivered system from the user's viewpoint. The ConOps document communicates overall qualitative and quantitative system characteristics to the user, buyer, developer and other organizational elements. It describes the user organization(s), mission(s), and organizational objectives from an integrated systems point of view.

Historically, the use of ConOps documents have proved valuable as a means to more successfully communicate what information system users needed and expected from new systems to system and software engineers responsible for developing them. This aids in the definition of user requirements and helps avoid costly changes much later in the development process.

A Regional Concept of Operations as proposed in this paper is derived from ConOps as defined by the systems engineering process, but evolves directly from Regional Transportation Operations Collaboration and Coordination. It is a high level, conceptual "set of expectations" that provide a framework for development of component systems or strategies, which in turn will have their own ConOps.

In the general systems engineering context, "users" are transportation system managers and service providers. "Buyers" and owners are transportation officials responsible for approving acquisition of transportation system improvements. In other words, the "buyers" are the transportation system agency executives and governing boards and the "users" are the professionals and operators who work for them. In many cases, especially at the managerial level, those responsible for "developing" the system for managing transportation operations will also be among the key "users." In a Regional Concept of Operations context, the user viewpoint must also strongly reflect the needs of those that use or depend upon the transportation system and the services that it provides, e.g. travelers, commuters, police, fire, emergency medical services, shippers, haulers, tourists, etc.

For systems engineering and software development, ConOps document format and contents are especially well described in the IEEE Standard: IEEE Guide for Information Technology – System Definition – Concept of Operations (ConOps) Document, (IEEE Std 1362-1998). This guidance is offered in the Appendix to this white paper for illustrative purposes.

Although the Regional Concept of Operations is a broad, strategic document, not linked immediately to technical systems and software, (there will be a number of necessary intervening steps) the format and content of a ConOps according to the IEEE standard can be productively and effectively adapted and augmented for a regional strategic document. Prepared in the language of policy makers and non-technical stakeholders, from the perspective of the system managers and operators, it should be organized in a format requiring description of expectations, perceived needs, objectives and requirements that will be conducive for development of subsidiary activities and system in a logical and coherent way.

The Importance of Developing a Regional Concept of Operations

There are a number of applications within a region that make having a shared set of expectations important to sustaining and maintaining transportation system performance and reliability. For example, some of these important applications include:

- The 24-hours-a-day, 7-days-a-week operating needs of transportation systems, taking into account welfare-to-work and access to jobs, sporting and other special events, the needs of shippers and goods movement, periods of maintenance and reconstruction, periods of adverse weather, natural disasters, public safety, incidents and emergencies, shopping, recreation, and tourism.
- Collaboration and information sharing required across agencies and jurisdictions to address crosscutting issues such as incident management and emergency response, electronic toll and fare collection systems, traveler information systems, commercial vehicle operations, and traffic signal systems.
- The need for faster, more coordinated responses to incidents and emergencies.
- Creation of a system for seamless, integrated transit fare payments and other transportation fee payment throughout a region.
- Sharing of data and information across agency and jurisdictional boundaries, especially between transportation managers and public safety officials.
- Opportunities for operating agencies to achieve needed system integration and interoperability.
- Anticipation and management of demand under a variety of conditions and events, e.g. sporting and special events, weather emergencies, tourist attractions, and road reconstruction.

A Regional Concept of Operations also develops, achieves consensus on, and puts into practice the use of performance measures to support a customer service mission for these applications. It helps decision-makers understand what resources will be needed to sustain and evolve technologies so that operators and planners can take advantage of their full range of capabilities. It creates the strategy for operating the elements of the transportation system so they work better and together. It also invigorates the vision for the regional transportation plan with a stronger systems management and operations perspective.

Relationship to Regional ITS Architecture

The development of an operational concept to support the regional ITS architecture process is closely related to the development of a Regional Concept of Operations to support regional operations collaboration and coordination. In fact, the structure, process, products, and resources for each are almost identical. A key difference is that one is focused only on the ITS components of a transportation system, while the other focuses on the operation of the entire transportation system. The system architecture describes the information systems that can be integrated. The Regional Concept of Operations emphasizes what and when elements for managing the transportation system should be integrated via both institutional and technical means.

Furthermore, a regional ITS architecture addresses integration of all functions and systems that can be foreseen as of value in the region for as far into the future as possible. A Regional Concept of Operations addresses what can be expected in a shorter, more immediate term.

The Regional Concept of Operations and the regional ITS architecture operational concept should be complementary. They can be developed concurrently, but if one precedes the other, it should serve as a platform for the newer effort.

Relationship to Regional Planning

Development of a Regional Concept of Operations should be distinguished from the planning process and the transportation management and operations elements included in that process. The Regional Concept of Operations is developed principally by the transportation system operators service providers, and public safety officials. It provides a framework for "twenty-four/seven" activity, involving and engaging transportation operators and public safety officials. It therefore must primarily reflect their interests, concerns, needs and requirements. It does not necessarily need to conform to a standard format or use standard definitions for regions, included systems or time frames. Instead, it focuses and addresses the issues of concern to the operators.

Thus, preparation of the Regional Concept of Operations must have the buy-in and support of the regional transportation planning process. Whether planning agency staff serve as facilitators or secretariats for concept of operations development will depend on the relationship, role, credibility and trust that such planning agencies have with operators. The planning agency may be the most obvious place for such activity to take place or on the other hand, state departments of transportation, regional operating partnerships (e.g. transportation management center or traffic operations center), or other operating organizations may be more appropriate. The key issue is the participation and credibility with the transportation system and public safety operators and managers.

In any case, those responsible for regional planning need to participate at some level in the development of the Regional Concept of Operations because it needs to mesh with the planning and transportation programs of the region. Investments associated with the Regional Concept of Operations must be incorporated into the regional transportation improvement program (TIP).

Examples of the Use of Concepts of Operations

Examples of how Regional Concepts of Operations have been applied include:

TRANSCOM's concept of operations is important to governing how the member agencies, as well as other agencies involved, interact with each other and share information. TRANSCOM maintains planning documents such as a multiyear strategic plan, an annual business plan and budget, information and communication systems plan, and a technology programs development plan.

The Southern California ITS Priority Corridor management Concept of Operations was prepared to synthesize participant views on levels of interagency coordination and integration. A management structure that supported information sharing without centralizing control was determined the best approach. Consequently, an open system architecture that would support technical information sharing and allow for the integration of disparate system was planned, with the Priority Corridor network as the backbone. The open system architecture supports technical information sharing and the integration of different systems. This concept lies behind the strategy to "develop once, deploy many times," thus allowing for cost sharing among a number of agencies.

Maricopa Association of Governments (Phoenix, AZ) defines a Regional Concept of Transportation Operations as a big picture view of a region's desired state of transportation operations and management, together with a cooperatively developed plan with institutional commitment to get there. The Concept of Operations includes an assessment of current operations in the region and identification of current resources, establishment of realistic and achievable short- and medium-term goals for integrated transportation operations, agreement on useful performance measures – objective and subjective, identification of required resources, roles and actions to achieve the goals, and a regional agreement on "integrated" transportation operations.

Metropolitan Transportation Commission (MTC) in the San Francisco Bay Area's Regional Concept of Operation focuses on freeway management in this multi-jurisdictional region where congestion and long daily commute trips through multiple jurisdictions are common and freeway expansion is unlikely. The goal of the Bay Area Freeway Concept of Operations project is to improve freeway operations policies, procedures and practices, and build consensus on the roles, responsibilities and resource needs for freeway operations. Freeway operations are defined as the activities that directly affect the safety, travel time, travel route selection, time of travel, or mode of travel, of travelers using or planning to use the freeway network. Phase one of the Concept of Operations project includes a Freeway Operations Strategy Report that recommends the future direction for freeway operations in the Bay Area, and an Action Plan to guide future work on the Concept of Operations.

Developing a Regional Concept of Operations

Similarly, the Regional Concept of Operation should be developed by the system operators or managers, or in the alternative, facilitated and documented by transportation planners but with major participation and ownership of the operators. It should include involvement of traffic, transit and public safety agency personnel from the various jurisdictions in the region. The various stakeholders will establish engagement and ownership of the document through its iterative and interactive revision. The effort

should have the enthusiastic endorsement and support of the participating agency executives.

Upon its completion, it should be published in draft form for open public and media review. After the review period, it should be formally adopted by the participating agencies.

Expectations to Be Addressed in a Regional Concept of Operations

There are numerous regional operations actions and activities that can benefit from a Regional Concept of Operations. As was mentioned earlier in this paper, these regional operations actions and activities may include, for example, traffic incident management, emergency management, homeland security, congestion relief, work zone traffic management, traveler information services, response to weather and special events, and electronic payment services. The Regional Concept Of Operations can address these actions or activities either individually or collectively.

The Regional Concept Of Operations contains the operators' collective expectations for these actions or activities in at least the following three areas:

1. Regional Operations
   - How should functions of mutual interest be managed and operated over the next 5-7 years?
   - How will integration and interoperability be achieved and with what priority for optimum performance?
   - How will strategic policies, programs, procedures, protocols, standards, and/or projects be developed that have regional benefit and significance?
   - What are the performance expectations?
   - How will better regional operations contribute to regionally defined goals and vision?
2. Regional Processes, Relationships, and Standards of Performance
   - How is information obtained, managed, and shared?
   - Does a regional intelligent transportation system (ITS) architecture exist? If not, will one be required? When and how?
   - Is regional operations collaboration and coordination consistent with the process for developing the regional ITS architecture?
   - Are there regional performance standards?
   - What policies, projects, architecture, standards, protocols, and measures will achieve performance expectations?
   - How do agencies and systems work together when necessary?
3. Investments for Evolution, Adaptability, and Agility
   - How do systems evolve over time and what resources (staffing, equipment, funding) are needed to sustain and meet performance expectations?
   - How will we achieve a regional vision for operations in regard to resources, investments, priorities, pathway, etc.?
   - How does the system adapt to changes in external circumstances that affect system performance or performance expectations (security, natural disasters, special events)?
   - How does the system respond to unanticipated conditions or demands?

Regional Concept of Operations Contents

Formats and level of detail may vary from one concept of operations document to another. A fairly detailed description of content for a possible such document is included as Appendix A. At the very least, such a document should include an existing system description, the scope, "set of expectations", new system description, scenarios, and resources required.

Description of Existing Operations

The description of the existing system provides an agreed context for system development. All of the participants need to understand the elements of all systems to be managed. As additional participants are added they will need this context for what they are building upon. The existing system description can probably be assembled, in large part, from existing planning documents and from the legacy systems description of the regional ITS architecture.

Scope

The scope defines the boundaries as to what the Regional Concept of Operations is addressing: What is the region? What systems are included? What other systems (external) must be linked? What time frame does it cover? Who are the players?

The region may include whatever boundaries the participants choose. It may correspond to the metropolitan area for planning or it may be greater or less than that area. It could include a multi-state area. It could encompass or only involve a rural area or corridor. Most of our experience with regional transportation management and operations has been focused on metropolitan areas, thus the examples and discussion are framed within that context in this paper. That, however, should not limit the scope of "region" to which the idea of a Regional Concept of Operations may be applied.

There are many operations actions or activities that could be addressed. It is probably best to start with a limited or manageable number to begin. It may even start from a specific problem (e.g. traffic incident management) or an impending event (e.g. a major sporting event). The operations actions or activities to which the Regional Concept of Operations applies will be a matter of priority and choice among the participating parties. Over time it is reasonable to expect that additional agencies, jurisdictions and functions will be added, increasing the systems or subsystems to be encompassed. Examples of system elements that might be included are travel information, freeway management, arterial management, incident management, emergency management and evacuation and transit operations.

No matter the scope of what is included in the systems covered by the Regional Concept of Operations, there will always be systems external to the Conops that must be connected. If traffic management and incident management are included for a group of jurisdictions, those systems will need to be linked to external jurisdictions. If the initial conops encompasses freeway management but not arterial traffic management or transit operations, then linkages must be addressed.

The most appropriate time frame would seem to be that which the participants developing the Regional Concept of Operations expect to execute. Thus a range of three to five or perhaps seven years is recommended.

The players or participants in the endeavor also define the scope of the Regional Concept of Operations. These players include jurisdictions, agencies, departments, and persons responsible for functions associated with the included systems.

Set of Expectations

This is the heart of the Regional Concept of Operations. Much of the detail behind this "set of expectations" was discussed in the previous section. It is important to note that this "set of expectations" needs to be prepared by or with the direct involvement of the transportation system managers, highway and arterial traffic managers, incident response and public safety professionals, and transit managers for the various jurisdictions in the region. In a Regional Concept of Operations context, the viewpoints must also strongly reflect the needs of those that use or depend upon the transportation system and the services that it provides, e.g. travelers, commuters, police, fire, emergency medical services, shippers, haulers, tourists, etc.

It requires subsequent significant involvement and adoption by the executive policy makers with governance authority for the regional transportation system(s). The "set of expectations" seeks to articulate a shared vision, from an operations perspective, of how the transportation system (or key aspects of the transportation system) is expected to ultimately operate over three to five years. It should build upon each partner's or participating agency's particular vision and represent stakeholders' consensus.

- The "set of expectations" along with a description of regional goals and objectives, which flow from it, should be one of the most comprehensive sections in the Regional Concept of Operations, in terms of technical, institutional, and resource matters.

Description of New System Operations

All of the system elements from all of the various organizational and functional perspectives should be described in lay or common terms, as the participants who develop the Regional Concept of Operations understand them. With regard to every system device and operation, which does what and how should be described.

Linkages or communications and information flows and integration of information from each involved individual, device and operation should be described, again, in common or non-technical terms.

Scenarios

Scenarios will describe how the system applies and is expected to operate and respond to various circumstances, such as

- Regular operations
- Not unusual occurrences, such as
  - Traffic Incidents
  - Adverse Weather
  - Major Construction and Maintenance Projects
- Special events
- Emergencies

Addressing the new system description in the context of "table-top" scenario exercises is one mechanism for effective involvement of the participating uses and stakeholders and identification of the issues that must be addressed.

Resources Required

The resources required section should most strongly link the Regional Concept of Operations with planning and programming activities. The needed funding, staffing (from what agencies) skills, training, facilities and equipment should be described.

Maintenance and Use of the Regional Concept of Operations

Once the Regional Concept of Operations is adopted, it should serve as the "living constitution" for development and management of regional transportation operations activities. If programmatic activities undertaken in operating the transportation are not envisioned in the ConOps, they should either be terminated or the ConOps document amended to incorporate the activity. The ConOps document must be placed under configuration control such that all parties will know they are relying on the most recent, agreed to description of the expected system and understand how the document has evolved. As the operations system develops, improvements are added, and the scope and definition of regional transportation operations expands, the ConOps will undergo revision, becoming more sophisticated and useful.

Establishing Structural Agreements

A contractual framework will be needed among the parties associated with Regional Operation Collaboration and Cooperation who must work together to fulfill the Regional Concept of Operations. The form and content of such an agreement will be influenced by previous agreements, relationships and experiences along with the history and culture of the transportation operations community. Agreements of different levels of commitment and specificity will be appropriate for the various stages of operations system design, development and implementation. A fairly simple Memorandum of Understanding may be sufficient for the process of development of the Regional Concept of Operations document. As the Regional Concept of Operations evolves with assignment of various responsibilities to operations agencies and definition of relationships among them, the requirement for a more extensive and specific set of contractual instruments will likely emerge. The process of developing the Regional Concept of Operations should enhance the environment for negotiation of the contractual arrangement at that time.

One principle that has proven to be useful in the shaping of interagency relationships necessary for first establishing operational concepts and in creating agreements supporting its use is the understanding that for effective operations to take place within a region it is necessary for parties to cooperate in the generation, sharing and use of operational information. It is often not necessary to first establish who is going to have to be "in charge" institutionally.

Regional Operations Action Agenda

The Regional Concept of Operations documents should provide the basis for the generation of a Regional Operations Action Agenda. An Operations Action Agenda can

flow from the Regional Concept of Operations, usually as a separate document. This is a program of investments designed to fulfill the regional concept of operations. The action agenda creates a linkage to the formal planning process, providing information needed for inclusion in the Transportation Improvement Program (TIP) and Unified Planning Work Program (UPWP).

The Regional Operations Action Agenda may also include a listing of operations development and systems acquisition activities and investments. It is likely to include programming preparation of subsidiary systems engineering activities that eventually will be needed in the development of various system components employed to fulfill the regional concept of operations.

Performance/Evaluation Feedback

A pressing issue and concern in the National Dialogue on Operations has been the need in any initiative to improve transportation system performance to be able to measure improvement in that performance. This is difficult in that in many cases, until the information systems needed to support operation is in place, the data needed for effective evaluation or measurement of performance. It is therefore likely, as with many other elements of operations improvements, performance evaluation and measurement will need to evolve over time. Assessments are likely to begin as broad and qualitative; becoming more quantitative as both the aims are better defined and understood and as the data becomes more plentiful.

Measuring transportation system and operations effectives must be closely tied to the vision developed for operations and oriented to the needs, perspectives and perceptions of the customers of the system – the traveling public. An important topic for discussion as the ConOps document is prepared is to be concerned with developing the means of measuring what is most important according to the region's vision and goal rather than assessing that with most easily measurable.

References/Acknowledgements

- *Regional Transportation Operations Collaboration and Coordination – A Primer for Working Together to Improve Transportation Safety, Reliability, and Security,* 2002, FHWA
- *Bay Area Freeway Concept of Operations, Strategic Plan, Deliverable No. 15*, June 7, 2002, Prepared by Kimley-Horn and Associates, Inc. for Metropolitan Transportation Commission.
- *Bay Area Freeway Concept of Operations, Action Plan, Deliverable No. 17*, June 7, 2002, Prepared by Kimley-Horn and Associates, Inc. for Metropolitan Transportation Commission.
- *Building Quality Intelligent Transportation Systems Through Systems Engineering*, April 2002, FHWA
- *IEEE Guide for Information Technology – System Definition – Concept of Operations (ConOps) Document*, (IEEE Std 1362-1998)
- *Organizing for Regional Transportation Operations: Southern California ITS Priority Corridor*, August 2001, FHWA.

- *An Overview of Systems Engineering: Participants Workbook*, October 2001, Prepared by FHWA-NHI.
- *Regional ITS Architecture Guidance: Developing, Using and Maintaining an ITS Architecture for Your Region*, October 2001, Prepared by the National ITS Architecture Team.
- *Transportation Management Center Concepts of Operations, Implementation Guide,* December 1999, FHWA.

Appendix – The IEEE Format for the Components of a Concept of Operations Document

This format for a concept of operations is based on an IEEE standard. It is offered here for illustrative purposes only and to highlight some of the underlying principles for idea of the Regional Concept of Operations presented in this white paper. It is not intended to be prescriptive of the content or organization for a Regional Concept of Operations.

A standard Concept of Operations document might appear as follows:

Preliminary Elements

Each version of the Concept of Operations document should contain a title and a revision notice unique to that document. Document revisions should follow a configuration control process.

The preface should include the purpose of the document, a description of activities that led to its creation, which prepared it, the intended audience for the document and the expected use and evolution for the document.

Section 1: Scope

The scope section provides an overview of the Concept of Operations document and a description of the regional transportation system to which it applies.

An Identification subsection c describes broader systems of which it is a part and subordinate systems and/or networked systems.

A Document Overview summarizes and explains the purpose and intended use of the document. It also describes the intended audiences for the document and describes its intended distribution.

The audiences for the Concept of Transportation Operations will necessarily be diverse, the document serving as shared vision and description as to what is expected of the system from the perspectives of public officials, executives, system managers and operators, system developers, other stakeholders and the general public and media.

The System Overview states the purposes of the regional transportation system to which the Concept of Operations document applies. It describes the relevant characteristics of the system: geography, system components, facilities, jurisdictions, agencies, management and dispatch centers, etc. Graphics are recommended including maps, flow charts and organization charts. Documents that further describe or define the regional transportation system may be referenced.

Section 2: Referenced Documents

This section lists the titles, identifiers and means of acquisition of all documents referenced or with direct relevance to the Concept of Operations.

Section 3: Current System and Situation

The regional transportation system is described as it pertains to operations, as it currently exists. Current System and Situation is organized in direct parallel with Section 5, Concepts of the Proposed System. The following subsections provide information

necessary to understand the problems and context for the changes and improvements to regional operations that are needed.

- *Subsection 3.1 – Background, Objectives and Scope*
- *Subsection 3.2 – Operational Policies and Constraints*
- *Subsection 3.3 – Description of Current System or Situation*
- *Subsection 3.4 – Modes of Operation for the Current System and Situation*
- *Subsection 3.5 – System operator, Manager and Service Provider Classes and Other Involved Personnel*
- *Subsection 3.6 – Support Environment*

Section 4: Justification for and Nature of Changes

This section describes the shortcoming or reason for change of the current management and operations program for the regional transportation system. It provides a bridge between the third section of the Concept of Operations that describe the current system and situation, and the fifth section which describes the proposed operations system or program. This section provides justification for the features and functions of the new system. Subsections include:

- *Subsection 4.1 – Justification for Changes*
- *Subsection 4.2 – Description of Desired Changes*
- *Subsection 4.3 – Priorities Among Changes*
- *Subsection 4.4 – Changes Considered but Not Included*
- *Subsection 4.5 – Assumptions and Constraints*

Section 5: Concepts for the Proposed System

This describes the regional transportation operations management system that will result from the changes specified in Section 4. The proposed system is described at a high-level, conceptual manner, including operational features to be provided without specifying design details. Detail should be provided only to the degree necessary to fully explain how the proposed system will operate to fulfill the system operators', managers' and service providers' (users') needs and requirements.

- *Subsection 5.1 – Background, Objectives and Scope*
- *Subsection 5.2 – Operational Policies and Constraints*
- *Subsection 5.3 – Description of Proposed System*
- *Subsection 5.4 – Modes of Operation*
- *Subsection 5.5 – System operator, Manager and Service Provider Classes and Other Involved Personnel*
- *Subsection 5.6 – Support Environment*

Section 6: Operational Scenarios

A scenario is a step-by-step description of how the proposed system should operate and interact with its system operators, managers and service providers and its external interfaces under a particular set of circumstances. Scenarios should be framed in a way that allows readers to "walk through" and understand how the various components interact and how the system responds to particular conditions. The scenarios should tie together all parts of the system, the system operators, managers and service providers, and other entities by describing how they interact.

Scenarios help readers to understand how all the pieces interact to provide operational capability. They also provide readers with operational detail, which enables understanding of system operators, managers and service providers' roles, how the system should operate, and the various operational features to be provided.

Section 7: Summary of Impacts

This section prepares affected organizations and personnel for changes caused by the new system and allows for preparation and planning by procurement agencies, user groups and support maintenance during the development and transition to the new systems:

- *Subsection 7.1 – Operational Impacts*
- *Subsection 7.2 – Organizational Impacts*
- *Subsection 7.3 – Impacts during development*

Section 8: Analysis of Proposed System

This includes an analysis of the benefits, limitations, advantages, disadvantages and alternatives/tradeoffs considered for the proposed system. It should include a framework for system performance measurement with measures of effectiveness and data collection capabilities that will be utilized for assess performance improvement or degradation:

- *Subsection 8.1 – Summary of Improvements and System Performance Enhancements*
- *Subsection 8.2 – Disadvantages and Limitations*
- *Subsection 8.3 – Alternatives and Tradeoffs Considered*

Section 9: Costs, Resources Required and Financial Strategy

This is a section that is not specified for a standard systems engineering Concept of Operations document. However for effective development of regional transportation system management and operations, the full costs of systems acquisition, development, operations and maintenance must be specified, an allocation and acceptance of organizational responsibility for providing funds and resources undertaken, and an identification of funding sources and financial strategy completed.

Section 10: Notes

This section should contain additional information to aid in understanding the Concept of Operations document.

Appendices and Glossary

To facilitate ease of use and maintenance of the document, some detailed information or that which requires frequent update may be presented in appendices rather than the body of the main document. Although great care should be taken to prepare a jargon-free document, a glossary should be prepared alphabetically listing all acronyms and abbreviations along with clear and concise definitions of terms used in the document. The glossary should be developed as the Concept of Operations is developed and consensus definitions should be included for any term for which there was question or confusion in the Concept of Operations development process.

ATTACHMENT C

ELEMENTS TO BE CONSIDERED BY A REGION IN ESTABLISHING A REGIONAL TRANSPORTATION OPERATIONS STRATEGY

While a single model for a Regional Transportation Operations Strategy (RTOS) is not recommended, there are common elements that will generally be addressed in most RTOS approaches. An RTOS may address one or multiple functions, such as traffic incident management. Further, each RTOS must be developed with a full recognition of the make-up of the intended audience. Common elements include

1. Preamble—a clear statement of the objective, emphasizing the commitment to improved operations and to providing a strategy (framework) for meeting the objective

2. Regional Operations

- Description of the current, baseline situation, including regional goals, system characteristics, functions to be addressed (e.g., response to terrorist attack), service providers' interests, and most significant problems in regional operations
- Areas of overlap and potential conflict in the authorities and objectives of the agencies with jurisdiction
- Self-assessment of current operations and the extent to which existing operational tools are addressing the above problems
- Contribution of better operations to meeting regionally defined goals and vision
- Guidance on developing strategic policies, programs, procedures, protocols, standards, and projects that have regional benefit and significance
- Approach to managing and operating functions of mutual interest over a period of time, for example, the next 5 to 7 years
- Process for achieving integration and interoperability, and priorities for optimum performance

3. Performance Expectations

- Regional and individual jurisdictional performance expectations and measures, such as levels of service, congestion reduction, emergency response and clearance times, and quality of user information
- Specific outcomes (objectives), such as reducing travel time on I-95 through the region by 5%, rather than esoteric measures such as total delay on all roads in the region
- Policies, projects, architecture, standards, and protocols for achieving performance expectations

4. Regional Processes and Relationships

- Structure and approach for agencies to work together

- Means of collecting, managing, and sharing information
- Relationship, compatibility, and consistency between RTOS and the regional planning process and regional intelligent transportation system (ITS) architecture

5. Resources

- Recognition that systems evolve over time and that continuing resources in staffing, equipment, and funding are needed to meet and sustain performance expectations
- Approach for achieving regional strategies for operation in planning for resources, investments, priorities, and pathway
- RTOS financial flexibility to adapt to changes in anticipated conditions and demands (e.g., rezoning of land use) and external circumstances (e.g., security, natural disasters, and special events) that affect system performance or performance expectations

ATTACHMENT D

ADDITIONAL BACKGROUND

The work of this Committee is part of a continuing evolution in developing strategic approaches to transportation systems management and operations. As such, some additional contextual information is useful.

History

The federal role in surface transportation has evolved from one of paving roads to get farmers out of the mud, to the construction of the Interstate highway system, to programs to enhance the overall performance of the existing system. As the Interstate system neared completion in the 1970s and 1980s, federal programs such as the Traffic Operations Program to Increase Capacity and Safety (TOPICS) and the Transportation Systems Management (TSM) began to emerge. The 1992 Intermodal Surface Transportation Efficiency Act (ISTEA) required the implementation of a series of management systems, including congestion management systems for metropolitan areas. ISTEA also ushered in a program for research, testing, and deployment of intelligent transportation systems (ITS). Subsequently, the Transportation Equity Act for the 21st Century (TEA-21) added management and operations as required elements of regional and statewide planning.

This evolution in the federal role has been paralleled at the state and regional levels, where public works agencies have expanded their earlier orientation toward building new facilities to include managing and operating existing facilities. This expansion has, in turn, increased the need for the management of resources and information, selection of appropriate operational applications, and investment in the appropriate support information and control infrastructure, on a seamless regional basis.

Recent Activities

The National Dialogue on Transportation Operations, initiated in 1999, has greatly accelerated this evolution. The National Dialogue has added support, substance, and tools to this movement. The need for collaboration and coordination in regional operations to achieve safe, reliable, integrated, and secure transportation was an important theme at the National Dialogue for Transportation Operations Summit, held in Columbia, Maryland, in October 2001, sponsored by the Federal Highway Administration (FHWA) and the Institute of Transportation Engineers (ITE). The summit brought together more than 240 professionals from academia, operating agencies, interest groups (e.g., for safety and pedestrians), and elected and appointed officials from local and regional governments. A consensus on key issues to move an operations agenda forward was achieved.

Greater emphasis on transportation system management and operations is now considered more essential than ever to help mitigate congestion and delay and to respond to incidents and emergencies. The regional approach to transportation systems management and operations has become a major interest of FHWA, the Federal Transit Administration

(FTA), the Association of American State Highway and Transportation Officials (AASHTO), the Association of Metropolitan Planning Organizations (AMPO), the Intelligent Transportation Society of America (ITS America), ITE, the Transportation Research Board (TRB), and many other organizations. For example:

- In 2001, the working group, Linking Planning and Operations, sponsored by FHWA and FTA, identified ways in which transportation planning and transportation operations can be more effectively linked. The working group concluded that "effective transportation system management can maximize transportation system performance through a coordinated and integrated decision-making approach to (1) construction, (2) preservation, (3) maintenance, and (4) operation of transportation facilities, with the goal of safe, reliable, predictable, and user-friendly transportation."

- The organizing for a Regional Transportation Operations Conference, conducted January 11–12, 2002, in Washington, D.C., by a joint subcommittee of TRB and ITS America, was co-sponsored by five national associations and the U.S. Department of Transportation. The key themes that emerged included

    - The need to advance transportation operations on a regional scale is driving cooperative efforts among jurisdictions.
    - Interagency partnerships for regional transportation operations take various forms; the critical factor is how partners are able to achieve results.

- "Regional Transportation Operations Collaboration and Coordination—A Primer for Working Together to Improve Transportation Safety, Reliability, and Security," published by FHWA in 2002, encourages more effective collaboration and coordination of operations within a region by transportation managers and public safety officials from cities, counties, and states. These managers and officials may include traffic operations engineers and managers, transit operations managers, police and fire officials, emergency medical services providers, emergency response managers, and port authority operators. The primer describes what regional operations collaboration and coordination means, why it is important, and how to get started.

- A National Conference on Traffic Incident Management was held in Irvine, California, sponsored by FHWA, AASHTO, ITS America, and TRB, in spring 2002. It brought together key representatives of the transportation and public safety community to focus on creating a collaborative agenda for traffic incident management, including both technical and institutional issues.

- During 2000 and 2002, organizations such as AASHTO, ITS America, and TRB extensively reorganized their committee structures to support and lead efforts to move to an operations orientation as a function of what has become known as the model for the 21st-century transportation agency.

Existing Programs

Several state, regional, and local agencies are already engaged to some degree in aspects of regional operations collaboration and coordination to address regional transportation operations and public safety issues. Four examples of noteworthy ongoing activities are

- The concept of operations of the Transportation Operations Coordinating Committee (TRANSCOM) in the New York, New Jersey, and Connecticut region is important to governing how the member agencies and other involved agencies interact with each other and share information. TRANSCOM maintains planning documents, such as a multiyear strategic plan, an annual business plan and budget, information and communication systems plan, and a technology programs development plan.

- The Southern California ITS Priority Corridor Management concept of operations was prepared to synthesize participant views on levels of interagency coordination and integration. A management structure that supported information sharing without centralizing control was determined to be the best approach. An open-system architecture was selected to support technical information sharing and allow for the integration of disparate systems.

- The concept of operations under development for the Maricopa Associations of Government in Phoenix, Arizona, includes an assessment of current operations in the region and identification of current resources; establishment of realistic short- and medium-term goals for integrated transportation operations that can be achieved; agreement on useful performance measures; identification of required resources, roles, and actions to achieve the goals; and a regional agreement on integrated transportation operations.

- The Metropolitan Transportation Commission (MTC) in the San Francisco Bay Area developed a Regional Concept of Operations focusing on freeway management in this multijurisdictional region, where congestion is common and freeway expansion is unlikely. Their goal is to improve freeway operations policies, procedures, and practices and to build consensus on the roles, responsibilities, and resource needs for freeway operations. Phase 1of its concept of operations project includes a Freeway Operations Strategy Report and an Action Plan to guide future work on the concept of operations.

COMMITTEE ON DEVELOPING A REGIONAL CONCEPT FOR MANAGING SURFACE TRANSPORTATION OPERATIONS

CHAIR

John Mason is professionally associated with the Science Applications International Corporation (SAIC), where he previously was a Vice President, a Division and Operations Manager, and Director of its Transportation Policy and Analysis Center. He currently works part-time. From 1990 to 2002, he served in the city of Fairfax, Virginia, as a member of the Fairfax City Council and as Mayor. For more than a decade, he was a member of the National Capital Region Transportation Planning Board (TPB), the metropolitan planning organization (MPO) for the Washington region. As a member of the TPB, Mayor Mason chaired its Vision Steering Committee, which resulted in the TPB's adoption in 1998 of a vision, goals, objectives, and strategies for long-range transportation planning for the Washington region. Mayor Mason was Chairman of the TPB in 2001, from which position he focused on establishing regional transportation priorities and, after September 11, 2001, on enhanced emergency transportation planning for the region. He served as a Vice Chairman of the Metropolitan Washington Council of Governments Emergency Response Task Force, with responsibility for developing its transportation aspects. He was Vice Chairman of the Transportation Coordinating Council of Northern Virginia, with its focus on coordinating transportation planning. Mr. Mason has been on the board of directors of the Association of Metropolitan Planning Organizations (AMPO) and served as its Chairman in 2000. A U.S. Army career officer (retired as Colonel), he holds a B.A. from the University of Massachusetts and an M.A. from New York University.

MEMBERS

Jonathan L. Gifford is Associate Professor in the Department of Public and International Affairs and Senior Research Fellow in the Institute of Public Policy at George Mason University, where he specializes in transportation issues. He has authored numerous papers and chaired a number of committees addressing regional organizations, transportation planning, and operations. Professor Gifford chairs the National Research Council (NRC) Committee for the Review of the U.S. Department of Transportation's (DOT's) Intelligent Transportation Systems Standards Program. He is also a member of the Transportation Research Board (TRB) Committees on Strategic Management, Transportation and Land Development, and Transportation History; of the TRB Task Force on Asset Management; and of the National Cooperative Highway Research Program (NCHRP) Project Panel on Needs in Communicating the Economic Impacts of Transportation Investment. He chairs the joint subcommittee on Regional Operating Organizations of TRB and the Intelligent Transportation Society of America (ITS America). He received a B.S. in civil engineering from Carnegie Mellon University and a Ph.D. from the University of California, Berkeley.

Matthew Edelman is the Executive Director of TRANSCOM, the Transportation Operations Coordinating Committee, where he helps coordinate the activities of the

public safety and transportation organizations throughout the New York/New Jersey/Connecticut Metropolitan region. He brings a regional operations and information-sharing perspective. He is a recognized leader in regional coordination of transportation operations and planning and has served on many national committees and made numerous presentations that address this topic. He was Chairman of the I-95 Corridor Coalition Steering Committee from 1992-1994, served on the Coordinating Council of ITS America, and is a Board member of ITS Connecticut and the Committee for a Smart New Jersey. He received a BA from Wesleyan University and an MS in Civil Engineering from MIT.

Andrea d'Amato was appointed Chief of Environmental Services by Boston Mayor Thomas M. Menino on November 10, 1997. She is also Commissioner of the City of Boston Transportation Department, overseeing a staff of 500 and a yearly budget of $25 million. She has worked with many agencies in a collaborative manner, especially when for special events, emergencies (e.g., snow), and reconstruction. As Chief of Environmental Services, Ms. d'Amato works in conjunction with all regional transportation agencies, serves on the advisory boards of the Massachusetts Bay Transportation Authority and the Massachusetts Highway System, and on the board of directors of the Metropolitan Area Planning Council. She also coordinates the City of Boston's relationship with the U.S. Environmental Protection Agency, federal U.S. DOT agencies, the State Executive Office of Environmental Affairs, and the Metropolitan Area Planning Commission. She is the current President of the National Association of City Transportation Officials (NACTO).

David S. Ekern is currently on assignment to the American Association of State Highway and Transportation Officials (AASHTO), where his focus areas include intelligent transportation systems (ITS), asset management, remote sensing technologies, operations management, homeland security, traffic incident management, public safety emergency response, and context sensitive design. At the Minnesota Department of Transportation, he most recently served as Assistant Commissioner for National and International Programs, Division Director of Engineering Services, Assistant Chief Engineer, and District Engineer. He has also held positions in environmental policy and planning, preliminary design, MPOs and regional planning, and highway maintenance. Mr. Ekern is a member of numerous professional associations and societies and has earned the standing of Fellow in the American Society of Civil Engineers. He is a registered professional engineer, received a B.S. in civil engineering from the University of Minnesota, and an M.B.A. from the University of St. Thomas.

Ann Flemer serves as the deputy director for operations at the Metropolitan Transportation Commission (MTC), the MPO for the nine-county San Francisco Bay Area. She oversees the agency's programs related to the coordination of the region's transit systems, freeway operations and incident management, regional traveler information systems, the regional ITS architecture, and the Bay Area Toll Authority. She is also responsible for the agency's internal administration and information technology services. Ms. Flemer brings a regional perspective. As head of operations for the MTC, she has prepared a regional operations plan called a Concept of Operations. She received

a bachelor's degree in urban studies from the University of California, Los Angeles, and an master's degree in city and regional planning from the University of California, Berkeley.

Emil J. Wolanin is Chief of the Division of Traffic and Parking Services for the Department of Public Works and Transportation of Montgomery County, Maryland,. Mr. Wolanin has been with Montgomery County since 1991. In his current role, he serves as the county's Chief Traffic Engineer and also manages the county's public parking program. For the 5 years before this, he was Manager of the county's Advance Transportation Systems Management Program, overseeing all transportation management and ITS activities, including operation of its internationally recognized transportation management center. Previously, he spent 8 years with a consulting engineering firm. Mr. Wolanin is past chair of the Washington Metropolitan Council of Governments' Regional ITS Technical Task Force, a member of the board of directors for ITS Maryland, and a member of Public Technology Inc.'s Urban Consortium Transportation Task Force. He has also served as a technical advisory committee member of the TRB-administered ITS Innovations Deserving Exploratory Analysis (IDEA) program. Mr. Wolanin received a B.S. in civil engineering from Pennsylvania State University.

W. Dennis Keck is a career New Jersey DOT employee with more than 30 years of service with the department. As Assistant Commissioner for Planning and Development, Mr. Keck is responsible for delivering the annual capital program and for managing five divisions—Systems Planning and Research, which requires close coordination with New Jersey's three MPOs; Local Aid and Economic Development; Project Planning and Development; Transportation Services, which includes rail and aeronautic operations; and Capital Investment Planning and Development. Mr. Keck previously served as Assistant Commissioner for capital program management, where he was responsible for delivering the annual capital program and managed three divisions—Project Management, Design Services, and Construction and Materials, with a combined workforce of more than 1,400 employees. Mr. Keck has also managed New Jersey DOT's Portway initiative, which supports the development and construction of New Jersey's premier intermodal and international corridor. From 1995 through 1999, he served as Senior Executive, responsible for coordinating all New Jersey DOT ITS activities. In this role, he also served as the Chairman of the I-95 Corridor Coalition Steering Committee and a member the board of directors of the Committee for a Smart New Jersey.

Stephen C. Lockwood is a senior-level advisor with Parsons Brinckerhoff (PB). Mr. Lockwood's background provides a combination of policy, finance, program, and technology knowledge, and more than 30 years of applications experience. Before joining PB, he served for 3 years as a senior FHWA policy officer, two years as Director of the Transportation 2020 Coalition, and more than 15 years as a principal-in-charge or project manager for highway and transit planning and project development projects for a major international consulting firm. While with FHWA, Mr. Lockwood was instrumental in the development of the first new national transportation legislation in more than 35 years. Mr. Lockwood's current responsibilities at PB include senior-level direction,

coordination, and liaison in firmwide efforts for innovative approaches to policy, finance, and project and program development related to systems operations, management, and ITS, with special emphasis on public–private partnerships, innovative finance and deployment, and other institutional issues.

Francis B. Francois, of the National Academy of Engineering, retired in 1999 as the AASHTO Executive Director. Previously, he was a member of the county council of Prince George's County, Maryland, an elected position in which he was involved in issues of transportation, public works, environment, and community development. In his capacity as AASHTO Executive Director, he was an active participant in and supporter of TRB and NRC activities, including the TRB Executive Committee and the Strategic Highway Research Program. He was recently a member of the Committee for a Study for a Future Strategic Highway Research Program and a member of the TRB Task Force on Critical Transportation Infrastructure Protection. He holds a B.S. in engineering from Iowa State University and a law degree from George Washington University.

Thomas R. Buick is currently director of the $100 million Maricopa County Department of Transportation. Prior to this post, he served as Chief Public Works Officer and also as Director of Maricopa County Department of Planning and Infrastructure Development. He has worked in the statewide Phoenix and Tucson metropolitan transportation fields for the last 30 years. He has degrees from the University of Arizona and Purdue University in transportation engineering.