Getting More by Working Together– Opportunities for Linking Planning and Operations

Draft Final for FHWA Review

September 10, 2004

U.S. Department of Transportation
Federal Highway Administration

A Joint Initiative between:

The Office of Operations and The Office of Planning, Environment, & Realty

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1 BACKGROUND AND PURPOSE

1.1 WHAT DO WE MEAN BY LINKING PLANNING AND OPERATIONS?

An effective transportation system requires not only the provision of highway and transit infrastructure for movement of the public and freight, but also the efficient and coordinated operation of the regional transportation network in order to improve system efficiency, reliability, and safety. Transportation Systems Management and Operations (TSM&O) is an integrated approach to optimize the performance of existing infrastructure through the implementation of systems, services and projects that enhance service efficiency; improve public safety and security; reduce traveler delays associated with incidents and other events; and improve information for businesses and for the traveling public.[1]

Traditionally, planning the transportation system and operating the transportation system have been two relatively detached sets of activities, with different requirements and different cultures. In the traditional model, transportation planning focuses on infrastructure projects, relying on an analysis of long-range travel demands, transportation system goals, and funding constraints, but often with limited consideration of short-term and on-going operational issues. Management and operation of the transportation system typically involves a different set of practitioners with a short-term or real-time focus, often with limited consideration of how activities relate to regional transportation system goals and objectives.

Transportation agencies, metropolitan planning organizations (MPOs), and other stakeholders are increasingly recognizing the value of coordination and collaboration among transportation planners and operators. Although they come from differing perspectives, transportation planning and operating agencies generally share the goal of enhancing system performance, and they can mutually benefit from stronger linkages.

Regional transportation planning and investment decisionmaking requires a great deal of coordination and collaboration among state and local governments, MPOs, highway and transit agencies, other stakeholder organizations, and the general public.[2] Similarly, effective regional transportation systems management and operations requires collaboration and coordination among operating agencies across jurisdictions and between transportation and public safety agencies in order to improve the security, safety, and reliability of the transportation system. Strengthening the connections between these two processes and activities – planning and operations – can enhance both activities.

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[1] Management and operations (M&O) is distinct from operations and maintenance (O&M), which typically involves local operating activities that do not necessarily merit regional coordination. O&M includes activities such as roadside vegetation control, routine signal maintenance, repaving local streets, and maintenance of local street signage.

[2] Transportation planning takes place at the state, regional, and local levels. The scope and nature of the process differs based on the area being covered and requirements set out in laws and regulations. Federal regulatory requirements for transportation planning are codified in 23 CFR 450, with Metropolitan Transportation Planning addressed in Subpart C, and Statewide Transportation Planning addressed in Subpart B. Although this guide focuses on metropolitan planning, the concepts of linking planning and operations are also applicable at the statewide and local levels.

The purpose of this guide is to describe opportunities for improving connections between planning and operations. It highlights how existing relationships can be strengthened and new ones developed, and how opportunities for greater coordination and collaboration can be exploited. It emphasizes the important role that both planners and operators have to play in building stronger connections, and the benefits of these relationships.

1.2 WHY LINK PLANNING AND OPERATIONS?

Linking planning and operations is important to improve transportation decisionmaking and the overall effectiveness of transportation systems. Coordination between planners and operators helps ensure that regional transportation investment decisions reflect full consideration of all available strategies and approaches to meet regional goals and objectives.

Factors Motivating the Linkage

Federal Requirements: Federal requirements emphasize this linkage. One of the seven planning factors that must be considered in the planning process at both the metropolitan and statewide levels is to "promote efficient system management and operation." The planning requirements, therefore, emphasize the important role that system management and operation should take in regional planning. Through the Metropolitan Planning Organization (MPO) certification process, the U.S. DOT considers whether these factors have been adequately assessed.

Environmental, Community, and Funding Constraints: At a practical level, increasing transportation needs and constraints faced by transportation agencies are pushing an emphasis on new solutions. At the same time communities are facing the need for mobility improvements, transportation agencies are faced with environmental, community, and funding constraints that limit their ability to build new capacity to address these needs. Moreover, the length of time if takes to complete large scale transportation infrastructure projects emphasizes the need for transportation solutions that can respond quickly to congestion, safety, and economic concerns. Given budget and other constraints, the public expects transportation agencies to operate the system at peak efficiency before providing funding to expand physical capacity.

New Technologies: New technologies and Intelligent Transportation Systems (ITS) provide the potential for operational improvements that substantially improve system performance, and for better data to pinpoint and prioritize transportation needs. These technologies also offer opportunities to improve reliability, safety, and security, which are difficult to address with traditional highway and transit capacity.

Benefits for Planners and Operators

Greater coordination and collaboration among planners and operators can help to focus attention on investments that more effectively and efficiently address short-term and long-term needs. Stronger linkages, therefore, help both planners and operators to do their jobs better, and make better decisions that affect the public.

For ***planners***, collaboration with operators can:

- Help planners better understand how operational strategies can meet regional transportation goals

- Provide access to system-wide 24-hour travel data that can be used to better characterize existing system performance and travel conditions, to identify the most critical transportation problems, and to prioritize funding
- Provide operations data and expertise to improve forecasts of future conditions, broaden the understanding of existing conditions, and analyze the effectiveness of alternative investments
- Foster greater consideration of the day-to-day functioning of the transportation network and the real conditions facing travelers, which can help frame transportation goals, objectives, and priorities
- Reveal how transportation plans can address issues such as reliability, security, and safety – issues that are difficult to address solely with traditional infrastructure investments

For ***operators***, collaboration and coordination with planners can:

- Help operators have a greater understanding of how the long range planning process can support M&O activities, and how M&O activities fit into the context of regional goals and objectives.
- Provide increased opportunities and incentives for getting involved in the planning process, and thereby helping to shape system goals and objectives
- Provide regional leadership and greater participation by stakeholders in regional M&O efforts
- Clarify the role of operations in meeting the region's transportation vision and goals
- Direct attention to the value of M&O strategies
- Increase resources assigned to operations projects and programs

Benefits for System Users

Ultimately, greater coordination and collaboration among planners and operators improves transportation decision-making and benefits the traveling public, businesses, and communities.

- *Improved ability to address short- and long-term needs*–More detailed and varied data on traffic operations can help planners to better predict future conditions and better prioritize locations in need of system improvements. It can also bring attention to operational improvements that can be implemented in a shorter time frame than traditional infrastructure investment.

- *Improved reliability*–Travelers and freight shippers are increasingly sensitive to unanticipated disruptions to tightly scheduled personal activities and manufacturing supply-chain processes. Yet trip times have become increasingly unpredictable due to the growth in non-recurring congestion -- unexpected or unusual congestion caused by accidents, inclement weather, special events, or construction. Growth in overall traffic volumes often means that even small disruptions can have a significant ripple effect on transportation system performance over a broad geographic area. Today, non-recurring congestion accounts for about half of all travel delay. The planning process typically deals with on-going or predictable congestion issues, and traditional infrastructure investments do not address the disruptions that are the source of non-recurrent congestion. Stronger connections between planners and operators helps planners consider programs and strategies to

address reliability, such as deployment of technologies to rapidly detect incidents; variable message signs and other approaches for providing quick, reliable traffic information to the public and media outlets; and traffic signal preemption and use of roving incident response teams to quickly clear accidents to open up a roadways for full operation.

- *Improved emergency preparedness*–Coordination between planning and operations reinforces efforts to ensure emergency preparedness and transportation security. Regional operations planning and flexibility is a critical element of a secure transportation system. States and regions that advance operational flexibility in their planning and investment prioritization are building their capacity to address the myriad of emergency and security situations that could arise. In addition, sources of funding may be available specifically for activities that support transportation security and emergency preparedness, which can be used to support transportation M&O objectives.

1.3 Can it be Done?

Challenges

Although there are many reasons for improving the linkage between planning and operations, there are also serious challenges. The challenges of linking planning and operations vary depending on factors such as the experience, size, institutional arrangements, and institutional culture within each region. Some challenges that are common to many regions include:

- Difficulty demonstrating the benefits of management and operations investments. Most analysis tools are oriented toward calculating the benefits of major infrastructure investments. These tools do not consider incidents, construction, or other special events. Moreover, travel demand models have been the subject of legal challenges, particularly in air quality nonattainment areas, and tools that model the effects of M&O strategies must have demonstrated the credibility to withstand such challenges.

- An initial unwillingness of local officials to discuss management and operations costs at a regional level. Often, there is a philosophy that management and operations are local, not regional, issues.

- A lack of training among planning staff about operations activities. MPO staff tend to be composed of planners and engineers whose primary focus has been on planning and programming of capital programs.

- A lack of training and experience among operations staff about planning activities. Operations positions tend to emphasize a short-term outlook, with limited consideration of how their activities fit into broader regional goals.

- Limited funding to pay for capital needs of the roadway and transit network that may have been in plans for years. This can push any consideration of funding for operational programs and strategies off the radar screen.

- Limited funding to pay for on-going operations. While the capital costs of ITS technologies and traffic management centers is often paid for with Federal funds, on-going operational costs typically fall to state, regional, and local agencies.

CAN THESE CHALLENGES BE OVERCOME?

Yes they can! That is what the remainder of this guide is about. Coordination between planning and operations is happening today, and is being enhanced through a diverse range of strategies. This guide discusses the lessons from those who have had success at building this linkage, and highlights opportunities to further regional coordination.

Historically, operational considerations have been integrated into planning for transit projects, but much less so for highway projects. However, that is changing. Today, highway agencies are evolving to focus greater attention on maintaining existing infrastructure and recognizing the critical role of operations in achieving regional mobility goals. Both transit and highway agencies are recognizing new opportunities to improve reliability, security, and safety, and public information through their investment programs. MPOs are increasingly seeing their role as not only facilitating regional transportation planning, but also facilitating regional transportation systems management and operation.

1.4 STRUCTURE OF THE GUIDE

This guide discusses opportunities to strengthen linkages between planning and operations.

Section 2 is the main body of this report and is organized around nine linkage opportunities: 1) The Regional Transportation Planning Process, 2) Data Collection and Sharing, 3) Performance Measurement, 4) Congestion Management Systems, 5) Institutional Arrangements, 6) Funding and Resource Sharing, 7) Regional ITS Architecture, 8) Regional Transportation Systems Management and Operations Projects, and 9) Regional Concept of Operations. For each group, it includes specific examples of opportunities and short case studies.

Section 3 is a self-assessment tool, which can be used by both planners and operators to think about current levels of coordination and opportunities for strengthening connections.

Section 4 provides resources for further information, including links to useful web sites, on-line tools, and on-line forums.

2 OPPORTUNTIES FOR LINKING PLANNING AND OPERATIONS

The Transportation Equity Act for the 21st Century (TEA-21) identifies seven specific planning factors that must be considered in the transportation planning process at both the metropolitan and statewide level. Although the TEA-21 legislation does not define these factors in detail, the importance of operating and managing the transportation system is a focal point for transportation planning. Specifically, Planning Factor #6 requires that transportation plans "promote efficient system management and operation." This Factor establishes a formal role for M&O activities in the transportation planning process (see Box 1). [3,4]

Box 1: The MPO Certification Process

Through the MPO certification process, the U.S. DOT considers whether the seven planning factors have been adequately assessed. Every three years, the Federal Highway Administration (FHWA) and Federal Transit Administration (FTA) are required to jointly review and certify that Transportation Management Areas (metropolitan areas with populations greater than 200,000) are planning in accordance with the TEA-21 Metropolitan Planning Regulations. For some MPOs, this certification process has been used to successfully promote greater consideration of systems management and operations in the planning process. The certification process is open to comment from other government agencies as well as from individuals and stakeholder organizations. MPO certification thus provides an opportunity for considering how well the regional transportation planning process is taking advantage of regional M&O strategies.

In addition, Highway Trust Fund dollars are available for implementing systems management and operations activities. For example, through the Congestion Mitigation and Air Quality Improvement (CMAQ) Program, a number of regions have implemented operations strategies to help meet mobility and air quality challenges. In general, projects eligible for CMAQ funds include programs to improve traffic flow, such as traffic signalization coordination and incident management programs, as well as transit, freight, and demand management programs. By dedicating funding to these alternative strategies, CMAQ has helped to foster greater consideration and awareness of operations projects and programs within the transportation planning process.

Planning Factor #6 and funding programs that inherently support system management and operations improvements (such as CMAQ) provide a genesis for linking transportation planning and transportation management and operations. Although the basis for the linkage has been established, however, both planners and operators need specific information on how to go about taking advantage of opportunities that exist within the current transportation decision-making process.

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[3] The Metropolitan Planning Regulations can be found in 23 CFR 450.

[4] Other planning factors focus on safety and security (#2), enhancing the integration and connectivity of the transportation system (#5), and preservation of the existing system (#7), emphasizing the importance of efforts to operate the transportation system efficiently and safely across multiple modes of transportation and across multiple jurisdictions.

This chapter provides a roadmap to linking planning and operations by focusing on nine linkage opportunities. First, a general discussion on integrating operations considerations into the core regional transportation planning process is provided. The purpose of that discussion is to demonstrate how the current planning process generally can serve as the foundation for a more integrative approach. Second, the following eight specific linkage opportunities are discussed:[5] 1) Data Collection and Sharing, 2) Performance Measurement, 3) Congestion Management Systems, 4) Institutional Arrangements, 5) Funding and Resource Sharing, 6) Regional ITS Architecture, 7) Regional Transportation Systems Management and Operations Projects, and 8) Regional Concept for Transportation Operations. The discussion of each of these eight linkage opportunities is organized as follows.

- *Background*–An overview of the linkage opportunity, with a general description of how it brings together planners and operators is provided in a background subsection. As appropriate, this subsection also identifies intended outcomes of successful linkages and describes geographic and institutional conditions under which the linkage is most applicable.
- *Linkage Implementation*–This subsection illustrates specific linkages along with illustrative examples. These examples are provided to give the reader a concrete sense of how an effort to engage in each described activity will enhance communication or coordination among practitioners.[6]
- *Lessons Learned*–This subsection identifies common challenges, obstacles, and unanticipated benefits. Issues that have been raised repeatedly during interviews with MPO and State DOT practitioners and that are discussed in the planning and operations literature are discussed. In addition, this subsection identifies actions for implementing the concepts and processes that may define a specific linkage opportunity.

[5] These eight linkage opportunities were identified via the literature analysis and practitioner interviews that were conducted as part of this effort.

[6] The examples that are used throughout this chapter focus disproportionately on the particular regions that were interviewed for this guidebook. There are undoubtedly many additional illustrations of the mechanisms discussed in this section that would be helpful to practitioners. Readers are encouraged to share successes and lessons learned so that others may continue to learn form each other's efforts. Some easy ways to share such examples are listed in the Reference Section at the end of the Guide.

2.1 THE TRANSPORTATION PLANNING PROCESS

The transportation planning process provides numerous opportunities to address transportation management and operations. This section briefly highlights these opportunities in general terms and discusses several current trends within transportation planning that compliment efforts to link planning and operations. Subsequent sections go into more detail about specific linkage opportunities within particular elements of the transportation planning process.

BACKGROUND

The transportation planning process has traditionally focused on long-range travel trends and infrastructure projects. Management and operations considerations such as such as incident response, special event planning, and work zone management have received relatively little attention. However, over the 20 years or so, a number of developments have highlighted the need for coordination of regional operations strategies within the planning process. These developments stem from a number of factors that are making it increasingly difficult to construct new highway and transit capacity.

- *Environmental, Community, and Space Constraints* – In many metropolitan areas, there are fewer opportunities for highway or transit capacity expansion along congested corridors. Often the environmental and community impacts that would result from new or widened roadways go beyond what is acceptable to the public. In some cases, there is little or no additional space within public right-of-ways. These limitations in traditional infrastructure construction have placed increased pressures on public officials and transportation agencies to find new ways to enhance the effective capacity and reliability of the existing transportation network.

- *Funding Constraints* – As transportation construction costs have increased, state and local budgets have become more strained. Some transportation capacity projects move forward despite community, environmental, and space constraints, but overcoming these constraints requires longer construction periods, frequent project mitigations, and more complex construction techniques. This means that each project consumes a bigger share of available funds. At the time that project costs are increasing, many states and localities are facing infrastructure deterioration from years of deferred maintenance. These funding challenges mean that few agencies can build all of the facilities that might be desired.

- *Inability to Respond to Short-term Problems* – Major construction projects rarely can deliver new capacity in the short term. In fact, some large-scale projects can take well over a decade to complete. At the same time, transportation patterns are more diverse and less predictable than ever. New transportation challenges emerge unexpectedly as a result of economic shifts or short-term trends. Thus, there is a need for transportation solutions that can respond quickly to congestion, safety, and economic concerns.

The regulations that govern the transportation planning process have the flexibility to accommodate, and sometimes encourage management and operations solutions. It has become clear that MPOs, State DOTs, and other agencies that lead transportation planning efforts can use the planning process as an important forum and tool for collaboration between planners and operators.

Opportunities in the Planning Process

Various stages in the transportation planning process afford opportunities to ensure collaboration between planners and operators and to incorporate management and operations strategies into the decisionmaking process. This section summarizes opportunities in each of these stages.

Outreach & Stakeholder Opportunities

The MPO serves as a regional agency coordinating transportation planning and programming among state and local agencies and jurisdictions. The regional transportation planning process is designed to foster involvement by all interested parties, such as the business community, environmental organizations, community groups, and the general public. This is accomplished through a proactive public participation process conducted by the MPO in coordination with the State DOT and transit operators. The inclusiveness of this process is an important reason for using it to build regional ties among a broader range of transportation stakeholders. The MPO can provide regional leadership in establishing a decisionmaking framework by bringing these diverse parties together.

Because interagency and inter-jurisdictional collaboration is critical for effective regional transportation management, the regional planning process is an important forum for addressing regional operations concerns. Through specific committees and task forces, the MPO can facilitate discussions between planners and operators, including public safety managers, freight stakeholders, and other operations stakeholders.

Box 2: Examples of Goals and Objectives that Acknowledge the Role of Management & Operations

Following are examples of goals taken from regional transportation plans that set out to achieve system performance based improvements through management and operations:

Wilmington, DE (MPO):
"To efficiently move people and goods… improve system performance… promote mobility, and accessibility."

Dallas/Fort Worth (MPO), TX
"Support management strategies that optimize transportation system performance through technology and innovation."

New Orleans, LA (MPO)
"We recognize today that resources are limited and improved management of existing systems can effectively add capacity to transportation networks."

Goals and Objectives

The framing of regional vision and goals affords an opportunity to integrate operations agencies into processes that shape future transportation systems. First, visions and goals need not be confined to the very distant future. Near term goals and visions are important for engaging businesses and members of the public in setting priorities. These shorter-term goals often demand a greater role for management and operations practitioners. Second, setting goals and objectives provides an opportunity to engage with M&O practitioners (see Box 2). The region's vision should emphasize efficient operations, as well as needed physical infrastructure investments.

Optimally, as regions strive to improve the efficiency, reliability, and safety of transportation systems, strategies that transcend the spectrum of options should be developed and evaluated early in the planning process (see Box 3). In this manner, "solutions packages" that combine operations, info-structure, infrastructure, and land use strategies and projects can be formulated. Such a "transportation-as-a-system" perspective can help to improve the quality and timeliness of transportation decisions, and inherently integrates operations into the planning process.

Define Performance Criteria and Data Needs

Performance measures help to determine whether resources are being prioritized properly to meet goals and objectives. The approach to performance measurement can dramatically influence what regional needs are highlighted within the planning process and which are downplayed or ignored. Transportation professionals with a management and operations focus contribute a unique perspective on how to measure performance, and therefore can add a great deal to the regional discussion about performance measurement at the system, corridor, or facility levels.

Box 3: Transportation Management in the Chicago Region Transportation Plan

In developing its 2020 Regional Transportation Plan, the Chicago Area Transportation Study (CATS) considered a range of transportation management strategies. The process was coordinated through the Transportation Control Measures Development Task Force. The Task Force examined travel demand management, transportation systems management, and ITS strategies to quantify the effectiveness of each proposed strategy, for VMT, emissions, and travel time reduction. Ultimately, 11 strategies were selected for inclusion in the transportation management component of the plan.

The availability of data also has a great deal to do with the types of performance measures that can be implemented. Operations data address real time performance of the transportation system, allowing for the development of measures that can better capture the experiences of users (e.g., travel time and travel time reliability). However, to access and properly apply real-time data, the resources and expertise of operations practitioners is needed in the planning process.

Assessment of Deficiencies

An important component of regional planning processes involves determining where transportation improvements are most needed. Needs assessment traditionally has focused on additional roadway or transit capacity to improve mobility in particular corridors. As the focus of planning efforts shifts from mobility to travel time reliability and accessibility, management and operations strategies grow in importance, especially given environmental, community, and funding constraints to new physical infrastructure projects. Consequently, the needs assessment phase provides an important opportunity to engage more effectively management and operations into the decisionmaking process. The need to better integrate management and operations into regional needs assessment is heightened further by the increased focus on transportation security, which will rely on effective operations planning and response to prepare for and respond to terrorist incidents.

Develop Alternative Scenarios

Many plans define two or more alternative scenarios, often relating to particular themes. For example, a region may define a scenario with all the desired capital investments, as well as a less costly scenario that seeks primarily to maintain the existing system. M&O strategies can form the basis for an alternative scenario (see Box 4). Developing an integrated M&O-focused alternative is an excellent opportunity for involving operations practitioners in the planning process. This is a chance to see how regional or state coordination of management and operations efforts can address short and mid-term needs. Moreover, incorporating M&O strategies into all types of capacity enhancement projects is important to ensure that the effective capacity of the system is maximized.

Box 4: MTC 2001 Regional Transportation Plan System Management Alternative

In its 2001 Regional Transportation Plan, the San Francisco Bay Area Metropolitan Transportation Commission (MTC) included a system management alternative. This alternative sought to address corridor mobility issues through a set of projects that were primarily operational in nature. Examples included expanded express bus service, reversible carpool lanes, and a better-connected HOV and transit system. The alternative also included more funding for streets and roads pavement shortfalls. Freeway ramp metering was assumed to be implemented for the most congested corridors, while congestion pricing was assumed for the region's major bridges in order to generate additional revenues, including transit-operating revenues. In this alternative, some highway projects were deferred to provide additional funding for these management programs.

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Evaluate Alternatives and Select Superior Options

Many planning agencies have developed advanced procedures for applying modeling techniques and economic assessments in order to choose between various capital investment options. This already challenging process becomes even more complex when transportation management projects and programs are included within competing investment scenarios. For example, evaluation techniques can rarely weigh the benefit from a coordinated set of corridor management strategies.

Involvement from operations practitioners is critical to ensure that the full range of benefits of these programs is considered. Involvement at this stage can help operations staff to see the importance of their expertise within the transportation decisionmaking process. Ultimately, interaction in this evaluation process can lead to improved mutual understanding and often raises new coordination steps for subsequent updates to the transportation plan.

Taking Advantage of these Opportunities

Implementing the broad opportunities discussed above requires specific consideration of the planning and operations activities that best afford new linkages. This is detailed in the subsequent sections of this chapter, most of which follow directly from the themes raised in this section.[7]

2.2 DATA SHARING

BACKGROUND

Using advanced technologies, it is now possible to collect and store vast amounts of data to support the planning and operation of transportation systems (see Exhibit 1). Roadway loop detectors, for example, can provide real-time information about traffic volumes and speeds. Global positioning systems and radio/cellular phone triangulation can determine vehicle location and speed. Electronic fare collection and automatic vehicle location systems can record detailed information on transit service and use. These rich data sources not only replace many more expensive traditional data collection methods such as manual traffic counts, surveys, and floating car studies, they also allow data to be combined across modes and operational environments in new ways. In doing so, these data sources can create a more complete picture of how policy, infrastructure, and service changes affect the performance of transportation systems.

Exhibit 1: Typical Operations Systems and Associated Data

- **Traffic monitoring and detection systems**: vehicle volume, speed, travel time, classification, weight, and position trajectories
- **Traveler information systems**: current traffic conditions (e.g., travel time, speed, level of congestion), traffic incidents, work zone and/or lane closures
- **Traffic control systems**: time and location of traffic control actions (e.g., ramp metering, traffic signal control, lane control signals, message board content)
- **Incident and emergency management systems**: location, cause, extent, and time history of roadway incident/emergency detection and clearance
- **Advanced Public Transit Systems**: transit vehicle passenger boardings by time and location, vehicle trajectories, passenger origins and destinations

[7] A Note of Caution on Time-Frames in Planning and Operations. This discussion and the remainder of this guide point-out opportunities within the planning process to coordinate with and incorporate shorter-term operations-oriented solutions. However, a shorter-term focus must be approached with caution. In cases where short term and long term responsibilities are assigned to the same organization, there is a danger that the immediate and tangible issues of the short term will overwhelm the time and resources available for long term planning responsibilities. One of the strengths of MPOs has been that their primary mandated responsibility has been to take the long view of the community's transportation needs, thus it is vital that a strong long-term perspective be maintained. A melding of the long-term focus of planning and the short-term focus of operations means that MPOs should take a more active role in forums for regional operations coordination and in coordination between short and long term planning. It does not mean that planning practitioners should prioritize short-term planning over long-term planning.

What is Data Sharing?

Data sharing refers to a broad range of activities that support the full use of readily available transportation information. Many government and private organizations collect data that can inform the design and operation of transportation facilities and systems. First and foremost, data sharing implies awareness about such data sources and a fresh perspective in considering their potential value in new uses. Data sharing typically requires that organizations store data and make it available in a useable format. It also requires a forum to coordinate with other organizations about potential data exchange opportunities.

How Can Data Sharing Create Stronger Linkages between Planning and Operations?

The collection, storage, and sharing of transportation data provides numerous opportunities to solidify the link between planning and operations. Real time data from system operators allows agencies to measure and track the characteristics of the transportation system that are closest to what users experience. This in turn allows planners to develop better performance measures and other analytical tools. As planners come to value the data available from management and operations programs, they build a broader awareness of such programs and their importance. When operations agencies share their data, they often focus more on improving data quality and transferability, and they may develop new relationships with other agencies in the process. Data sharing can also foster a spirit of regional collaboration among operations practitioners and even universities.

Why is Data Sharing so Important?

Interest in data sharing is prompted in part by growing concern about the performance of transportation systems in addition to the performance of individual facilities, and by the increased focus on system management and operations as a tool to enhance transportation systems performance. Efforts to improve travel time reliability and predictability require more detailed data than has traditionally been analyzed by planners. The system focus means that data on conditions are needed virtually everywhere on the transportation system, across jurisdictions and modes. This contrasts with the typical “hot-spot” approach that has governed data collection and transportation management in the past (see Exhibit 2).

Exhibit 2	**Traditional Survey Data Sources**	**ITS Data Sources**
Time-frame	Infrequent	Continuous
Resource	Labor intensive; Individual efforts	Automated; Collected for Operations
Sample	Specific time period; Broad coverage	All time periods, Specific coverage
Reliability	High reliability; Errors often apparent during inspection	Reliability checks required; Errors easily missed
Storage	Small storage requirements	Large storage requirements

As data collection and storage have become more cost effective, the capacity for transportation practitioners to make use of vast amounts of data for policy analysis has also increased. For example, desktop geographic information systems (GIS) applications have continued to become more advanced and more pervasive. GIS is a valuable tool for organizing spatial data from multiple sources. Other powerful software tools allow simulation of complex traffic conditions on individual computers.

For years, many groups within State transportation agencies have operated independently, collecting their own information using different reference systems, databases, and analysis packages. Many States are now using relational databases, GIS, and other tools to assist them in bring together these dissimilar datasets.

The ITS Architecture also encourages the identification of new data sharing opportunities. One element of the National Architecture (and regional architectures) is the information flow analysis. This is typically diagramed in a way that illustrates the appropriate information flows between each major component of the transportation system, thereby highlighting potential data sharing options. A related element of the National ITS Architecture, the Archive Data User Service, was designed to facilitate alternative uses of ITS data, including use of data for transportation planning. The Archive Data User Service helps promote a regional data sharing approach that is consistent with current and anticipated technological capacity.

Organizations that receive data benefit from valuable information on transportation system demand and performance, often at little or no cost. Sharing data can benefit the organization providing data by building awareness about the agency's programs and creating a check on data accuracy. Data sharing may necessitate changes within the agencies receiving data, including a willingness to evaluate planning practices and operations strategies in light of more complete information.

LINKAGE IMPLEMENTATION

Data sharing is often a first step toward broader coordination between planning and operations. Sharing data will require establishing new relationships with other agencies and building mechanisms to support sustained data exchange and storage. Issues such as data formats, accuracy, consistency, and appropriate use can complicate the process of establishing inter- and intra-agency data sharing programs, but these challenges can be overcome. A number of small steps can help to initiate the process. Once agencies learn about the resources available in their region, they will be more interested in exploring the benefits of data exchange. This section discusses several specific opportunities to use data sharing as a mechanism to link planning and operations.

Develop a Regional Data Clearinghouse

A central data clearinghouse can help facilitate access to the region's full range of transportation data for both planning and operating agencies. This requires that a regional agency take stock of all transportation data that are available and develop partnership agreements to make data retrievable from a central access point. There will be barriers for certain sensitive data sources, but the effort should include all planning and operating agencies, public safety agencies, as well as private sector sources such as freight companies. An initial effort to compile a list of all electronically available data sources is an excellent place to begin a discussion about regional data sharing mechanisms.

The Regional ITS Architecture is likely to include a detailed description of the types of data that are available from various transportation, emergency management, and public safety agencies. In this way, the ITS Architecture can be used to guide data sharing and the development of a central Clearinghouse. (Regional ITS Architecture opportunities are discussed in Section 2.7.)

Coordinate Data Resources with Transit Agencies

As a result of ITS deployments, transit agencies are becoming more valuable data sharing partners enabling them to participate in regional planning activities in new ways (see Box 5). With numerous vehicles throughout their service area traveling on regularly scheduled routes, transit agencies are in an excellent position to provide roadway system data using automatic vehicle location technology. This includes information on current speeds throughout the roadway network and changes in speeds on a particular route throughout the day and over longer time periods. When such information is collected and stored, it can be useful for evaluating the impacts of system improvements. For example, by comparing express bus travel times during the specified time periods on a particular day, such data could allow evaluation of the deployment of a traffic control feature during special events.

Box 5: Puget Sound Region Uses Transit Vehicles as Speed Probes

Roadway infrastructure used to obtain travel times and speed data is expensive. The University of Washington Transportation Center (TRAC) funded the UW Electrical Engineering Department (UWEE) to use transit vehicles equipped with automatic vehicle location (AVL) devices as speed and travel time probes in an effort to gather such data more efficiently. UWEE's analysis found that transit vehicles could be used to successfully estimate acceleration, speed, and position for specific locations and times. The ITS research program at UW is creating a server to place data from the transit probe virtual sensors into the Washington State DOT Northwest Region's operational Traffic Management System. This work will increase WSDOT traffic management sensing capabilities without installation and maintenance costs of roadway loops and cabinets. Seattle region travelers will benefit from better arterial traveler information.

For more information: http://www.its.washington.edu/transit-probes/

When they share data with other agencies, transit providers assist with improving regional system operations by enhancing roadway network monitoring, and they assist with improving regional planning by facilitating the development of performance measures. Transit agencies themselves benefit from vehicle location data when it provides information on real-time system conditions, such as incident information. And communicating real-time vehicle location and arrival information to transit customers improves transit service and can boost ridership.

Use Specific Events to Initiate New Data Partnerships

Amidst the day-to-day duties of transportation agencies, taking time to discuss data collaboration is often viewed as a low priority. The need to reach out to new agencies can be heightened when preparing for special events. Special events create an opportunity to develop awareness of data that are available from other organizations (see Box 6). When participating in transportation planning for a special event, consider how the agencies involved might share data on a long-term basis.

Use Universities to Help Develop Integrated Databases

Universities are natural partners for developing data sharing resources (see Box 7 below). Their technological capabilities, their positions outside of the established institutional framework, and their role in developing a new generation of practitioners all contribute to their value as data sharing partners.

Most major universities can be expected to have the technology and expertise required to develop large data collection, storage, and distribution systems. Moreover, universities that are involved with transportation policy, engineering, or planning may have already taken steps to develop regional transportation databases that link existing data sources in innovative ways.

Box 6: Salt Lake City's Olympics Games Leads to Continued Data Sharing

Commuter Link is a web-based traveler information system for the Salt Lake City region. The system components include closed-circuit television cameras, electronic roadway signs, a 511 travel information line, coordinated traffic signals, ramp meters, traffic speed and volume sensors, pavement sensors, and weather sensors. Transportation officials demonstrated a new willingness to devote attention to this coordinated data service in preparation for the 2002 Winter Olympics. During the Olympics, the system worked extremely well. Since the Olympics, this data sharing has continued and has proven to be useful in coordinating traffic management centers across jurisdictions.

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Universities are typically perceived to be somewhat impendent of local and regional transportation agencies. This means they may have a unique capacity to build bridges between agencies. And because universities are usually removed from day-to-day collection and use of transportation data, they may be able to offer creative ideas for new uses of existing data.

Finally, when local universities are focused on developing integrated transportation data management systems, students involved with this work will leave the university with an understanding of the data sources and how they can be related. This helps train a generation of professionals who see transportation planning and operations across modal and jurisdictional boundaries in a more integrated fashion, helping to build a foundation for longer-term linking of planning and operations.

As a first step toward developing these partnerships, identify universities in the region that have transportation research programs. Contact key faculty to discuss what they are currently doing with regional transportation data and what capacity they may have to play a more significant role in developing regional data management products.

Box 7: ARTIMIS: The Kentucky-Ohio Planning Data Partnership

The Advance Regional Traffic Interactive Management and Information System (ARTIMIS) covers the greater Cincinnati area with ITS equipment deployed over 88 miles of highway. ARTIMIS has brought together the Ohio-Kentucky-Indiana Regional Council of Governments (Cincinnati area MPO), the Ohio DOT, the Kentucky Transportation Cabinet, FHWA, the City of Cincinnati, and the Northern Kentucky Area Planning Commission. The partnership was forged in order to create a framework for standardizing and applying data made available through ITS, choose appropriate technology, collaborate on archiving decisions, and control data quality.

Developing the partnership proved challenging, however. The Kentucky Transportation Cabinet noted, "The cultural barrier is the marriage between planning and operations necessary to obtain planning data from a system mostly run by operations personnel." Over time and through several meetings, planning and operations personnel have made significant progress towards coordination with respect to archiving data. In pursuit of better data processing techniques, the University of Kentucky initiated an archived data management system (ADMS) study with the intent of establishing a permanent ADMS in Kentucky. One of the advantages of the University's involvement is that, as an outside party, it assists in overcoming barriers between the planning and operations functional areas.

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Use Operations Data to Develop More Effective Performance Measures

Operational data is also essential for the development of many performance measures (see Box 8). For example, measuring and monitoring travel time reliability has historically been difficult due to the lack of detailed data. Reliability measures can now be developed by collecting loop detector or traffic camera data at frequent intervals (two minutes or less), processing the data to determine instantaneous speeds, aggregating speed information to specified time intervals (20 seconds to 15 minutes),

Box 8: Washington State DOT Uses Archived Data for Improved Performance Measurement

In the late 1990s, Washington State DOT engaged the University of Washington to use years of archived traffic data to explore benefits of operational improvements such as ramp metering and incident response programs. Based on these historic performance data, the University built analytical tools to demonstrate benefits from the proposed operations investments. The University now provides ongoing support for operations investments.

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then storing the data for later analysis. MPOs and DOTs can use these measures to identify segments with poor travel time reliability, improve performance measurement, and better target public investments.

Box 9: Operations Data for Transportation Planning in Montgomery County, Maryland

In the past, the Maryland-National Capital Park & Planning Commission (M-NCPPC) maintained an extensive traffic count program. These traffic counts provided the foundation for identifying congestion problems and calibrating the area's travel demand models. With reductions in funding, the traffic count program was scaled back and then eliminated. At the same time, M-NCPPC was being asked to provide better information on congestion locations so that system improvements can be targeted to the most cost-effective locations.

As a result of this situation, M-NCPPC staff determined that they needed to depend on the county's advanced travel management system (ATMS) as their principal source of planning data. The agency is currently developing systems to make the best possible use of this operations data. The process has generated great interest from the planning staff in how the ATMS functions, and has led to more sustained communication between planning and operations practitioners in the region.

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Use Operations Data to Improve Planning Analysis Tools

Data gathered through transportation systems management activities can be valuable to transportation planners for improving travel demand models and developing other analytical tools. While planners have traditionally relied on average values and national standards for many analytical tasks (such as volume-delay relationships in the *Highway Capacity Manual*), planners may now have access to data such as the variation in traffic volumes and travel times throughout the day, crash frequency and location, vehicle classification counts, and transit rider origin-destination data (see Box 9). The availability of more detailed operations data can lead to better travel demand forecasting models, including models that are more sensitive to the effects of operations strategies.

Use Archived Data to Inform Management and Operations Planning

While archived data can be useful to transportation planning agencies, it can also help those responsible for management and operations to internally plan and coordinate their activities for the most effective results. For example, by archiving and processing existing data, traffic management center staff can observe network performance characteristics on a weekly or monthly basis. This provides a tool to assess how TMC activities are affecting system performance and also helps operations managers frame their role within the broader transportation planning process.

LESSONS LEARNED

Some regions have developed advanced data sharing arrangements (see Box 10 below), while other regions are just beginning to consider opportunities for data sharing. This section highlights some of the specific challenges that can arise when data is shared across organizational and jurisdictional boundaries, and how those challenges can be overcome.

Sharing Data Will Focus Attention on Data Quality Concerns

Sharing data often results in highlighting data inaccuracies. Significant errors are common in electronically collected data due to systematic bias or simply from basic equipment malfunction.

Errors may be difficult to identify within large isolated data sets, but often become apparent when the data overlaps with data from another source or when they are used for a new purpose. For example, data collected by induction loops may normally be used to time a signal or measure service at particular intersections. When these data are put to use in an effort to develop an integrated corridor signalization plan or to calculate vehicle speeds, it may become apparent that equipment has been operating improperly. Ultimately, these discoveries are valuable because they lead to more accurate information for decisionmaking, or at least a better understanding of the quality of the data that exist. Nonetheless, the discovery of data quality and consistency problems can cause frustration, and agencies may be deterred from sharing data by these prospects.

Box 10: Data Sharing Between Agencies in the Portland, Oregon Metropolitan Region

In the Portland Metropolitan Area, several agencies have collected transportation operations data for many years. The Oregon Department of Transportation (ODOT) uses loop detectors at ramp meters and along freeways to measure freeway volumes. The City of Portland determines traffic volumes from loop detectors placed within the City. Tri-Met, Portland's transit agency, collects extensive transit data using automatic vehicle location (AVL), global positioning systems (GPS), and other advanced technologies. Technological advances have increased data sharing and planning for future collaboration. A fiber optic cable connecting Metro (Portland region's MPO), ODOT, City of Portland, and Tri-Met facilities has enabled Metro to receive data from each agency. Tri-Met's bus movement data is being used by ODOT, the City of Portland, and Metro to detect corridor congestion. In the future, ODOT hopes to use the data to evaluate the efficiency of traffic signal timing. Metro has used the operations data in planning and programming processes to quantify the benefits of ITS and compare operations projects with traditional roadway expansion projects.

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The malfunction of transportation data collection equipment is common, in part because many agencies cannot allocate resources to properly test and maintain the equipment. In regions that have experience implementing ITS solutions, stakeholders are learning the importance of incorporating rigorous equipment maintenance systems into their ITS deployment plans. Ensuring reliable transportation data sets has benefits beyond the agencies that rely on the data for analysis. Public agencies that have tried to encourage private sector use and distribution of ITS data are finding that high quality data are important for getting private sector stakeholders involved.

Privacy and Security Concerns Require Attention

Some useful data may not be appropriate to share for reasons related to security, personal privacy, or business confidentiality. For example, security concerns may require limited distribution of a strategic emergency response route or details of the transport of certain dangerous materials. Freight shippers and carriers may not want to reveal to their competitors data on their transportation activity. Personal information about individual travelers must also be kept private in most cases. Data privacy issues can become disruptive during the process of establishing data sharing agreements unless these issues are addressed forthrightly and early on in the process. Modern database tools can facilitate specific data accessibility for each user and prevent access to confidential information. But significant planning still is needed to organize data appropriately and to educate data partners about measures to protect confidentiality.

Begin by Identifying Benefits

Data sharing can save staff time and resources, but it also requires staff time and funding to establish procedures and to maintain data collection devices and networks. For any given data sharing proposal, it is important to begin with a list of likely benefits from shared data to ensure that the effort remains focused and to build support among potential partner agencies and funding bodies. Benefits may include reduced resources devoted to surveys and traffic studies, ability to make use of new tools for faster and more accurate forecasting procedures, and ability to provide stronger state, federal, and public support for transportation investments.

Increase Data Integration and Access Rather than Changing Data Ownership

Some transportation management officials have the perception that sharing data means losing control of data or that it will lead to loss of decisionmaking authority. This common perception can prevent a full exploration of data sharing options, such as pooling data in a central location versus simply establishing better connections between existing data sources. Past experience suggests that the emphasis should be placed on changing database integration and access, not ownership.

Key Resources on Data Sharing

- *Data Partnerships, Making Connections for Effective Transportation Planning,* TRB Transportation Research Circular E-C061. http://trb.org/news/blurb_detail.asp?ID=2990
- *Sharing Information between Public Safety and Transportation Agencies for Traffic Incident Management*, NCHRP Report 250, 2004 http://trb.org/news/blurb_detail.asp?id=3748
- *The Roadway INFOstructure: What? Why? How?*, Transportation Research Circular, November 2003. http://gulliver.trb.org/news/blurb_detail.asp?id=2066
- *Archived Data User Service (ADUS): An Addendum to the ITS Program Plan,* Version 3, September 1998. http://www.itsdocs.fhwa.dot.gov/jpodocs/repts_pr/41401!.htm

2.3 PERFORMANCE MEASURES

BACKGROUND

"What gets measured gets managed." This often-repeated maxim recognizes that performance measurement can focus the attention of decision-makers, practitioners, and the public. By focusing attention on the operating performance of the transportation system, performance measures are an important mechanism for increasing awareness of management and operations (M&O) approaches within the planning process. Performance measures provide a means to link a transportation agency's perspective with the experience of those who use the transportation system. The act of defining performance measures and tracking performance requires communication and coordination between those who manage operations for the transportation system, who often have data and expertise on real-time system performance, and those involved with planning and policy development, who can use this information in order to set goals, track progress, and make investment decisions.

What is Performance Measurement?

Performance measurement involves the act of developing specific transportation system performance criteria and tracking those measures. Performance measures have many functions. They can be used to:

- Frame what attributes of the transportation system are most important;
- Provide information on current conditions and trends;
- Evaluate the success of implemented and on-going projects;
- Provide a metric for communicating with decisionmakers and the public about past, current, and expected future conditions; and
- Serve as criteria for investment decisions in the transportation planning process.

Performance measurement is encouraged by federal transportation planning legislation. Encouragement in ISTEA and TEA-21 include the planning factors, required management systems, and the requirement to fiscally constraining capital improvement programs and link them to plans and program. In addition the Federal government is developing several pilot programs to implement performance measurement programs and demonstrate resulting benefits.

	Traditional Capacity Measures	**M & O Oriented Measures**
Input Measures	Capital projects budget	Number of incident response patrols
Output Measures	Miles of roadway built	Response time to incidents
Outcome Measures	Reduced miles of congestion	Change in incident-related delay

Exhibit 3: Classes Of Performance Measures

Performance measures can be grouped into three categories: (See Exhibit 3 for examples)

- Input measures – which generally address the supply of resources;
- Output measures – which address the delivery of transportation programs, projects, and services; and
- Outcome measures – which address the degree to which the transportation system meets policy goals and objectives.

While input and output measures are the easiest to implement, outcome measures focus on the effects that the traveling public most cares about – issues such as travel time and delay, safety, and reliability. Increasingly, MPOs, transit operators and DOTs are becoming customer-focused, which increases attention to the development of outcome measures. Still, outcome-oriented performance measurement is minimally practiced in many regions. A survey of MPOs asked, "does your planning process reflect measurements of actual system performance, like travel time, reliability, and incidence of non-recurring congestion?" Of those that responded, 45% answered no.[8]

How Can Performance Measurement Create Stronger Linkages between Planning and Operations?

Performance measures can help link planning and operations by focusing attention on customer-oriented outcomes and elevating attention to M&O strategies within the transportation planning process. Increased coordination and collaboration among operations and planning staff can also help instill operations thinking into policy and planning decisions.

Outcomes are beneficial for both planners and operators, as shown in Exhibit 4.

Exhibit 4

Coordination and collaboration on performance measures

For Planners

Enables a more customer-oriented focus
Provides "real world" data that can be used to assess progress in meeting goals and objectives
Fosters greater consideration of the day-to-day functioning of the transportation network, which can help frame transportation plans
Helps in prioritizing projects for funding

For Operators

- Provides an opportunity to get involved in the planning process, and help shape system goals and objectives
- Lends clarity to the role of operations in terms of the regional vision and goals
- Directs attention to value of M&O strategies
- Elevates the status of M&O strategies in the transportation planning process

Key ways in which performance measures strengthen such collaboration are described below.

[8] *Survey of MPOs on Linking Planning and Operations*, Association of Metropolitan Planning Organizations, January 2004.

Performance Measures Bring Focus to Customer-Oriented Outcomes

Performance measurement has traditionally been in the realm of planners and policy analysts as part of the planning and investment prioritization process. Metrics tended to be those that can be modeled and used for long-term investment decisionmaking, such as average travel times and miles of congested roadways.

Increasingly, transportation agencies are moving toward a customer-oriented focus and want to develop performance measures that reflect what is most important to transportation system users (see Box 11). Examples of performance measures that focus on management and operations include:

- Total or average hours of incident related delay
- Consistency of peak and off-peak travel times
- Extent of real-time information provision (e.g., lane-miles or intersections for which information is available; number of ways to access such information)
- Transit on-time performance
- Percent of signal systems coordinated across jurisdiction boundaries
- Frequency of work-zone accidents
- Number of signals with preemption capabilities
- Number of travel information website hits

Box 11: Focusing on the Customer: Washington State DOT

As part of Washington State DOT's efforts to define performance measures for traffic congestion, the agency moved beyond traditional measures of average travel speeds to define measures focused on travel reliability (e.g., though use of a "buffer index"* to account for non-recurring delay). These measures were developed through coordination between planners and operators, and involve on-going coordination in tracking performance. Prior to this effort, non-recurring delay did not receive this systematic consideration.

WSDOT publishes a quarterly report on the state's transportation system titled *Measures, Markers, and Mileposts.* Also referred to as the Gray Notebook, the report highlights the status of current projects, details where transportation funds are being used, and updates progress on management and operations measures such as incident clearance time and travel information provision. Washington State DOT has found the customer-oriented performance measures to be very effective in drawing attention to the benefits associated with its transportation investments and in building credibility for the agency.

According to a Washington State DOT staff person:

"The Secretary felt that by building the state DOT's accountability, the agency could attract more funding. The Secretary focused on making the case that WSDOT is on top of things. The best way to do that was through operations data because it gets at aspects of the system that the public cares about."

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** The Buffer Index expresses the amount of extra time a traveler must allot for each trip in order to be on-time 95 percent of the time. As an index, this measure is useful for comparisons regardless of travel time and trip distance. The measure can also be presented in actual minutes of extra time required in cases where one wishes to evaluate reliability for a particular trip. Typically, the index is calculated for each road segment and a weighted average is calculated using vehicle-miles of travel as the weighting factor.*

By focusing attention on system characteristics that are important to our customers, the traveling public, increased emphasis is placed on bringing in the perspective of those involved in management and operations, who deal with transportation system users on an on-going basis.

Thus, the process of developing and implementing effective performance measures can motivate collaboration between transportation operations and planning staffs. Moreover, advances in ITS and real-time monitoring of traffic mean that operators have access to an incredible depth of traffic data that can be used to measure more accurately the real traffic conditions experienced by users. This information brings to light a range of issues, such as incident-related delay and reliability, which are important customer issues but have not traditionally been included as performance measures.

Performance Measures Elevate the Status of M&O Approaches

Efforts to focus on system performance often result in better recognition of the value associated with M&O approaches. Data on system performance can highlight the value of investments in programs that minimize incident-related delays, provide information on real-time travel conditions, and improve emergency response times by showing how they can improve transportation system reliability and reduce travel times for customers. The limited number of tools to quantify the benefits of operational strategies is often noted as a constraint in bringing greater attention to M&O strategies. However, there are a growing number of tools on the market today to predict the effects of operational strategies on system performance. (See Exhibit 5, below, for examples of several tools.) Some agencies also have found success in measuring performance before and after implementation of operations-oriented projects.

Box 12: Elevating M&O Strategies: North Central Texas Council of Governments (NCTCOG)

At NCTCOG, the MPO for the Dallas-Fort Worth region, data on system performance were used in developing an annual performance report to the MPO board (e.g.: region-wide lane-miles of congested roadway, transit on-time performance). The performance report presented a forthright statement to local officials about the significant transportation, air quality, and funding constraints facing the region. The performance report helped local officials appreciate the important place of M&O strategies in the regional transportation vision.

Measurement of performance in terms of incident-based delay also yielded positive impacts in the planning process in the Dallas-Fort Worth Region. When estimating vehicle emissions many regions that struggle with air quality issues do not consider the delay (and associated pollution) caused by incidents. As a result, incident response programs are undervalued. In response to this situation, NTCOG estimated the contribution of incident delay to regional emissions based on number of incidents, average delay per incident). As a result, the MPO was able to take credit in its air quality conformity analysis for emissions reductions resulting from a successful incident response program.

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Given increased traffic congestion, limited road space, and funding constraints, public decision makers in many areas recognize the limitations associated with constructing new transportation infrastructure to meet regional transportation goals. Use of performance measures, and measurement of the benefits of M&O strategies, can help these decision makers to appreciate the value of M&O approaches toward meeting both short-term and long-term goals (see Box 12).

Performance Measures Help Inform Policy Decisions

By focusing attention on system characteristics that are important to the traveling public, performance measures can help planners focus on the day-to-day experience of transportation system users. This provides important balance in settings where planners have been exclusively focused on very long-term development of the network. With greater focus on the day-to-day characteristics of the system, the issues faced by operators such as incident response, work-zone management, and provision of traveler information take-on greater importance. As a consequence, mid- and long-term planning will reflect greater consideration of management and operations planning and investment needs. Greater understanding of operations issues by planning staff can also help in setting transportation policies.

Exhibit 5: Sample Tools for Measuring Performance of M&O Strategies

IDAS (ITS Deployment Analysis System) – a sketch planning approach focused on helping practitioners with specific ITS investment choices. IDAS draws on a database of a diverse set of ITS project evaluations in order to provide comparative costs and benefits over a range of possible ITS alternatives. Comparisons may be less precise than other methods because they do not account for specific local conditions, but the tool is relatively simple to operate and has low data requirements. More information on IDAS can be found at: http://www.camsys.com/idas03.htm

PRUEVIIN (Process for Regional Understanding and Evaluation of Integrated ITS Networks) – an analysis methodology containing techniques, programs, and data sources designed to assess the benefits of several integrated ITS services at the corridor level. Once set-up, PRUEVIIN can be used repeatedly by both planners and operations personnel to explore optimal system arrangements, accounting for daily variability in travel demand, weather, and incidents. PRUEVIIN has modest data requirements but requires significant effort to operate. An application of PRUEVIIN can be found at: http://www.itsdocs.fhwa.dot.gov//JPODOCS/REPTS_TE//13605.html

DYNASMART-P – a software tool developed for traffic operations planning applications under Federal Highway Administration's Dynamic Traffic Assignment (DTA) research program. DYNASMART-P combines (1) dynamic network assignment models, used primarily in conjunction with demand forecasting procedures for planning applications, and (2) traffic simulation models, used primarily for traffic operations studies. DYNASMART-P overcomes the limitations of traditional static assignment and simulation models by using advanced traffic modeling techniques to capture the dynamics of congestion formation and dissipation associated with time-varying demands and network conditions. Potential applications include:

- Providing dynamic traffic assignment methods for traditional transportation planning analyses.
- Assessing impacts of Intelligent Transportation Systems (ITS) and non-ITS technologies on the transportation network in the planning process.
- Assessing impacts of different traffic operation and control strategies.
- Supporting decision-making for work zone planning and traffic management.
- Evaluating incident management strategies.
- Evaluating congestion-pricing schemes that vary with location, time, and prevailing roadway conditions.

DYNASMART-P is expected to be available in late 2004 from the McTrans Software Center: http://mctrans.ce.ufl.edu/. For further information contact Henry Lieu at FHWA, Henry.Lieu@fhwa.dot.gov.

LINKAGE IMPLEMENTATION

There are a number of opportunities to use performance measurement to build stronger linkages between planning and operations. Some specific ways to use include the following:

Involve Operations Managers in the Process of Developing Performance Measures

Agencies responsible for major investment decisions often take the lead in developing performance measures. However, it is critical that this process involve practitioners who are concerned primarily with day-to-day operation of the transportation system. The operator's perspective relates closely to near term concerns of the traveling public. Involving operations practitioners in designing performance measures may require understanding how these individuals can contribute, and extending a personal request that communicates why operations expertise is needed.

Incorporate Operational Performance Measures into Strategic and Long Range Transportation Plan (LRTP)

Performance measures in the LRTP should be driven by the goals and objectives of the plan, which in turn, should reflect the public's vision for its transportation system. Customers (including the general public, freight shippers, and others) increasingly care about operational performance of the transportation system, including the reliability of the system and the availability of information about travel conditions that can inform the best travel time, mode, and route (see Box 13).

Incorporating operational performance measures into the LRTP provides an avenue for operators and customers (through public involvement) to get involved in the planning process. It can provide better information to customers and stakeholders on the progress being made toward desired goals and objectives, and can therefore, serve to make long-range plans more "real" to the public. Moreover, incorporating performance measures helps to ensure that regional transportation system management and operations programs receive adequate attention in prioritization of projects for funding.

Box 13: Incorporation into Strategic Plans: California Department of Transportation (Caltrans)

Caltrans developed performance measures into the agency's strategic plan. The agency links transportation system performance measurement to informed decisionmaking by focusing on measures that reflect the role that the transportation system plays in achieving broader state objectives. The measures are focus on outcomes and address system-level characteristics rather than specific projects. Some of the measures oriented toward systems management and operations include:

Number of corridors with reasonable alternatives during closures, and

Hours of both recurring and non-recurring delay by mode.

Caltrans seeks to use the measures to improve partnerships with stakeholders and to improve linkages with non-transportation issues (such as economic development and shifting demographics). The agency has developed an operations-oriented strategy to provide a framework for coordinating institutional linkages and partnerships that are necessary for successful systems management.

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Use Operations Data for Tracking Performance in Annual or Quarterly Reports

Periodic performance reports provide an excellent mechanism to make planning more relevant to everyday experience. A number of MPOs, transit operators and State DOTs use performance reports to inform decision-makers about the trends in system performance.

Such reports work as a linkage in a number of ways:

- First, they provide a realistic view of system performance improvements achievable through management and operations investments.
- Second, they provide operations managers with guideposts and goals that provide some measure of how operations programs are contributing to the long-term goals of the system.
- Third, they support policy that is realistic about system constraints and that supports the role of management and operations in maintaining acceptable transportation performance.

Agencies that report performance measures in a quarterly or annual performance report encourage a sustained communications link between planning and operations staffs. Even a very simple report providing one or two performance measures can have a positive effect in broadening the discussion over investment priorities. There are many cases where a particular activity or project requires temporary coordination or exchange between planners and operators, but sustaining such communication is critical for changing the everyday perspective of these departments to routinely consider operations tools within the planning process. Routine, sustained, performance reporting is therefore, particularly valuable (see Box 14).

Box 14: Examples of Performance Reports

The Mid-Region Council of Governments (MRCOG), the MPO for the Albuquerque metropolitan area, demonstrates the region's transportation system performance through an annual publication called *Local Motion*. This performance information is available to the public on MRCOG's website and is intended to educate the public, the staff of local governments, and elected officials. *Local Motion* summarizes continuously collected traffic count data on freeways, arterials, and collector streets. Every three years, *Local Motion* includes a report card for the area's transportation system to assist in developing the long-range Metropolitan Transportation Plan. The report card rates the system based on criteria that relate to management and operations such as emergency vehicle response time, congestion levels, and miles of roadway with ITS coverage. As a result of these performance reports, transportation officials and the public are able to evaluate the success of existing programs and target future projects accordingly.

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Florida DOT (FDOT) prepares a *short-range annual performance report* that seeks to provide a yearly update on progress toward achieving state's long-range plan goals and objectives. The short-range plan relates annual performance to FDOT's three strategic goals summarized as follows: 1) preserve and manage a safe, efficient transportation system, 2) enhance Florida's economic competitiveness, quality of life and transportation safety, and 3) Pursue organizational excellence. An annual performance report that relates directly to the long-range plan helps motivate planners to consider the short-term tools that can contribute toward transportation goals. Such reports also provide a mechanism by which management and operations staff can see how they are contributing toward long-term objectives, thereby increasing their stake in the planning process.

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Use Performance Measures to Motivate Data and Tool Development

Given the rapid evolution of automated travel data collection technology, it is helpful to discuss performance measures beyond those that are supported by current capabilities. As one element of a performance measurement effort, transportation agencies within a region may jointly wish to define the most appropriate measures and associated data needs, without allowing current resources to limit the discussion. This can be used to establish goals for data collection and measurement and to provide some focus in reviewing the stream of evolving transportation information technologies.

LESSONS LEARNED

The very characteristics that make performance measurement a useful linkage between planning and operations can also make performance measurement a complex challenge. The process often demands new data and tools and may require new levels of coordination between agencies or departments. The following lessons have emerged from agencies that have faced such challenges.

Begin with Simple Output Measures

Some regions focus on output measures, which are often simpler than outcome measures. For example, the Maricopa Association of Governments performance measures include the number of signals coordinated and the percent of cross-border signals coordinated between cities. While not specifically related to the customer, such measures can still succeed in increasing policy and investment focus on the region's M&O progress. Output measures are particularly effective where there is already some appreciation among local decision-makers for the value of M&O solutions. Using simpler output performance reporting can inspire the attention and collaboration necessary to design measures that address the most important aspects of the system performance.

Do Not Expect a Clean and Simple Process

Defining performance measures takes time and may not yield immediate, refined outputs. This is particularly the case when the process is working. When new stakeholders and perspectives are attracted to participate, the process becomes more complex; deciding on concrete characteristics to measure raises difficult questions about the fundamental objectives served by the transportation network. Agencies should approach performance measurement with awareness that the effort will be a challenge. Initial performance measures may not be quite right, but initial steps are apt to attract greater interest and advance the effort.

2.4 CONGESTION MANAGEMENT SYSTEMS

BACKGROUND

First required in ISTEA, Congestion Management Systems (CMS) emphasize the role of management strategies to address traffic congestion within the regional transportation planning process. Because the CMS is a Federal metropolitan planning requirement with a specific policy goal of emphasizing systems management and operations, it can serve as a strong link between planning and operations.

What is a Congestion Management System?

A CMS presents a systematic process for managing traffic congestion and provides information on transportation system performance. A CMS should include alternative strategies for alleviating congestion and enhancing the mobility of persons and goods to levels that meet state and local needs.[9] A CMS can take a variety of forms. At the core, a CMS should include a data collection and monitoring system, a range of strategies for addressing congestion, performance measures or criteria for identifying when action is needed, and a system for prioritizing which congestion management strategies would be most effective (see Exhibit 6). These components are typically described in a CMS report.

A CMS is required in metropolitan areas with population exceeding 200,000, known as Transportation Management Areas (TMAs). In TMAs designated as ozone or carbon monoxide non-attainment areas, the CMS takes on a greater significance. Federal guidelines prohibit projects that increase capacity for single occupant vehicles unless the project comes from a CMS.[10] Federal requirements also state that in all TMAs, the CMS shall be developed and implemented as part of the metropolitan planning process.

Exhibit 6: A CMS must do the following

- Measure multi-modal transportation system performance
- Identify the causes of congestion
- Assess alternative actions
- Implement cost-effective actions
- Evaluate the effectiveness of implemented actions

How Can a CMS Create Stronger Linkages between Planning and Operations?

The CMS process is one of the few federally defined components of the metropolitan planning process that consistently involves transportation operations. A CMS can create stronger linkages between planning and operations by helping to raise awareness among the planning community of the efficiencies that operational strategies contribute, and by exposing operations managers to regional planning. A CMS can be an integral component of the planning and programming process when CMS performance measures and strategy evaluations are fully utilized in the development of the long-range plan and TIP. These linkages are described below.

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[9] Federal Register, Part III, FHWA, FTA, U.S. Department of Transportation, Management and Monitoring Systems. Section 500.109.

[10] Safety improvements and the elimination of bottlenecks are exceptions to this restriction.

A CMS Can Expose MPOs to a Broader Range of Strategies for Addressing Congestion

Federal regulations require that a CMS give serious consideration to strategies that have a demonstrable impact on congestion and that a CMS include an assessment of the cost effectiveness of strategies. A CMS must consider strategies that "improve existing transportation system efficiency." Thus, the CMS development process may highlight opportunities to address congestion using cost-effective operations strategies that might otherwise be overlooked.

In cases where the CMS considers a broad range of strategies, the planning staff involved in CMS development is exposed to a diverse set of management and operations solutions. For example, some CMSs include operations strategies that address non-recurring congestion. These types of strategies are more likely to be included in a transportation plan when they are put forth as part of the CMS process. Explicit consideration of non-recurring congestion in a CMS may also help to engage the planning and policy community in the significant challenge of defining and measuring congestion.

A CMS Puts Performance Measures into Practice

A large part of the CMS process involves the development and implementation of performance measures (see Box 15). In fact, every CMS is required to use performance measures to evaluate congestion mitigation strategies.[11] Performance measures can help link planning and operations by focusing attention on customer-oriented outcomes and elevating attention to operations strategies within the transportation planning process. Because the development of a CMS entails a multi-agency, public process, the CMS performance measures are regionally endorsed, meaning that a broad range of stakeholders have a say in them. When the process successfully engages a diverse set of stakeholders, it can function as an educational tool, bringing attention to performance measurement and to operations strategies that can efficiently address regional mobility concerns.

Box 15: Wilmington, Delaware CMS Considers System Impacts of Forecasted Growth

Representatives from a diverse group of Federal, state, county, and city agencies developed the 2003 CMS for the Wilmington Area Planning Council (WILMAPCO). WILMAPCO's CMS takes a systems approach to addressing congestion by carefully considering the regional effects of local solutions before making recommendations. As an integral part of the WILMAPCO planning process, the CMS begins by assessing the performance of the system with the following metrics: volume/capacity, intersection level of service, percent of posted speed, and transit utilization. These metrics are evaluated for four different land-use/growth scenarios developed through the regional planning process. The CMS evaluates strategies for addressing congestion, with priority given to demand management, then roadway operations, and finally capacity additions. The system impacts from projected economic, population, and employment growth is also used to prioritize mitigation strategies. Recommendations are then evaluated and prioritized in the region's long-range transportation plan. The most recent WILMAPCO CMS can be found at http://www.wilmapco.org/cms/index.htm

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A CMS Can Promote a System-level Approach by Operations Managers

While the CMS can expose planners

[11] In this regard, many of the opportunities to link planning and operations described in Section 2.3 (Performance Measurement) exist within the CMS process.

to new operations strategies, it also can help operations managers view problems at the regional, cross-jurisdictional systems level. When a CMS is explicitly driven by regional goals and objectives, and when operations managers are involved in the CMS development and implementation, it affords an opportunity for operations managers to recognize how their transportation strategies support the underlying objectives of the region's transportation planning and programming. In addition, the CMS allows operation managers to see their congestion mitigation strategies on the table along with a diverse range of alternative strategies. This presents an opportunity for interjurisdictional discussions about which strategies work in coordination. In some cases, a planning agency will specifically prioritize coordination between different congestion mitigation strategies, thus providing an incentive within the CMS for operations staffs to work together.

LINKAGE IMPLEMENTATION

Regions have a number of opportunities to use the CMS to advance planning and operations coordination. The most appropriate steps to enhance this coordination depend on the degree to which a region is currently using its CMS for decisionmaking. Following are several opportunities.

Involve Operations Managers in CMS Development

Although the CMS is the responsibility of the MPO, the expertise of transportation operations managers is vital to developing and evaluating congestion mitigation strategies. Because the CMS typically considers a diverse set of strategies, it is often accessible to a wide range of stakeholders. A concerted effort to engage operations managers in CMS development and implementation is likely to be rewarded, not only by a more effective CMS, but by the information sharing that occurs during CMS development.

Some actions may help draw additional stakeholders to the CMS process:

- *Define clear roles for operations staff.* Examples of roles for operations practitioners include brainstorming operations oriented congestion mitigation strategies, identifying congestion data sources and measurement techniques, developing balanced performance measures, and identifying approaches to strategy implementation.

- *Summarize CMS actions that have been implemented to date.* This can help stakeholders to see that the prioritization of projects and strategies through the CMS process actually influences funding and implementation priorities. To improve this understanding, consider identifying specific strategies that have been implemented because of their identification and performance within the CMS process.

- *Propose CMS Strategies for Non-Recurring Delay.* A CMS should include a full range of operations strategies, including strategies that seek to reduce recurring and non-recurring delay. Raise the issue of non-recurring delay with the CMS team and identify currently listed and new strategies to reduce this source of congestion. Some examples of strategies to reduce non-recurring delay include incident response programs, work zone management strategies, and event coordination.

Integrate the CMS into the Planning Process

The CMS can best link planning and operations when it is explicitly integrated into the development of regional planning and programming documents, including the long-range plan, the TIP, and the unified planning work program (see Box 16). Making this integration transparent and consistent will help to ensure that the CMS process attracts a range of stakeholders and serves as a focus for planning and operations collaboration. One way to link the long-range plan with the CMS is to require that the performance measures used in the CMS evaluation also be used to evaluate the performance of the long-range plan. Linking to the TIP can be accomplished by establishing a clear relationship between the evaluation and performance of strategies in the CMS and the prioritization of those strategies for inclusion in the TIP.

Ideally, a CMS involves transparent performance measures that have been developed through regional consensus and that reflect regional objectives. If the CMS applies these performance measures consistently, it would be appropriate to use the CMS directly in determining regional funding priorities.

Box 16: Approach to Integrating CMS into Planning

Salt Lake City Region - Using the CMS to Promote a Balanced Transportation Program

The Wasatch Front Regional Council (WFRC), the MPO for the Salt Lake City area, uses its CMS as a tool to assist in the development of the Long-Range Transportation Plan and the TIP. First, it determines levels and locations of congestion using both modeled peak-period delay as well as archived field data. Second, specific locations prone to congestion are addressed directly with proposals of Transportation System Management (TSM) and Travel Demand management (TDM) solutions that compete for funds. Sponsors of capacity-increasing projects receive guidance from WFRC on which TDM and TSM strategies would be effective for their projects. Third, the CMS affects the project selection process by using models to identify areas most likely to experience future congestion. Results are given to the Long Range Planning team for consideration in the plan. As part of their ongoing CMS analysis, WFRC evaluates the effectiveness of congestion relief strategies by collecting “before and after” data on implemented projects.

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Integrating the CMS with the MPO’s annual Unified Planning Work Program (UPWP) can be an effective way to promote planning and operations collaboration (see Box 17 below). The UPWP defines the MPO’s short-term (I-2 year) planning priorities within a metropolitan planning area, and involves a time frame that is more familiar to those involved in management and operations activities. Many of the strategies discussed in a typical CMS are well suited to short-term MPO programmatic reporting. Similarly, strategies commonly addressed within the UPWP, such as TDM programs and ongoing regional management and operations programs, are appropriate for inclusion in a CMS.

Box 17: New York’s Capitol District Region Links the CMS with the UPWP

The Capitol District Transportation Commission in the Albany, New York metropolitan area prioritizes management strategies in developing the CMS and then builds CMS principles and strategies into the long-range plan. Recommendations from the CMS appear in the Unified Planning Work Program. Because the outcome of a CMS leads to strategies and programs that receive funding, the process can attract substantial regional and professional interest.

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Use the CMS to Build a System for Rapid Response to Congestion Issues

In addition to linking with longer term planning goals and forecasts, a CMS can be designed to swiftly address small-scale congestion problems that threaten the efficiency of the regional transportation network (see Box 18). Prioritization criteria and funding set asides can be established to support small-scale projects and programs that do not justify a larger corridor analysis. By building the capacity of the regional planning agency to deliver immediate solutions, the planning agency can become more responsive to the needs of the traveling public and more relevant to the transportation management and operations community.

Box 18: The Miami Region CMS Can Respond to Short-term Transportation Needs

Miami's RUSH (Resourceful Use of Streets and Highways) addresses congestion bottlenecks that do not justify a full corridor study. Projects that cost less than $500,000 and that are determined to have insignificant environmental impacts are prioritized by member agencies. A lump sum of TIP money is set aside for projects that will be selected through the RUSH process, allowing for swift implementation of the designated improvements.

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LESSONS LEARNED

Since the passage of ISTEA in 1991, regions have been involved with the CMS process, and have learned a great deal about the benefits and the challenges of building and maintaining a comprehensive CMS. This section highlights a few of the lessons that relate most closely to planning and operations coordination.

Full Potential Yet to be Achieved

In some regions, the CMS functions primarily as a routine analysis and data collection process, isolated from most planning and programming and from ongoing management and operations efforts. Such regions could be capitalizing on an opportunity to highlight and coordinate operations strategies. The CMS can play a more active role in the regional planning and programming process if it is used to analyze and prioritize regional projects. This will also help to attract stakeholders to the CMS process.

For several reasons, the CMS process has been marginalized in some regions. However, many of these challenges can be overcome. For example, intensive data collection activities have turned some stakeholders away from the CMS process. Fortunately, the effort required to collect data relating to congestion has become easier with ongoing implementation of ITS technologies, and in some cases, data are actively collected to support advanced traveler information systems. In reality, the CMS is a particularly useful tool to engage diverse practitioners because it considers multiple modes with congestion mitigation in mind. The CMS should be promoted as a process to encourage focused, performance-based multimodalism.

If policy weight is given to the CMS project prioritization process, other challenges may arise due to resistance from stakeholders who see the possibility of losing current levels of support. While this is a significant challenge, the debate that it inspires is an opportunity to engage stakeholders in a conversation about regional performance measures and how they fit into congestion management strategy investments.

Regions that take steps to make use of the CMS as a valuable tool for linking planning and operations will be rewarded with better regional collaboration and more efficient and targeted transportation policy priorities which ultimately will lead to a transportation system that is more responsive to its customers.

Comparisons of Operations Strategies with Other Strategies Presents Challenges

The quest for rigorous evaluation criteria is a significant challenge to the CMS process. Some CMS projects do not lend themselves to quantitative analysis of their effectiveness. Other CMS projects can be quantified, but not in a way that facilitates comparison with other types of strategies. For example, comparing the effectiveness of demand management strategies with system management strategies may present problems because they differ in their immediate objectives.

A diverse set of analysis tools is an important component of a successful CMS (see Box 19). In some cases, specific tools and methods will be needed to evaluate strategies. Many regions are seeking tools that can capture the effects of regional management and operations strategies. Regions that have invested in the development of such tools and methods have found benefits through a more versatile CMS process.

Box 19: New York City Region's Tools for Management and Operations in the CMS

The New York City Region MPO uses the Post Processor for Congestion Management Systems (PPCMS) as a methodology for predicting the impacts of incidents on freeways. PPCMS uses the estimation of delay as a result of freeway incidents in combination with analysis of incident data obtained from eight U.S. metropolitan areas as the basis for its calculations. This tool is focused exclusively on accounting for non-recurring delay.

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Key Resources on Congestion Management Systems

- FHWA Resource Center CMS Course: http://www.fhwa.dot.gov/resourcecenter/courses_mp.htm#scms
- FHWA Peer Exchange on the CMS for the Albany, NY region: *http://www.planning.dot.gov/Peer/Albany/albany_peer.htm*
- CMS for the Wilmington, DE region: *http://www.wilmapco.org/cms/*
- CMS for the Salt Lake City, UT region: *http://www.wfrc.org/programs/cm.htm*

2.5 FUNDING AND RESOURCE SHARING

BACKGROUND

In developing strategies to fund M&O activities, regions have an opportunity to promote new relationships and arrangements that support broad regional systems management perspective and better link operations with regional planning. For example, a planning and programming process that places a high priority on interjurisdictional coordination can encourage normally independent practitioners to collaborate and identify opportunities for shared equipment and facilities. Funding strategies can also be used to help ensure implementation of M&O objectives developed through the planning process or to attract new operations stakeholders to planning forums. This section discusses strategies that use funding and resource sharing to improve coordination between planning and operations.

What is Funding and Resource Sharing?

Funding and resource sharing refers to a variety of arrangements by which transportation and other operating agencies collaborate to submit funding requests, develop pooled funding mechanisms, or share equipment and facilities. As a linkage mechanism, this also refers to efforts to increase the consistency between transportation systems management as discussed in plans and the associated regional funding policies and commitments.

What are the Sources of Funds for Management and Operations Efforts?

A number of funding sources can support management and operations activities and equipment. In practice, however, funding for system management and operations must often rely on the discretionary budgets of individual jurisdictions and/or agencies.

Federal policies allow several funding sources to be used for regional systems management and operations programs. In TEA-21, the Federal-aid Highway Program continued eligibility of operating costs for traffic monitoring, management, and control systems. Such operating costs can include funding for both the establishment and continuous operation of management systems such as integrated traffic control systems, incident management programs, and traffic control centers.

For projects located in air quality non-attainment and maintenance areas, Congestion Mitigation and Air Quality Improvement Program (CMAQ) funds may be used for activities that demonstrate a reduction in traffic delay or emissions. CMAQ can support an individual M&O program for up to 3 years.[12] Examples of projects eligible for CMAQ funds include the implementation of ITS strategies, enhanced signalization projects, and intersection improvements.

Although there are greater federal funding opportunities for management and operations than many regions perceive the bulk of funds typically must come from states and localities. State and local funding processes make it difficult to fully integrate planning and operations by creating separate categories of funds for capital and operations expenses.

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[12]]Eligibility requirements for CMAQ are listed in 23 USC 149(b).

Degrees of Funding and Resource Coordination

The structure of resource sharing arrangements may evolve over time in response to changing regional needs and changing relationships between agencies. Initially, sharing may be limited to supplying staff, equipment, or facilities in support of regional meetings or other regional collaboration activities. If appropriate, participating public and private organizations may develop more formal sharing arrangements, including pooling of funds and other resources to sustain cooperative regional efforts. In some regions, agencies may provide funding to support a regional entity charged with leading regional collaboration or an entity that owns and operates regional transportation system assets. Exhibit 7 illustrates this range of resource strategies.

Exhibit 7: Range of Resource Strategies

Less Formal ←		→ More Formal
	Pooled Resources	**Funding Entity**
• Individuals commit to periodic meetings to address issues of regional significance. • Agencies assign staff members and other resources (equipment, facilities) to support collaboration efforts on an ongoing basis.	• Jurisdictions and public and private organizations pool funds, people, assets, and other resources to sustain collaboration. • Agencies and jurisdictions commit resources (people, assets) to be used in regional operating activities (e.g., mutual assistance agreements).	• Jurisdictions and public and private organizations allocate funds to support a regional entity responsible for regional collaboration. • Entities are formed and funded to own and operate assets (e.g., transit systems, maintenance vehicles, emergency response assets) on behalf of multiple jurisdictions.

Source: Regional Transportation Operations Collaboration and Coordination, FHWA, 2003.

LINKAGE IMPLEMENTATION

All regions lack sufficient funds to implement the full spectrum of transportation projects and programs desired by the region. Sometimes, competition for resources between and within agencies can hinder regional coordination and prevent the region from achieving the full benefits of system-wide M&O strategies. This section discusses some approaches to funding and resource sharing that can help to build bridges between planning and operations practitioners.

Link Funding to Planning Goals and Objectives

Increasingly, local and regional transportation plans include language supporting improved transportation systems management, promoting more efficient use of existing infrastructure, and adopting a more customer-oriented approach to transportation service provision. Yet the funding and staff resources to support the implementation of such planning objectives are often lacking. For example, a plan might state that regional coordination to maximize efficiency of the existing system is a top priority, but no funding is then allocated toward regional incident management programs, corridor management strategies, or regional traveler information systems.

Several approaches have been used to more closely link funding to operations goals. One approach is to have regional stakeholders determine minimum budget requirements to support long-range transportation plan objectives in each program area (see Box 20).[13] Based on these minimum requirements and total funding availability, each program area is assigned a target budget. Projects slated to receive new funding are then prioritized based on whether the target has been met for each proposed project's program area. For example, if new roadway construction is targeted to receive 40% of the transportation budget and the current TIP devotes 50% of its funding to this category, then other program categories (such as M&O) would receive higher priority when selecting projects in a new TIP.

Box 20: Albany New York's Funding Prioritization Process

The Capital District Transportation Commission (CDTC) is the MPO for the Albany, New York metropolitan area. CDTC brought together a wide range of stakeholders from 1993 to 1997 to develop a new approach to long-term planning. This effort involved workshops, conferences, nine topical task forces, and a yearlong public review. The product was a more integrated approach to long-term planning and new prioritization procedures that acknowledge the importance of a variety of transportation options, from management and operations strategies to TDM to smart growth.

One critical outcome of this long range planning process was a new method for funding allocation. It defined the distribution of all regional funds between 17 project categories, consistent with the proportions agreed upon through the planning process. Projects in a given category could not be added to a new TIP if the current TIP projects exceeded the designated funding percentage for that category. This process has worked to balance the distribution of funds in a way that is more consistent with the plan's stated priorities. For example, road construction projects have consistently used more than their target share of regional dollars because of a backlog of TIP projects in this category. Consequently, no new roadway construction projects have been added to the TIP, allowing other classes of projects (such as ITS) to come closer to their target share of regional funds.

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Some regions employ a project prioritization process that deliberately assigns more weight to projects that support regional management and operations objectives, as outlined in the region's long-range plan. This approach encourages planners and operators to cooperate when assessing the cost-effectiveness of management and operations strategies. In these cases, the likelihood that management and operations programs receive significant funds depends on how M&O criteria are weighted relative to other prioritization criteria. At a minimum, this approach will assist stakeholders in clearly articulating where M&O investments should be positioned amongst the region's competing transportation needs.

Develop Innovative Operations Funding Sources

New funding mechanisms can help to create bridges between planners and operations managers. One strategy is to fund certain M&O efforts as part of an initial capital investment (e.g., ITS equipment that enhances corridor management activities, see Box 21 below). Planners and operators increasingly recognize that the best time to secure funds for management and operations is at the moment when funds are allocated to major new construction or rehabilitation. Working together, planners and operators can make the case that

[13] Program areas include, for example, ITS, bicycle and pedestrian systems, transit programs, and roadway construction.

proper management of new transportation facilities will maximize the long-term benefits of the initial investment. Some areas have required consideration of M&O by developing a checklist for project sponsors.

Box 21: Hampton Roads Region Includes ITS in Long Range Investment Planning

The Hampton Roads region incorporated ITS into the MPO's project selection process for regional STP and CMAQ funding programs. ITS projects were scored for their capacity to support planning objectives. As a result, several ITS plans and projects have been funded through this process, including a regional roadway information system, a centralized traveler information system, signal system upgrades, and implementation of the local Smart Traffic Centers. ITS is also a distinct element of the MPO's long range plan. The current draft of the region's 2026 Plan includes long range investments for future ITS projects.

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In the search for funding for system operations, some regions have turned to land developers. The practice of requiring developers to fund transportation improvements as a way to mitigate the transportation impacts of their projects is well established, but relying on this as a source of management and operations improvements is relatively new (see Box 22). Developer concessions can provide an important source of revenue, and can also encourage more detailed planning for management and operations programs. In order to require developer funded improvements, local governments typically must show how the management strategies can mitigate transportation impacts, such as improvements to traffic flow in a particular corridor. This funding opportunity may also prompt local governments to more thoroughly identify management and operations needs so that individual funding opportunities can work together to support an integrated operations approach. This is critical, since operations must typically be applied on a system rather than spot location basis.

Box 22: Developers Fund Operations in Montgomery County

In Montgomery County, Maryland, an impact fee for large developments has replaced the use of some discretionary transportation funds. This new funding source has helped to promote coordination between planning and operations. The county's public works department is using these impact fees to fund operations equipment, such as monitoring cameras and signal timing improvements. In one instance, a major development funded an electronic message sign that indicates when transit parking is filled at more central rail stations, encouraging vehicles to use station parking lots located further from the region's core.

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Planning and operations coordination can also be strengthened when transportation management strategies are viewed as a potential source of transportation dollars. Pricing mechanisms are an effective tool for managing transportation demand and achieving more efficient use of existing facilities. Moreover, new technologies, such as electronic toll collection, can enable greater use of pricing while reducing collection costs. They can also serve to generate funds for both management programs and new infrastructure. As such, these transportation management strategies naturally capture the interest of planners and decisionmakers, opening the window for a broader discussion between planners and operations managers.

As a first step toward incorporating some of the funding strategies such as those discussed above, examine regional planning documents for goals or objectives that support regional systems management activities. Consider how such objectives are supported with funding, performance measures, or decision criteria in the plan. Develop recommendations for plan

future updates that could promote funding for management and operations objectives, such as project prioritization criteria that favor M&O strategies or multi-jurisdictional operations initiatives.

Build on Emergency Response Needs to Create Regional Momentum for Collaboration

The recent focus on improving emergency preparedness and response has heightened the need for coordination between planning and operations. Increased transportation resources are available to conduct emergency response exercises and planning. Explore these funding sources as well as opportunities to use existing emergency management activity to initiate regional interagency collaboration.

Prioritize Multi-Jurisdiction Funding Requests

A number of MPOs give preference to collaborative funding requests in the project prioritization process (see Box 23). This encourages funding requests for ITS and other systems management initiatives that are coordinated between organizations and jointly submitted by different agencies and jurisdictions. Inter-jurisdictional collaboration is frequently a stated objective or strategy in regional transportation plans, so preference for these funding requests is well justified. Such coordination can help to promote a regional systems management approach.

Box 23: Salt Lake City Region Encourages Joint Funding Requests

In the Salt Lake City Region, the MPO has indicated its preference that applications for limited ITS funds come from multi-agency teams. As a result, Utah DOT, the Utah Transit Agency, and individual cities routinely submit joint applications. This has increased interagency management and operations coordination and limited the number of times that the MPO must go through the process of selecting between individual city requests.

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Integrate Capital Investments and M&O within one Budget Process

State and regional management and operations activities are often lumped under broad operations budget categories. These operations categories are usually assessed through a process that is separate from the capital investments planning and budget process. Where this is the case, MPOs might consider ways of incorporating specific management and operations activities as individual budget items within the capital investments budget.

Along the same lines, transportation agencies may consider addressing management and operations costs associated with a particular project as part of the capital investment decisionmaking process. This is can link planning and operations by explicitly addressing M&O investments that would be required to optimally integrate the proposed project. This would provide a stronger motivation to include operators in the discussion of the M&O costs associated with capital investments. (NOTE: This discussion does not imply that routine operating costs would be supported with Federal funds.)

Share Office Facilities

Sharing office facilities inspires enhanced collaboration. In some cases, office sharing is intended because there is recognition that transportation agencies must be working in the same space to do their job more effectively (see Box 24 below). A common example is a traffic

management center shared by traffic operators, transit staff, and public safety personnel. In these cases, the planning and development of such facilities functions to inform all stakeholders about the importance of regional coordination between practitioners in these lines of work.

Box 24: Central Ohio Regional Transportation and Emergency Management Center (CORTRAN)

In 2001 the Mid-Ohio Regional Planning Commission (MORPC) recognized the need for a multi-jurisdictional operations facility where transportation and emergency agencies work side-by-side to manage traffic, transit, incidents, and emergencies. MORPC conducted a feasibility and cost study, involving stakeholders in the identification of funding opportunities and in the development of an operational concept, functional requirements, and overall design of the facility. Following the study, CORTRAN evolved into a collaborative effort between state, county, and city transportation agencies, as well as emergency and public safety agencies. When the facility is finished, CORTRAN will have 50 to 60 full-time staff to control the Columbus Freeway Management System, to operate a transit computer-aided dispatching service, and to monitor video feeds of the local roads. The expected benefits of CORTRAN include improving incident management, coordinated emergency response, avoiding duplicate facilities, and providing a single source for media and communications. MORPC continues to support the CORTRAN effort by including it in the TIP with state and local funds, and by guiding the partners in forming an intergovernmental agreement.

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At times, sharing of facilities is not by design. Groups that typically work independently may be required to share office space due to funding or facility limitations. Some agencies that have found themselves unintentionally co-located have discovered that this makes an important difference in the degree of communication between practitioners. When planners and operators are co-located, they are more likely to communicate about their projects, develop new personal relationships, and discover opportunities to assist each other.

In many cases, there is a tradition of agency and jurisdictional independence, and some practitioners may have never considered options for sharing facilities or equipment. The increased efficiency and professional ties that can grow from such cooperative arrangements suggest that they this should be a more conscious part of institutional consideration.

Use Funding as a Tool to Attract Participation in M&O Discussions

Funding is a powerful tool for promoting participation. When groups are unaccustomed to coordinating with many other agencies or perceive that such coordination would provide more hardship than benefit, one way to overcome this barrier is to provide additional resources to such groups in exchange for participation in collaborative efforts. In some cases, MPOs have attempted to create training programs or other forums to promote the consideration of management and operations strategies (see Box 25 below). There are inevitably difficulties in getting some jurisdictions or stakeholder groups to the table, particularly when a forum or activity is not part of an established regional process. MPOs have had success in overcoming these barriers by linking participation to funding access. For example, a jurisdiction may become eligible for matching funds only by participating in a management and operations training program. Or a public safety group may gain access to new sources of funds contingent upon its participation in regional M&O forums.

Box 25: Examples of Using Funding to Attract Participation

The North Central Texas Council of Governments developed training on sustainable development that incorporated management and operations priorities. The MPO used access to a new source of local matching funds as an incentive to get local jurisdiction managers to participate.

In order to demonstrate to public safety officials that participation in regional incident management discussions can lead to tangible results, the Maryland DOT paid for the retrofit of police facilities to accommodate Coordinated Highways Action Response Team (CHART) equipment and staff, and paid for additional state police vehicles in order to improve response times to incidents.

LESSONS LEARNED

This section reviews some lessons learned through efforts to secure funding for M&O programs. Past experience has highlighted some of the challenges associated with using resource sharing as a means to link planning and operations, and provides guidance on some ways to overcome these challenges.

Funding Constraints Can Elevate M&O Solutions

Almost every transportation agency identifies inadequate funding as a major concern. At the same time, virtually every agency acknowledges that funding constraints are a major impetus for advancing management and operations strategies. Planners often become champions for management and operations strategies only when they recognize a serious discrepancy between available funds and the cost of new capital investments necessary to maintain regional mobility (see Box 26). This does not imply that planners should wait until desperate times before offering regional leadership on management and operations coordination, nor does it imply that practitioners should always view operational improvements and new roadway construction as a trade-off. Rather, the lesson is that periods of severe funding shortfalls should be seen as opportunities to educate a broader regional constituency about management and operations solutions.

Box 26: Washington DOT Policy on Funding

Washington State DOT had to address a severe disparity between transportation needs and revenues in its 20-year transportation plan. The plan prioritizes investment choices as follows:

1. Maintenance, traffic operations, and preservation activities are top priorities and are first in line for available revenues.
2. Highway safety, environmental retrofit, economic initiatives, and a Puget Sound core system of HOV lanes are high priorities and are second in line for available revenues.
3. Revenues remaining after the above priorities are addressed go to other highway mobility improvements.

Traffic operational solutions are considered as the first step in addressing a congestion problem identified in the plan. The stated goal of operational strategies is to reduce delay of both people and freight on the state's system. The plan defines operational strategies to include traveler information systems, safety enhancements, ramp metering in peak hours, service patrols and incident response teams, signal timing and HOV lanes, and improving advanced technology applications for commercial vehicles.

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Perspectives Differ on the Value of Dedicated M&O Funding

Practitioners voice significantly different perspectives regarding how funding sources can best be structured to promote management and operations more consistently during the planning process. Some practitioners find that management and operations strategies are hindered by regional, State, or Federal restrictions on how particular funds can be spent. From this perspective, funding categories tend to prevent systems managers from using the most efficient approach to manage the transportation system. For example, one region maintains that ITS earmarks have been detrimental to integrated planning because they tend to set ITS on a separate track from other transportation planning activities. In some cases, this may mean that the planners and stakeholders who are involved in regional transportation planning are not exposed to ITS strategies.

Other practitioners have observed that the absence of funding sources specifically designated for management and operations can make it difficult to include such projects in the long-range transportation plan (see Box 27). Although M&O activities are frequently funded under broad operations or TDM categories, this often means that they are not specifically listed in the funding program. By creating more narrowly defined M&O funding categories, MPOs and State DOTs can make it clear to agencies and jurisdictions that such projects are appropriate uses for regional, State, and Federal funds. They also elevate the profile of such activities among transportation practitioners.

Box 27: Baltimore Region Considers M&O Project Categories

Staff members for the Baltimore Regional Management and Operations Partnership submitted a traffic detection and real-time traffic operations project for consideration in a recent update of the regional transportation plan. The project did not technically fit under the capacity expansion or the maintenance and system preservation categories. Ultimately, this project was lumped together with other projects in a general TDM/TSM category. For the next plan update, the Partnership has recommended that it work with the MPO to revise project categories so M&O projects can be considered alongside traditional capital projects.

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MPOs and DOTs May Resist New Operations Programs

Both MPOs and State DOTs tend to be reluctant to commit to new management and operations programs. This is generally because of the perspective that these activities are continuous and therefore commit the agency to provide funding every year or else face the unpopular option of cutting an existing program. Consequently, MPO and DOT leaders prefer that such ongoing funding requirements be left to local jurisdictions. This can create a situation in which management and operations activities are a patchwork of programs from various jurisdictions, limiting their efficiency and effectiveness at the regional scale.

CMAQ Provides Pilot Funds for M&O Strategies

Air quality nonattainment areas have access to Federal CMAQ funds for management and operations activities that can reduce congestion and improve air quality. This program has proven to be an important source of funds to initiate regional M&O programs. Because CMAQ funds require consideration of how the project can relieve congestion and improve air quality, use of the funds also functions to highlight the capacity of M&O projects to serve regional

planning goals. In some cases, the projects prove to be popular and are then funded by local sources.

The Unified Planning Work Program Can Help Define Commitments to M&O Planning

Planning agencies continue to face the perception that management and operations planning is a secondary activity to other MPO and State DOT responsibilities. As such, when agencies are facing staffing and funding shortfalls, it can be difficult for them to initiate regional systems management activities. Some MPOs have found that specific enumeration of regional management and operations activities in the agency's Unified Planning Work Program (UPWP) is a way to ensure that such activities are implemented (see Box 28). This also builds the understanding that the MPO intends to take a leadership role on regional M&O issues.

Box 28: Maricopa Association of Governments Uses the UPWP to Support M&O

Through the development of an initial regional ITS architecture, stakeholder agencies and jurisdictions in the Phoenix metropolitan area recognized the need for a Regional Concept of Transportation Operations. The Maricopa Association of Governments, the region's MPO, wanted to ensure that this M&O planning work took place in a timely fashion because it was central to ongoing M&O coordination activities. By including the Regional Concept of Operations project in MAG's UPWP, staff ensured financial support for this critical activity. The project was completed in 2003 and is the fist comprehensive example in the US for an urban transportation operations plan.

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2.6 INSTITUTIONAL ARRANGEMENTS

BACKGROUND

In most regions, institutional issues are one of the most significant barriers to a coordinated regional approach to transportation planning and operations. Today, a variety of changes are occurring that necessitate rethinking existing institutional arrangements and, at the same time, that provide opportunities to address some of these institutional barriers. For example, technological advances have allowed the deployment of ITS systems that cross many jurisdictional boundaries, requiring coordination in funding and operations. Transportation agencies that have traditionally focused on planning, programming and maintaining roadway capacity additions are now focusing more on managing and operating a mature system. There is also greater need for public and private sector collaboration, and for more cooperation among public agencies, partly in response to funding limitations and partly in response to the increasing system performance effects of non-recurring incidents. As a result of these changes, transportation agencies are taking on new responsibilities and exploring new relationships. This section discusses how institutional arrangements can be put to use to strengthen the linkages between operations and regional transportation planning and programming.

What Is Meant by Institutional Arrangements?

Institutional arrangements refer to agreements and organizational structures both within transportation agencies and between agencies. This can mean forums that regularly bring together transportation planners and operations practitioners. It also refers to arrangements that promote involvement of management and operations practitioners in planning processes, or that promote a regional planning perspective within an operations environment.

New institutional arrangements are created for a number of reasons. There may be a seminal event (e.g., hosting a major national or global event, or responding to a major natural disaster) that motivates planning and operating agencies to coordinate more effectively. New arrangements may also be conceived to manage new programs (e.g., ITS), to respond to new State or Federal mandates, or to take advantage of new funding sources. Moreover, arrangements are often formed to achieve a specific regional operations objective, such as regional management of work zones, coordinated incident management, or ITS deployment. Sometimes these regional institutional arrangements broaden their mandate over time to include an integrated set of operations-oriented strategies.

Some of the examples discussed as part of other opportunities in Chapter 2 highlight institutional arrangements that can link planning and operations for the purposes of a specific process (e.g., an interagency committee that oversees the development of performance measures). Many regions have other types of institutional arrangements that focus on M&O more broadly, and can serve as a link to regional planning activities. Although the circumstances that lead to institutional innovation may differ across regions (see Box 29 below), examples of arrangements that better tie together planning and operations include the following:

- Regional management and operations committees within the MPO or other regional body,
- Regional collaborations that function as independent partnerships between transportation and public safety organizations,

- Transportation agencies that include both operations and planning divisions (often State DOTs and transit agencies), or
- Regional traffic management centers co-managed by public safety officials and traffic operations staff.

Box 29: Examples of Circumstances That Led to New Institutional Arrangements

- of the merger of two smaller MPOs. At the same time that these two MPOs merged, the two major transit agencies in the region also merged. These shifts established the need for institutional change as well as interjurisdictional and interagency coordination. A culture of enhanced collaboration and communication arose at the time when ITS opportunities were beginning to be taken seriously in the planning process. The challenges associated with ITS implementation highlighted the benefits of a more collaborative regional environment.

  divided between two states, making it difficult for one State DOT to take the lead on operations coordination. As a result, the Mid-America Regional Council (the region's MPO) has taken on a leadership role in management and operations issues out of necessity.

  roadway, and port operating agencies in the states of New York, New Jersey and Connecticut. Under these circumstances, the need for regional operations coordination was so extreme that an agency devoted to coordinating construction projects, emergency response, and traveler information services was conceived. Today, this multi-agency body can bring a coordinated management and operations agenda to the planning table.

How Can Institutional Arrangements Improve Planning and Operations Coordination?

Institutional arrangements such as those discussed above can improve the linkage between planning and operations in a number of ways. They enable the development of a regional vision for systems management and operations, which in turn creates an opportunity for addressing technology-oriented solutions, short-term coordination goals, cooperative funding, and coordinated implementation processes. Some arrangements create a more centralized point of contact for regional operations responsibilities, increasing the sense of accountability, and consequently increasing the need to coordinate.

Some institutional arrangements will increase the number of operations stakeholders that view their contributions from a regional context. This is important because many public and private transportation providers and users have little involvement in the transportation planning and programming process. New forums or organizations that focus specifically on management and operations can attract these stakeholders who previously had no satisfactory way to be engaged at the regional scale. Expanded stakeholder participation not only brings critical new perspectives to the task of enhancing regional management and operations, it also increases the number of local agencies and jurisdictions that consider regional goals in developing their own operations strategies. In addition, when new stakeholders perceive benefits to their own interests from regional coordination, they will help pressure elected official to secure funding for regional management and operations solutions.

LINKAGE IMPLEMENTATION

Some common strategies have emerged for building institutional arrangements that can better link planning and operations. Changing institutional relationships and behavior is a tremendous challenge and requires a sustained effort. But laying the groundwork for such change can begin immediately. The following approaches can highlight opportunities for existing institutions to better coordinate planning and operations and prompt leaders to consider where new institutional arrangements may be needed.

Designate an MPO Stakeholder Forum on Regional Management and Operations

An increasing number of MPOs support interagency committees that deal directly and regularly with the management and operations of regional transportation systems. In hosting such committees, the MPO facilitates a vital forum where interjurisdictional coordination, funding strategies, and data sharing can be addressed (see Box 30). In addition, the MPO can use the committee's diverse operations expertise to inform M&O issues in regional planning documents and in the MPO's annual work program. The forum allows operations managers to increase their awareness of broader regional trends, needs, and strategies.

Box 30: National Capital Region's Management, Operations, and ITS Task Force

The National Capital Region Transportation Planning Board (TPB) initiated an ITS Task Force in 1997. After the region received federal earmark funding for ITS, the task force attracted interest from a number of agencies in the region. These agencies collaborated to develop CapWIN, a wireless integrated mobile communications network that supports coordination between public safety and transportation agencies. Later that year, the TBP divided the Task Force into a technical task force and a policy task force. This facilitated the direct involvement of policy-level officials in ITS activities, while maintaining the capacity to address technical details associated with ITS integration and coordination. In 2001, the TBP changed the name of the two task forces to the Management, Operations, and Intelligent Transportation Systems (MOITS) Policy Task Force and the MOITS Technical Task Force to reflect a broader focus on management and operations from a regional perspective.

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Developing an effective structure for these MPO committees can be difficult. One reason is that regional management and operations planning must often deal with narrow technical issues. Example might include how to provide back-up power at signals, use of various signalization software programs, and measures of effectiveness for signals. These forums may be invaluable as an information exchange for operations practitioners, but less useful as a forum for addressing broader coordination issues. As a result, some MPOs have created separate subcommittees for technical and policy issues. A technical subcommittee focuses on the details of equipment coordination, while the policy committee addresses regional funding strategies and prioritization of regional operations initiatives. Periodic meetings of the full committee allow exchange between technical and policy staff.

Attract Stakeholders with Specific Regional Operations Programs

One way to achieve greater stakeholder participation in stakeholder forums is to focus discussions on specific operations concerns (see Box 31 below). This makes it clear to both operations practitioners and policy makers when the forum is within their area of expertise. For example, someone who manages first responders is more likely to attend a committee dealing with regional incident management than a committee dealing with the very broad topic of

regional management and operations coordination. A focused forum will also likely benefit from participants who have a grasp of both the technical and the institutional challenges associated with regional coordination for that specific topic.

Box 31: Wasatch Front Regional Council Promotes Traffic Management

In the late 1980s and early 1990s, the Wasatch Front Regional Council (WFRC) recognized that it needed to make better use of the existing transportation system by expanding traffic signal coordination within the region. WFRC hosted a forum for city and county engineers to address signal coordination. This coordination helped gain the support of legislators. Based on growing interest, a signal coordination committee was formed under the Utah DOT. Committee members included representatives from cities, counties, WFRC, and the Utah Transit Authority. Over time, the committee's focus expanded, and it evolved into the current traffic management committee. A significant achievement of the committee was the implementation of the traffic management system led by UDOT.

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Freight transportation planning is an area where focused forums have been successful. Engaging shippers, freight carriers, and freight terminal operators in the regional planning discussion has been challenging, in part because the long time frame of planning is foreign to most private sector entities. Freight companies may also be mistrustful of government planners, and concerned about divulging proprietary business information. Some regions, however, have successfully developed forums or task forces specifically to address regional freight operations planning. Part of the success has come from a committing funds toward short-term freight corridor improvements and making clear that the committee input would influence actual freight management investments. Such committees have managed to bring freight needs and perspectives to the planning process, helping to promote a regional perspective on operations challenges (see Box 32).

Box 32: Puget Sound Freight Roundtable

In 1993 the Puget Sound Regional Council (PSRC), the MPO for the Seattle-Tacoma metropolitan area, with the assistance of the Economic Development Council, gathered public and private freight sector representatives to form the Puget Sound Freight Roundtable. The Roundtable was created in an effort to better involve the freight industry in the planning process. The first task of the Roundtable was to provide input on freight issues to the update of the Metropolitan Transportation Plan. Since then, the Roundtable has influenced the transportation planning process in several ways. It advises PSRC on freight needs and the potential impact of proposed projects on freight mobility. It educates policy-makers and the public on freight issues. And it helps to develop performance measures, data collection systems, and analysis techniques necessary to study freight movement. The benefits from the Roundtable extend to both the Roundtable participants and PSRC. The private sector freight members have been learning how the MPO funding process works and how to be heard, increasing the awareness of freight with the public, decision-makers, planners, and other Roundtable members. The planning process now considers freight transportation improvements and evaluates the effects of policy proposals, capital improvements, and operations projects on freight.

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Involve Regional Operations Forums in the Planning Process

Regional transportation operations collaborations and traffic management centers (TMCs) increasingly offer forums for integrated operations that are independent of other regional bodies. These organizations may have specific mandates, such as running a regional incident management program, providing real time traffic information, and coordinating emergency

management plans. They often provide a unique opportunity to bring together the public safety and operations management communities, and thus are well positioned to address broader operations issues.

Regional transportation operations collaborations and TMCs can provide valuable input to the planning process. At the same time, state and regional planners should ensure that these organizations are aware of the planning cycle and planning decisions that could influence regional management and operations initiatives.

Beyond offering a forum for coordination on operations issues, a growing number of regional transportation operations collaborations are taking the lead in ensuring coordinated interagency operations planning to address challenges over the longer-term (see Box 33). Specifically, the functions of these organizations have grown to cover:

- Integration of personnel from multiple agencies into focused program implementation teams;
- Integration of equipment though sharing of communications infrastructure, specialized vehicles, and data; and
- Source of funding for coordinated operations activities, both through pooled funds from participating agencies and through direct State and Federal funding awards.

Consequently, through the development of regional operations plans, regional organizations collaborations are in an excellent position to ensure that operations goals, objectives, and strategies are integrated into the regional transportation planning process. Such operations plans not only help to address immediate operational needs, but also allow operations managers to come to the planning table with an integrated set of strategies. In this manner, operations managers can more effectively advocate for appropriate policies and coordinated funding within the regional planning and programming process.

Box 33: Central Florida's Regional Operations Consortium Helps Attract Federal Funds

The Central Florida Regional Transportation Operations Consortium began as an ITS Working Group seeking to improve interagency coordination on ITS projects. Agencies involved include the state DOT district office, turnpike and expressway authorities, several cities and counties, the regional transit agency, and the local state highway patrol troop. The group formalized this relationship in a Memorandum of Understanding (MOU). The object of this MOU is to:

> *Establish the organizational structure to promote coordinated decisionmaking and information sharing in planning, developing, and funding a Regional Transportation Operations Consortium of operating agencies within the Central Florida region for the deployment, operation, and maintenance of ITS initiatives.*

In May 2003, FHWA awarded a $20 million grant for the Florida model deployment program. The existence of a body that was actively collaborating on operations played an important role in the contract award. FHWA recognized the value of this strategic partnering in making the most effective use of ITS deployment dollars.

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Define an Organizational Structure for the MPO that Reflects the Importance of Regional Operations

MPOs have historically been organized around long-range planning and programming of capital projects. In recent years, many MPOs have expanded their role to include greater involvement

in regional systems management issues (see Box 34 below). Some agencies have chosen fundamental restructuring to reflect a growing responsibility for regional management and operations. MPOs should consider the potential benefits of an institutional structure that reflects a heightened focus on managing the regional network.

One option for such a restructuring is to develop a division within the MPO that is specifically responsible for regional system M&O activities. This body may be charged with promoting data sharing programs, coordinating operations between jurisdictions, ensuring intermodal coordination, and leading ITS planning. The advantage of such a structure is that practitioners within the regional planning agency are directly responsible for management and operations activities. These individuals are more likely to be familiar with the timing and details of the planning and funding process, and thus able to be effective in advancing systems management programs. An operations arm of an MPO may appear more accessible and carry more legitimacy with operations staff in the other bodies such as the State DOT, local jurisdictions, transit agencies, and private fleet operators.

Box 34: Innovative Institutional Arrangements

Operations in the Metropolitan Transportation Commission's Institutional Structure

The institutional structure of the Metropolitan Transportation Commission (MTC), the MPO for the San Francisco Bay Area, promotes parity between transportation planning and operations. MTC is heavily involved in operations activities, such as the Freeway Service Program, the ITS Early Deployment Plan, a traffic engineering technical assistance program, and an advanced traveler information system.

To reflect its growing role in operations, MTC reorganized its structure into two units: operations and policy. The operations branch is concerned with bridge and highway operations, transit coordination and access, and advanced systems applications. The policy branch focuses on planning, finance, programming and allocations, and legislation and public affairs.

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The Chicago Area Transportation Study's Institutional Structure Includes Operations

The organizational structure of the Chicago Area Transportation Study (CATS) reflects management and operations as a significant force in the region's transportation decisionmaking. Institutionally, CATS is divided into four core functional groups: planning, programming, operations, and development. The operations group consists of three support divisions: transportation management, operations analysis, and advanced technologies. The transportation management division analyzes strategies, programs, and protocols (such as expressway ramp HOV lanes) to provide recommendations for the Regional Transportation Plan (RTP). The operations analysis division focuses primarily on addressing intermodal freight movement within the region and provides input to the RTP process. It collects and analyzes freight data, participates in national forums on freight operations and planning, and assesses regional traffic signal issues. The advanced technologies support division is responsible for assisting in the ITS component of the RTP, the development of the Regional ITS Architecture, and the multi-state Gary-Chicago-Milwaukee ITS Corridor.

Link Planning and Operations within State DOTs and Transit Agencies

Unlike MPOs, most State DOTs and regional transit agencies traditionally have included both planning and operations functions. They have an opportunity to better coordinate planning and operations without some of the interjurisdictional and interagency challenges faced by MPOs. Some DOTs have bridged this gap because of the initiative taken by both planners and operators. Planners get involved in operations activities in cases where policy issues become integral to operations decisions (e.g., developing policies regarding the use of HOV lanes). Operators assist planners in some technical aspects of prioritizing needs according to specific objectives, and by helping to apply performance measures.

The development of the statewide plan offers additional opportunities to link planning and operations. In some cases, an operations committee or operations division has led development of portions of the statewide plan (see Box 35). This is a valuable means for raising awareness of the planning process within the operations community, while bringing operations expertise into the planning process.

Box 35: Operations Division Does Planning at WSDOT

Washington State DOT is developing a statewide multi-modal transportation plan. For the first time, the operations division of the agency is leading the development of the highway component of this plan. This represents the DOT's realization that operations issues form the foundation for the state's highway strategy and priorities. The state thus determined that highway system operations expertise was needed at the leadership of this component of the plan. Because the operations division has developed sufficient familiarity with the planning process over several years of collaboration, the DOT felt comfortable with this division leading a component of the statewide plan.

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Building bridges between staff members is a critical step in breaking down intra- and inter-agency barriers. Agencies and jurisdictions should explore options for a staff exchange between agencies to promote such connections. Identify specific projects for which a staff exchange would benefit both agencies while exposing staff members to new institutional processes and cultures. Work toward a regular exchange program that will build a network of interagency or interdivisional relationships and experience.

Reinforce Institutional Links by Integrating Operations into Project Design and Delivery

Operations practitioners should be involved in project design at the earliest possible stage in order to ensure that projects support, or at the very least, do not conflict with regional operations strategies. Institutional relationships between planning and operating agencies are supported when practitioners collaborate to accommodate ITS, transit, and operations flexibility into design during the early stages of the project development process. In some cases, management and operations options are only possible if they are funded as an integrated element of a broader infrastructure project. To ensure that operations strategies are embedded in capital projects, MPOs should take steps to ensure that appropriate operations stakeholders become part of the early stages of the project development and design process. This includes key constituents who may not participate in an existing regional operations forum (e.g., major employers, shippers, major housing or commercial developers, and special events managers).

LESSONS LEARNED

Institutional arrangements that have worked well in some regions have fallen apart in others. Below are several lessons learned from institutional arrangements that have been developed in the field.

Common Institutional Challenges

A number of hurdles have emerged for regions attempting to develop institutional arrangements suited to implement regional management and operations initiatives. One of the most common challenges is getting public safety officials involved (see Box 36). Regions routinely struggle to attract public safety officials to meetings that cover broader issues of operations coordination. Some regions attribute the problem to differences in management approach between public safety officials and other transportation agencies; many public safety management practices follow a strict command structure and less consensus-oriented decisionmaking. Some regions have found that demonstrating the benefits of involvement to public safety officials can increase their engagement. Benefits of coordination in some regions have led to better exchange of information about emergency response routes, active management of traffic to facilitate faster response, and access to funds for better communications equipment. Others have found success through implementation of regional traffic management centers. When public safety officials are involved in cooperative management of these TMCs, a forum is created for communication and for learning more about each other's roles.

Box 36: Tailoring Workshops for Specific Stakeholders in Hampton Roads

The Hampton Roads Planning District Commission has faced challenges in getting emergency planners to participate in regional M&O planning efforts. They achieved success by using the MPO's emergency planning committee to host workshops on ITS for emergency management.

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Regions have also faced challenges in engaging a committee of diverse stakeholders on the sometimes broad and amorphous topic of regional transportation systems management and operations. By focusing a committee narrowly (e.g., on freeway management, or on corridor signal synchronization), a sponsoring agency may be more effective in drawing practitioners from diverse agencies and jurisdictions. Practitioners tend to participate in a committee if they are confident that it relates to their expertise. However, this more focused approach to regional management and operations has drawbacks. Some regions have found the threat of redundancy in activities when management and operations committees are narrowly focused. More importantly, the opportunity to integrate various specific operations activities is diminished. These challenges are inspiring agencies to seek more creative techniques for drawing a broad range of stakeholders to the table for integrated regional M&O discussions. Appropriate use of task forces and subcommittees within a broader management and operations committees appears to offer the best solution.

The Importance of Interagency Staff Relations

Transportation agencies often cite personal relationships within and between agencies as one of the most important factors influencing the likelihood of regional planning and operations coordination. In some cases, key staff members have spent time in both operating agencies and transportation planning agencies (see Box 37 below). This breadth of experience creates a familiarity with the structures, processes, and cultures in both operating and planning

environments, enabling more frequent and effective coordination. In other cases, many of the transportation practitioners scattered among different planning and operating agencies have connections through their university background, and have maintained an interest and capacity to communicate and work together toward regional transportation solutions.

Box 37: Strong Ties between Planning & Operations in Maryland

Although there is not a formal structure for collaboration among planners and operators in Montgomery County, Maryland, the Operations Division of Montgomery County Department of Public Works and Transportation (DPWT) and the Montgomery County Department of Parks and Planning in the Maryland-National Capital Park & Planning Commission (M-NCPPC) find numerous opportunities to work together for improved transportation system performance. Their working relationship was solidified in part by a former transportation coordinator at DPWT who moved to M-NCPPC. This opened new channels for communication as the former operations practitioner could bring operations issues to the planning agency, communicate with operators, and give credibility to M-NCPPC among transportation operators. The relationship between DPWT and M-NCPPC continues to be strengthened by such relationships between personnel, but it is no longer dependent upon individuals within the agencies. The familiarity with each other's practices and long history of cooperating on projects has helped these agencies to seize opportunities for collaboration.

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Regions differ in terms of the level of cooperation within and between agencies. Some regions have a culture of positive and cooperative interagency relations while others are more inclined toward disagreements and interagency turf wars. These differences often stem from some combination of historical, political, and cultural factors. Regions with a history and habit of conflict between agencies and divisions will require greater effort and a greater variety of strategies to build collaborative thinking.

Key Resources on Institutional Arrangements

- Organizing for Regional Transportation Operations: An Executive Guide, FHWA/ITE, July 2001. http://www.ite.org/library/reg_trans_ops.asp
- What have we learned about ITS: Cross-Cutting Institutional Issues, FHWA. http://www.itsdocs.fhwa.dot.gov/jpodocs/EDLBrow/@@401!.pdf
- Wide-ranging internet resources on institutional issues relating to implementation of ITS. http://www.its.dot.gov/EVAL/docs_instissues.htm

2.7 REGIONAL ITS ARCHITECTURE[14]

BACKGROUND

A regional ITS architecture establishes a framework for implementing Intelligent Transportation System (ITS) projects at the regional level (see Exhibit 8). Because the development of the architecture is a federal requirement, it presents a strong opportunity to enhance collaboration between a region's operations and planning practitioners. The development, use, and maintenance of a regional ITS architecture will highlight the importance of operations strategies that can improve transportation system performance, including strategies that address recurrent and non-recurrent congestion. The architecture can also help to ensure that these projects are included in the region's long-range plan and TIP.

Because operations managers participate in development of the regional ITS architecture, they work closely with transportation planners and are exposed to the region's planning and programming process. Planners who engage in the development of the regional ITS architecture will develop greater appreciation for the use of integrated communications and data technologies to enhance the efficiency of the transportation system. In addition, the architecture development process can highlight for planners the importance of integrating ITS technology and management considerations into regional plans.

Exhibit 8: A regional ITS architecture must include

- Description of the region
- Identification of participating agencies and stakeholders
- Operational concept, including roles and responsibilities of participating agencies and stakeholders
- Any agreements needed for operation
- System functional requirements
- Interface requirements and information exchanges with planned and existing systems
- Identification of applicable standards
- The sequence of projects necessary for implementation

What is Regional ITS Architecture?

ITS projects make use of electronics, communications, or information processing to improve the efficiency or safety of a surface transportation system. Because information technology is generally most effective when systems are integrated and interoperable, the U.S. DOT has established the National ITS Architecture to provide a common structure for the design of ITS projects. The National Architecture describes what types of interfaces could exist between ITS components and how they will exchange information and work together to deliver ITS user service requirements.

To implement ITS projects with the Highway Trust Fund, Federal regulations require that a region must develop a regional ITS architecture, using the National ITS Architecture as a resource.[15] The purpose of developing a regional ITS architecture is to illustrate and document

[14] This section focuses primarily on regional ITS architectures. There are also statewide ITS architectures and many of the same points may apply. The focus here is on the regional architecture because this is where the MPO role is likely to be greatest.
[15] 23 CFR Part 940.3

regional integration so that planning and deployment of ITS projects can take place in an organized and coordinated fashion.[16] Once developed, any ITS project in the region that receives funding from the national highway trust fund must adhere to the regional ITS architecture. A region can be specified at a corridor, metropolitan, statewide, or multi-state level, although the Metropolitan Planning Area is the minimum regional size within a metropolitan area.

How Can the Regional ITS Architecture Create Stronger Linkages between Planning and Operations?

The regional ITS architecture serves as a focal point for coordination and collaboration between planning and operations practitioners. In a broad sense, the regional ITS architecture presents an accessible way for transportation planners to become more familiar with integrated management and operations activities and capabilities. It can also help to engage operations managers in regional planning, including establishing transportation investment priorities (see Box 38).

Each of the discrete steps involved in the development, implementation, use, and maintenance of the regional ITS architecture provides opportunities for coordination and collaboration between planners and operators. In fact, the success of the regional architecture depends on planners and operators working together and bringing their expertise and perspective to bear throughout this process.

Box 38: Hampton Roads Region: ITS Planning Kicks-off an Era of Collaboration

In the Hampton Roads metropolitan area of Virginia, planning and operations coordination began when the region was preparing to deploy ITS technologies. An initial meeting was held with planners, traffic engineers, and other regional stakeholders. By the end of this meeting, most of the stakeholders saw the need for improved coordination. Everyone exchanged contact information and, from this point forward, have been coordinating to let each other know about events and activities relating to ITS. From this initial meeting, the ITS Committee was formed and has been collaborating effectively ever since. The committee includes officials from the local MPO, planning and public works departments in the various jurisdictions, transit agencies, Navy, ports, state police, and many different offices within VDOT.

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Step 1 (Getting Started) in the development of the regional ITS architecture involves defining the stakeholders and people that will be involved, building consensus in the region, and establishing an overall plan for development (e.g., regional definition, timeframe, basic scope of services to be included). Operators bring to this process knowledge of operations stakeholders and potential leaders, and an understanding of service boundaries and areas of jurisdictional overlap. Planners bring experience working with diverse stakeholder groups and with elected officials, and ability to build regional consensus.

Step 2 (Gathering Data) of the development process assembles an inventory of existing and planned ITS systems in the region, defines the roles and responsibilities of stakeholders, and documents the ITS services to be provided and the functional requirements of each service. Operations practitioners are vital to this step because they bring a detailed understanding of existing ITS systems, particularly of systems that support interfaces that cross stakeholder

[16] This is described in the FHWA rule and companion FTA policy published in January 2001 to implement section 5206(e) of TEA-21.

boundaries. Operators also play a key role in identifying candidate ITS services that can address regional needs. Planners bring an understanding of the region's transportation needs, through detailed knowledge of the region's long-range plan and transportation investment programs. This perspective is critical to ensure that the architecture accounts for any new facilities or services planned for the region, and for the evolution of the system in general. Planners and operators then work together directly to discuss integration opportunities as part of the development of the operations concept and definition of system functional requirements.

Step 3 (Defining Interfaces) identifies the interconnections between systems and defines the information flow between systems. As in Step 2, operations stakeholders bring to this process a unique understanding of ITS systems, including connection points and information flows. Through their efforts to collect, organize, and disseminate data on transportation system conditions, operators work daily with information flows within and between ITS systems. Because only a portion of the possible information exchanges suggested in the National ITS Architecture will be included as interconnects in the regional architecture, the planning perspective is useful to hone in on those that help support the needs (and corresponding services) of the region.

Step 4 (Implementing the Architecture) defines several additional products that bridge the gap between the regional ITS architecture and regional ITS implementation. During the project sequencing step, operations experts are instrumental in identifying project elements that are dependent on other projects, estimating project costs, and identifying any regional ITS standards to be used in projects. Planners contribute an understanding of a region's existing short- and long-term project priorities and can assist with assessing ITS project benefits to the regional transportation system. Planning and operations stakeholders contribute to developing a list of agency agreements – operators because they typically maintain some existing agreements, and planners because they can provide leadership in the lengthy process of executing new agreements.

Step 5 (Using the Architecture) is where the regional architecture directly supports the planning process, as spelled out in DOT's guidance. This occurs, for example, through increased stakeholder participation in the long-range plan development and through better system and inter-jurisdictional integration. The architecture can directly support the selection of projects for the TIP. The architecture can also serve as the basis for an ITS strategic plan and play a role in the development of corridor plans. Likewise, **Step 6 (Maintaining the Architecture)** provides further opportunity for planners and operators to participate in continuing forums to address ongoing operations priorities and integration opportunities.

LINKAGE IMPLEMENTATION

Most regions either have completed an initial ITS architecture or currently are in the process of developing one. This experience has demonstrated a number of linkage opportunities, as discussed below.

Designate the MPO to Lead the Development of the Regional ITS Architecture

Federal regulations do not specify which agency should lead the development of a regional ITS architecture. In practice, a variety of agencies have taken the lead in different regions. At the regional scale, MPOs are ultimately responsible for ensuring that the regional ITS architecture requirements are met for the purpose of using Federal funds.

In regions where MPOs lead or are heavily involved in the development of the architecture, there is a strong opportunity for coordination with broader planning processes (see Box 39). MPOs often have expertise in managing a broad set of stakeholders who can work toward solutions to regional transportation issues. Concurrently, MPOs can benefit from exposure to a process that focuses on management and operations strategies, since this may be unfamiliar territory for them.

Box 39: NCTCOG: MPO Leads the Regional Architecture

Over the past 6 years, the North Central Texas Council of Governments (NCTCOG) has been an advocate for the collaborative development of ITS in the region. In 1998, the MPO, local jurisdictions, TXDOT districts, transit and toll authorities, universities, and other stakeholder groups signed a Memorandum of Understanding agreeing to coordinate in the planning, implementation, and operation of ITS. As a result of this MOU, NCTCOG began leading regular meetings to enhance understanding of ITS, discuss methods for deployment, and develop a regional ITS architecture. Some participants were skeptical of the MPO's capacity to lead the architecture development, but they recognized the important resources that the MPO brought to the process. NCTCOG offered expertise and authority with respect to funding sources. NCTCOG also brought experience with diverse stakeholders and provided the region-wide and long-term perspective vital to the architecture.

Through this multi-jurisdictional interaction, representatives have started to coordinate mobility crews on the freeways, cameras, variable message signs, and other ITS programs. Currently, the architecture is evolving from a statement that defines where the region wants to be in future years into a concrete prioritization of investments. NCTCOG is preparing to include the architecture in the long-range plan and use it in the short-range plan for prioritizing corridors for capital investment.

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Given the authority that most MPOs have in regional transportation decisionmaking, they are in a unique position to ensure that the ITS architecture is relevant for informing the transportation planning process. For example, data collection for planning purposes is not typically a high priority of operating agencies; the MPO can ensure that this need is recognized in the architecture. In addition, the MPOs' experience with regional funding strategies allows them to inform stakeholders about opportunities and realities during the course of developing the ITS architecture.

In some regions where the MPO has not led the regional ITS architecture process, the MPO has been asked to adopt the architecture. Although this is not a Federal requirement, adoption of the architecture by the MPO does provide another opportunity to engage a broader range of stakeholders. Similarly, it encourages the MPO to ensure that the priorities of the ITS architecture are consistent with the needs and objectives enumerated in the regional transportation plan.

Make the Regional ITS Architecture Part of an Integrated Regional Plan

Once a regional architecture is created, it is important that it serve as a resource for planning, programming, designing, and deploying ITS projects. The architecture should serve as a tool to improve regional thinking on operations. One way to promote the architecture's use is by incorporating it into the region's long-range transportation plan (see Box 40 below). This helps encourage consistency between proposed ITS projects and the architecture and ensures that additional integration opportunities are considered.

Making the architecture part of the long-range plan also helps give operations managers a stake in the planning process. The architecture provides an avenue of entry to the broader planning effort, and allows operations managers to see how the ideas embodied in the architecture are framed within the context of the region's transportation policies, initiatives, and activities.

Box 40: Chicago Area Planning Integration of ITS Architecture

In the Chicago metropolitan area, the Northeastern Illinois Regional ITS Architecture was used to update the Regional ITS Vision, the Regional ITS Integration Strategy, and the Deployment Action Plan. The updated ITS plan then became a key input to the long-range Regional Transportation Plan as the first step in deployment.

Following are some steps that can begin to link the ITS architecture with the regional plan:

- Get involved with the regional architecture. Your area may already have completed an initial regional architecture or may be in the midst of developing one.[17] Consider getting involved in this process. Consider what your agency can contribute to the development of the architecture and how the architecture may affect your agency's activities.

- Identify how the architecture incorporates regional goals and objectives. The ITS architecture should relate to other planning documents, particularly the long-range or regional transportation plan. Review the goals, objectives, and strategies set forth in transportation plans and note the opportunities for coordination with the regional ITS architecture. If you do not see cross-referencing in these documents, consider appropriate mechanisms to better link the architecture with planning documents.

- Adopt a regional ITS architecture. A completed regional ITS archtecture will provide the greatest benefit if relevant agencies use it as a framework to inform decisionmaking and promote communication. Attempt to identify all agencies that have been involved with the architecture development and any additional agencies that might make decisions relating to transportation operations and ITS. Encourage these agencies to adopt the architecture to guide ITS-related decisionmaking.

Link the Architecture to the TIP

[17] The best way to identify the status of your region's ITS architecture is through the state DOT or MPO. You can also check the following status website maintained by U.S. DOT's ITS Joint Programs Office http://www.its.dot.gov

Ultimately, the goal of the architecture is to facilitate the efficient deployment and use of ITS equipment, networks, and management structures to create a safer and more efficient transportation system. This implementation requires prioritization of resources over a long period (see Box 41 below). U.S. DOT requires that the architecture include a sequence of projects.[18] Developing the sequence is a consensus building process that considers costs and benefits, technological feasibility, and project readiness. While not intended to be a formal ranking of ITS projects, the project sequence can be carried over to the TIP process. Both activities aim to use local knowledge and consensus-building to determine the most suitable sequence of projects to create a transportation network that best meets the region's needs.

Box 41: Anchorage Prioritization Process for ITS Projects

The Anchorage area MPO facilitated development of Alaska's regional ITS architecture. The architecture includes short- and mid-range priorities and system maintenance strategies. Anchorage has been able to build consensus around a prioritization process that acknowledges both mid-term operational needs and long-range planning goals. This was achieved by engaging both operations managers as well as planners and decision-makers in the development of architecture's project selection criteria.

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Some MPOs have connected the ITS Architecture to the project development process by way of a checklist that is presented to all project sponsors (see Box 42). This is a simple and useful way to promote incorporation of consistent ITS elements into appropriate projects, particularly in areas where reference to the architecture tends to come late in the project development process. When project sponsors are prompted to consider ITS early in project development, ITS will be better integrated into projects and will be more likely to improve system efficiency. Consider developing a checklist for project sponsors that describes important ITS considerations.

Box 42: Salt Lake City Region: ITS Consistency Checklist

The MPO for the Salt Lake City region has developed a checklist of ITS considerations for project sponsors. This checklist includes the following:

- Briefly describe how this project fits in with the regional ITS integration strategy.
- Note on the Regional Architecture Diagrams how this project fits with regional ITS.
- Briefly describe what connections and architecture flows are planned to existing ITS as part of this project.
- List stakeholders that have been and/or will be involved in project concept development.
- Briefly describe how this project will facilitate implementation of other future elements of the Regional Architecture.

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Build from the Architecture's "Operational Concept."

The regional ITS architecture includes an operational concept that defines the institutional relationships among the organizations involved in the deployment and operation of regionally integrated ITS systems. Consider using this operational concept as a starting place for linking planning and operations more broadly. Consider how the operational concept can function to guide operations coordination beyond ITS.

[18] FHWA Rule 940.9(d)6 and FTA National ITS Architecture Policy Section 5.d.6.

Build a Sustained Forum around Maintenance of the Architecture

A region's ITS priorities and organizational approach will need to evolve along with the region's travel patterns, available funding, and technological capabilities. Project implementation may also be a catalyst for maintenance of the architecture. As projects come into final design the regional architecture should be reviewed to see if there is any impact to the capabilities documented in the regional architecture. Likewise, the architecture will need to respond to changes in the region's long-term goals and objectives. For these reasons, agencies should consider procedures and responsibilities for maintaining the regional ITS architecture as needs evolve within the region. The requirement to maintain the regional ITS architecture provides an opportunity to institutionalize certain planning and operations linkages.

Without active engagement, stakeholder participation has a tendency to fall off when the architecture is complete. Agencies can identify activities to maintain involvement of a core group of stakeholders. Such a group can also serve to help coordinate transportation planning and operations more broadly. A good way to keep the stakeholder group active is to involve it in on-going regional transportation planning and programming activities. In addition, a number of regions have maintained engagement by designating a steering committee and by developing a regional ITS architecture website.

Although a single agency may be designated to maintain the architecture, it is important that a diverse set of stakeholders remain actively engaged in the architecture review and maintenance processes. These groups of stakeholders can also function as ongoing forums where planning and operations practitioners ensure that their activities are coordinated.

LESSONS LEARNED

With many regions in the midst of ITS architecture development, there is a wealth of perspectives on how the process is working. Two lessons relating to planning and operations coordination have been expressed frequently.

Stakeholders Take Interest in Concrete Benefits

A number of regions have labored to attract a diverse range of stakeholders to participate in the regional ITS architecture process. While coordinating ITS may already provide benefits to many planning and operations stakeholders, practitioners may not readily link these benefits with the more abstract architecture process. This challenge has been successfully addressed in several ways. Many regions have found that the architecture tends to attract more interest if it is promoted as a step to enhance existing successful ITS initiatives (see Box 43). This may be a traffic management center, an incident response program, or some other initiative that is particularly important to the stakeholders being targeted. Furthermore, to better engage stakeholders in developing the operations concept, real-world operations situations or

Box 43: Kansas City Scout: Inspiring Participation in the Architecture

Kansas City Scout is an extensive freeway management system for the bi-state Kansas City metropolitan area. The system came about prior to development of a regional ITS architecture. According to ITS planners in the region, existence of Kansas City Scout made it easier to engage stakeholders in ITS issues going forward. The success of the system has drawn interest from cities throughout the region. These jurisdictions understand that further expansion and development must be consistent with the regional architecture, and based on the success of Kansas City Scout, they see the value in intra-regional coordination.

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scenarios can be used to guide the discussion and make the concept more accessible. Finally, all stakeholders take interest when funding is at stake. Greater participation has been achieved by highlighting the linkage between the ITS architecture and access to Federal funds, or by communicating ways that the architecture will delineate regional ITS investment priorities.

The ITS Architecture Can Be Expected to Enhance Collaboration over Time

FHWA's ITS Architecture rule requires that the regional architecture be developed by April 8, 2005. After this deadline, Federal funds cannot be used for ITS projects until an ITS architecture has been developed. Understandably, many regions that have not yet developed an architecture are focusing their attention on satisfying this Federal requirement. As a result, some of the more complex institutional issues are not being fully addressed in these initial regional architecture plans. Once the deadline is satisfied, regions that have recognized this value will have the opportunity to refocus on aspects of the architecture that help collaboration between jurisdictions and between ITS and regional planning processes. On-going implementation and maintenance of the architecture affords numerous opportunities to implement some of the collaboration opportunities that become apparent in the initial architecture development.

- Regional ITS Architecture Maintenance Website: http://www.its.dot.gov/aconform/Guidance.htm
- Joint ITS Program Technical Assistance Site: http://www.its.dot.gov/itsweb/Technical/technical.htm

2.8 REGIONAL TSM&O PROJECTS

BACKGROUND

Some projects naturally bring together planners and operators. Many regional transportation system management and operations (TSM&O) projects require involvement of State or regional transportation planners in order to provide an understanding of and access to regional funding opportunities, to coordinate across jurisdictions and modes, or simply to provide regional leadership. As shown in Exhibit 9, some examples of such regional TSM&O projects include regional signal coordination, development of HOV/HOT lanes, management of the impacts of large special events, and regional incident response programs.

Exhibit 9: Examples of Regional TSM&O Projects and Programs

- ✓ Arterial management systems
- ✓ Work zone management systems
- ✓ Emergency management
- ✓ Electronic toll and fare collection
- ✓ Automated enforcement
- ✓ Traffic incident management
- ✓ Roadway weather management
- ✓ Traveler information services
- ✓ Commercial vehicle operations
- ✓ Traffic detection and surveillance
- ✓ Freight management
- ✓ Parking management

What is Meant by Regional TSM&O Projects?

Regional transportation systems management and operations means an integrated program to optimize the performance of the existing infrastructure though implementation of multi-modal, cross-jurisdictional systems, services, and projects. These systems, services, and projects are designed to preserve capacity and improve security, safety, and reliability of transportation systems. Regional TSM&O projects include a diverse range of activities, as illustrated in the box to the right.

How Can Regional TSM&O Projects Create Linkages?

Regional TSM&O projects can help to link planning and operations in a number of ways. If an MPO leads an operations-oriented project, for example, MPO planners often work closely with operations agencies, and develop a better understanding of operations in the process. The involvement of planners helps to ensure that regional TSM&O projects are adequately supported in the long-range planning and programming process. As long-range plans focus more on maximizing the efficiency of a mature system using regional TSM&O projects, planners will require the involvement and expertise of operations practitioners. Regional TSM&O projects can also educate operations managers about broader regional planning and policy objectives that cut across modes and jurisdictions.

LINKAGE IMPLEMENTATION

This section highlights opportunities to link planning and operations through specific types of regional TSM&O projects. Nearly every regional TSM&O project can help to strengthen the planning and operations link in some way, so these examples should be considered as illustrative rather than as a comprehensive list. Indeed, the very existence of regional TSM&O projects is often an indication that some coordination between planning and operations is already occurring within a region. For example, development of an effective regional incident management program most likely involves input from operations managers as well as some institutional capacity at the state and regional planning level to recognize the need and to fund

such a program. Through the ongoing implementation and expansion of regional TSM&O projects, planning and operations coordination will continue to evolve in a productive manner.

Work Zone Management Programs

The goal of work zone management programs is to reduce the impact of roadway construction and maintenance on mobility and safety. Travelers are often frustrated when they perceive that the impacts of highway construction activities have been poorly managed resulting in congestion and delay. In response to customer concerns and the potential for efficiency gains, work zone management programs have become a focus of regional operations thinking and have gained recognition as an important area for interagency and interjurisdictional coordination.

Work zone management is inherently an operations concern, since it focuses on strategies for minimizing disruption to the roadway system. However, planners can play a significant role in helping to ensure that construction and maintenance projects scheduled for a corridor are considered early in the planning and programming process to minimize the impacts of multiple work zones. Planners can also help to ensure coordination between jurisdictions when scheduling roadwork.

Traditionally, conducting the work during off-peak hours minimized work zone mobility impacts. This has become more difficult as peak-periods are spreading and the time window for conducting work is shrinking, making it critical to plan for work zone impacts early in the project development process. It is also typically more expensive to do work during off peak hours, consuming a larger share of scarce resources. Planners are beginning to get involved in work zone management at the corridor level, including learning the details about the work and exploring regional options to mitigate traffic impacts (e.g., development of service roads or advance preparation of alternate routes). Work zone management issues can even be considered during the regional project prioritization process.

Through involvement in work zone management programs, planners gain exposure to traffic management strategies that may have broader application for addressing short-term regional concerns. Concurrently, planners bring to the table expertise in public information distribution, stakeholder involvement, and transportation system network behavior. For these reasons, the MPO often serves as a good forum for coordinating work zone management between agencies and jurisdictions.

Major transportation construction projects also offer an opportunity to demonstrate the capacity for management and operations strategies to mitigate impacts to the regional traffic network. Such mitigations could include travel demand management services and their promotion, temporary signal timing adjustments on alternate routes, or advanced traveler information strategies (such as variable message signs) to keep travelers apprised of real time conditions before they reach the work zone. Implementation of such strategies can be a way to demonstrate their potential for broader application to address regional traffic disruptions.

Regional Incident Response Programs

Incident management is the process of managing multi-agency, multi-jurisdictional responses to highway traffic disruptions. Efficient and coordinated management of incidents reduces their adverse impacts on public safety, traffic conditions, and the local economy. These programs typically require involvement from a wide range of stakeholders including state and local law

enforcement agencies, fire and rescue agencies, HAZMAT clean-up services, towing and recovery companies, and public and private traveler information providers. Due to the wide range of actors involved, these programs provide a mechanism to link operations stakeholders and help to jumpstart other regional operations efforts. Several regions have sponsored conferences to share information and best practices on incident management. Conferences provide opportunities for operations practitioners to work with planners to expand services and discuss facility design issues that affect the efficiency of incident response efforts.

In some regions, MPOs have taken the lead role in advancing coordinated incident response and freeway service patrol programs (see Box 44). Because traffic incidents are responsible for such a large portion of regional congestion, MPOs are becoming more active in incident response. When the MPO takes the lead, it provides an important opportunity for broader involvement by the MPO in thinking about day-to-day management of transportation facilities. In addition, operations managers within the region may come to see the MPO as a more relevant player and, consequently, participate more actively in the MPO's activities.

Box 44: Bay Area Freeway Service Patrol

Established in 1992, the Bay Area Freeway Service Patrol (FSP) is a joint project between the Metropolitan Transportation Commission (MTC) Service Authority for Freeways and Expressways, the California Highway Service Patrol, and the California DOT. The 74 FSP trucks patrol 450 miles of the Bay Area freeways to clear crashes, remove debris, and help stranded motorists without a fee. FSP's fast response time helps to reduce congestion and secondary crashes. Patrol trucks are equipped with advanced communications equipment, including an automatic vehicle location system to assist in dispatch. As an indication of its widespread success, on March 24, 2003, FSP recorded its 1 millionth driver assist.

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Special Events Management

Transportation practitioners often comment on the power of major special events to promote unparalleled levels of planning and coordination between normally disconnected transportation agencies. This condition is particularly evident for special events that bring broad national or international attention to a particular city, such as major sporting events or high-profile conventions (see Box 45).

A special event can serve as a catalyst for the development of a new model for planning and operations coordination – a model that can potentially continue to function long after the event has occurred. To sustain and build upon the collaborative attitudes that are common during special events, it is important that stakeholders consider in advance how to build from these events. Planners and operations representatives can work together to discuss opportunities to build from successful event coordination.

Box 45: Dallas/Fort Worth Region Olympic Bid Lessons

In preparing a bid for the 2012 Summer Olympics, the Dallas/Fort Worth region worked collaboratively to design a system of managed lanes throughout the region. Through this planning exercise, operations managers and planning staff learned that managed lanes were the only feasible way to provide rapid priority travel to particular sites. Although Dallas did not win the Olympic bid, the planning exercise resulted in some important lessons about the flexibility of a regional HOT lane network.

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Regional Signal Coordination

Signal coordination programs, traditionally conducted in isolation by individual cities, are now being conducted across jurisdictions. Interconnecting traffic signals and optimizing signal timing has been shown to reduce travel times by 8 to 25 percent along an arterial or corridor. Some regions are also working to integrate arterial signalization systems with transit operation, emergency operations, and/or freeway management efforts.

Cross-jurisdictional signal coordination is often led by a city, usually a large central city coordinating with smaller surrounding cities. But MPOs and other regional agencies also can lead regional signal coordination efforts, and in the process help to strengthen ties between planners and operators (see Box 46). For example, some MPOs have formed a traffic signal coordination committee, made up primarily of local government traffic engineers and public works managers. The committee works together to craft a written agreement on signal timing that is consistent with regional planning objectives and also acceptable to the local jurisdictions. The involvement of the regional planning agency can help to bring all the necessary stakeholders to the table while ensuring that the signal coordination supports regional air quality planning, ITS deployments, transit operations, and other regional initiatives.

Box 46: Kansas City Operation Green Light

Operation Green Light is a joint effort between state and local governments to synchronize traffic signals on 1500 intersections throughout the Kansas City area in order to improve traffic flow and air quality. The Mid-America Regional Council (MARC), the area's MPO, is the umbrella under which the Missouri and Kansas Departments of Transportation and 17 area cities work together to develop coordinated timing plans and signal communication systems. The coincidence of several key events helped bring Operation Green Light into existence. In 1998, MARC allocated funds to study the impact of traffic signal coordination on emissions reduction. That same year the Missouri DOT and the Public Works Department of Kansas City conducted a study addressing common hardware standards for traffic signal equipment. In the summer of 1998, the two studies were combined and resulted in a recommendation for regional signal timing coordination. With its recent eligibility for CMAQ funds, the Kansas City region was able to initiate Operation Green Light. At the present time, the region is assembling resources and working with local agencies to deploy signal-timing plans. Operation Green Light is expected to reduce traffic delays, improve traffic flow, reduce emissions, and assist in managing changes in traffic patterns resulting from a new freeway management system.

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HOV Lane Development

Some new transportation infrastructure projects inherently involve consideration of regional TSM&O issues as well as regional planning and policy issues. HOV lane (or HOT lane) development is a prime example. HOV lane construction involves all of the engineering and operational considerations associated with traditional freeway lane additions plus a range of planning and policy concerns. For example, HOV lane projects must address detailed operational considerations for lane access points as they relate to overall system performance. HOV lanes also require state and regional policy considerations such as hours of operation, vehicle occupancy requirements for access, exceptions to HOV requirements, and policies relating to emergency and special event use of HOV lanes. These are frequently controversial topics related to broader regional demand management efforts. MPOs and State DOT planning agencies are usually more versed in the broader policy considerations, but operations practitioners are needed for the consideration of operations constraints. As a result, HOV

projects tend to generate numerous opportunities for new professional connections between planning and operations (see Box 47).

Box 47: HOV Projects Drive Coordination at Washington State DOT

There have been major debates within the Seattle region regarding who has driving privileges in the HOV lanes. Operations managers at the state DOT recognized that these policy concerns were the domain of planning practitioners. Planners who became involved with HOV policy development had to learn everything about the operation of such facilities so that they could make well-informed policy decisions. As a result of taking the time to understand the systems operations issues associated with HOV operations, these planners have gained a broader connection with operations staff and have been exposed to "operations thinking".

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Transportation Emergency Preparedness and Security Planning

Agencies involved with transportation management and operations are increasingly focused on disaster preparedness planning and emergency response coordination – coordination that should take place at the regional scale. A number of regions have established a management and operations committee that focuses on day-to-day operations activities, with a transportation emergency preparedness subcommittee that focuses on longer range planning and training programs related to emergency management. Arrangements such as these serve to facilitate better coordination between planning and operations.

Recent efforts to model emergency situations have applied traditional planning tools to improve transportation management practices. These models often combine GIS, travel demand forecasting procedures, and simulation of emergency scenarios to assist in emergency response planning (see Box 48). Setting up and running these models may require involvement of both regional transportation planners and system operations experts.

Box 48: Operations Coordination Peaks for Nebraska's Emergency Management Exercises

The Nebraska Department of Roads has been involved in extensive disaster preparedness training exercises. They have observed high levels of collaboration and cooperation among agency divisions and regions during the exercise development and execution process. There trainings have led to a better understanding of the physical assets and expertise available to each agency and region, helping to promote greater collaboration in day-to-day management and operations activities.

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Regional Traffic Management Centers

Regional traffic management centers (TMCs) are involved with many of the TSM&O projects and programs discussed in this section. A TMC may serve as headquarters for incident management activities and is also likely to be an important participant in planning for emergency preparedness and for special events. TMCs by themselves can also create opportunities for improving planning and operations coordination.

For planning agencies, establishment of a TMC can serve as a unique bridge from a capital project focus to management and operations coordination. Planners who are familiar with the capital project development process usually lead the process of funding, designing, and constructing a TMC facility. But the TMC development process can also stimulate a broader discussion of what takes place within the traffic management center, such as:

- Who must be involved in its design and management?
- How will the activities be sustained?
- How will it link with other centers?
- What is the ultimate scope of management activities that could occur in the center?

These topics can help engage operations management and planning agencies in a broader discussion of M&O coordination.

A number of regions report that the operation of regional TMCs has helped build broader cooperation in regional TSM&O efforts (see Box 49). For example, some TMCs are co-managed by the state police. This ensures that this constituency is consistently involved in broader policy considerations about the center's roles and responsibilities. In other regions, emergency management practitioners have witnessed the benefits of operations technologies (e.g., signal priority exemption for emergency vehicles), and as a result become more interested in regional ITS planning and deployment.

As the operations community looks to expand its role in the regional transportation planning process, these multi-agency working relationships can prove to be critical. The ability to bring a multi-agency perspective to the planning table should enhance the decisionmaking process and result with increased system performance as, for example, incidents get cleared in a more timely and effective manner.

Box 49: Austin's TMC is Building New Interagency Connections

In its initial several weeks of operation, the Combined Transportation, Emergency and Communications Center (CTECC) in the Austin, Texas region demonstrated its capacity to increase coordination between traffic operations, emergency services, and police departments. For example, by facilitating direct communication between the traffic operations and emergency services staff, the center has increased awareness about traffic impacts caused by accidents so that emergency vehicles are less likely to unnecessarily block traffic. As the region considers new projects in the future that involve emergency services, the CTECC will provide a forum to involve the broad range of management and operations constituents in regional planning.

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Cross-cutting Regional Implementation Actions

While the previous linkage implementation steps each referred to particular RTSM&O activities, the following short-term actions apply to a wide range of RTSM&O programs. These are some examples of how agencies can focus on using existing TSM&O projects to build a broader regional link between planning and operations.

- Identify multi-jurisdictional M&O programs that should involve the MPO. MPOs have skills relevant to many integrated management and operations strategies. These include experience with bringing together diverse stakeholders to receive feedback, distributing information to the broad public, and awareness of a broad array of funding opportunities. But MPOs are not always well informed about the range of active RTSM&O activities. MPO staff should identify management and operations programs within the region and assess the extent of MPO involvement. Consider strategies to increase MPO involvement in programs that are dominated by operations practitioners.

- Expand participation in existing TSM&O projects. Many regions have nascent regional TSM&O projects and programs with involvement from a limited number of regional

stakeholders. For example, signal coordination efforts and special event management programs often include no more than a few local governments. Identify opportunities to expand these programs so that they embrace a larger portion of regional stakeholders, becoming true cooperative regional systems management and operations efforts.

- Use specific M&O successes to sell new regional coordination efforts. Agencies can identify successful local examples of coordination between regional planning and TSM&O projects or programs. For example, it may be a special event for which transportation coordination went particularly smoothly, a successful interjurisdictional work zone management effort, or multi-jurisdictional signalization coordination that considered the needs of multiple modes. Identify factors that contributed to the success of these efforts, and work to replicate the success in other regional TSM&O projects.

LESSONS LEARNED

Implementation of regional TSM&O projects has exposed numerous challenges and highlighted some promising ways to overcome them. Many of the lessons learned are specific to one type of TSM&O project or program, and are discussed at length in other resources. This section reviews several lessons that apply to regional TSM&O efforts broadly.

Organizing at Regional Scale May Highlight Differences Between Objectives

Operations practitioners and local decision-makers are likely to be concerned about centralizing control of traffic management at the regional scale. These concerns are legitimate – local operators often have vital information about the particular issues in each jurisdiction that cannot be readily communicated to regional agencies. What is best for regional management is not always best for particular local stakeholders. Any regional TSM&O effort must be open to discussing and accommodating issues related to the authority of existing operating organizations. While it will not eliminate such concerns, a focus on coordination rather than centralization is critical for the success of such regional efforts, and is a necessary prerequisite for engaging operations managers in a broader regional planning dialogue.

Regional TSM&O Efforts Face Pressure to Expand in Scope

Some regions have faced a situation in which they set out to develop a specific regional TSM&O program and found that the discussion quickly expanded to cover a broad array of management and operations efforts. Regional coordination, information sharing, and public involvement in one management and operations area often illuminate needs and opportunities for regional coordination in other operations areas. For example, when work zone management programs are coordinating with regional transit operators, it becomes apparent that incident management programs and regional signal coordination programs should be doing the same thing. Similarly, efforts to establish an incident management program may highlight poor coordination between various jurisdictional traffic management centers.

Successful TSM&O task forces or consortiums should carefully assess how much responsibility they wish to take on beyond their original focused effort. Some groups have successfully expanded beyond straightforward original goals such as work zone management, taking on broad responsibilities for a range of regional management and operations efforts. Other groups have determined that their institutional arrangement left them best suited to focus on a specific TSM&O program and concluded that increasing demands called for developing management and operations oversight within the State DOT or MPO.

2.9 Regional Concept for Transportation Operations

The previous seven subsections discuss specific strategies that encourage and support linkages between planning and operations. Each of these strategies has a role within the existing regional transportation planning process. In addition, these strategies should be coordinated to support regional system management and operations. This section introduces the idea of a Regional Concept for Transportation Operations (RCTO), a strategy for ensuring that management and operation activities build toward a common vision and relate to the broader regional planning process.[19] An RCTO links planning and operations by providing a coherent operations strategy for consideration during the planning process and by supporting the linkages discussed in previous sections.[20]

An RCTO presents a regional objective for transportation operations and describes what is needed to achieve that objective within a reasonably short timeframe, often three to five years. The development of the RCTO should include participation by the MPO to ensure consistency with the region's vision and goals. It should also involve stakeholders that depend on regional operations coordination (see Exhibit 10). The process of developing an RCTO requires sustained collaboration among these stakeholders.

To date, only a small number of regions have developed RCTOs. Therefore, rather than focusing on the few examples of how RCTOs have linked planning and operations, this section describes in general how an RCTO can support planning and operations coordination and how it can support other strategies discussed in this reference guide.

Exhibit 10: Transportation System Management and Operations stakeholders who may help develop the RCTO include:

- ✓ State DOTs
- ✓ MPOs
- ✓ Local Planning Departments
- ✓ Local Public Works Departments
- ✓ Air/Sea Ports
- ✓ Local Chambers of Commerce
- ✓ Transit Agencies
- ✓ Public Safety/Security Agencies
- ✓ Tourism Bureaus
- ✓ Major Employers
- ✓ Community Groups
- ✓ Toll Authorities
- ✓ Advocacy Groups
- ✓ Major Freight Shippers
- ✓ Local Jurisdictions
- ✓ Commercial Vehicle Operators

What is Included in an RCTO?

An RCTO can vary significantly in scope depending on the region and the range of programs it seeks to address (see Exhibit 11 below), but certain fundamental components must be included. A RCTO should include a description of the operational objective, physical elements, relationships and procedures, and the resource arrangements needed to achieve the RCTO goals. These sections of an RCTO would typically address the following:

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[19] For a more detailed discussion of this topic, see *Regional Concept for Transportation Operations: A Tool for Strengthening and Guiding Regional Transportation Operations Collaboration and Communication*, FHWA, http://ops.fhwa.dot.gov/publications/rcto_white_paper/index.htm.

[20] For a more detailed discussion of this topic, see *Regional Concept for Transportation Operations: A Tool for Strengthening and Guiding Regional Transportation Operations Collaboration and Communication*, FHWA, http://ops.fhwa.dot.gov/publications/rcto_white_paper/index.htm.

- Operational Objective: the desired state of operations at the end of a three- to five-year period. All stakeholders should agree upon this outcome, it should be consistent with regional goals expressed in regional planning documents, and it should be realistically achievable given the time frame and available resources.

- Physical Elements: the equipment, technology, facilities, people, and systems needed to achieve the operational objective.

- Relationships and Procedures: the working agreements, institutional arrangements, MOUs, and procedures needed to achieve the operational objective.

- Resource Arrangements: the funding and other resource requirements (e.g., staff and equipment) and how those resources are to be obtained and applied to achieve the operational objective.

Exhibit 11: Examples of services likely to benefit from regional coordination through a RCTO

- ✓ Traffic incident management
- ✓ Traveler information
- ✓ Electronic payment services (e.g., transit, parking, tolls)
- ✓ Emergency response and homeland security
- ✓ Traffic signal coordination
- ✓ Road weather management
- ✓ Freight management
- ✓ Work zone traffic management
- ✓ Freeway management
- ✓ Congestion management

How Can an RCTO Link Planning and Operations?

The RCTO links planners and operators by helping operators participate in planning process and by helping planners understand how operations can support the region's broader transportation goals. The RCTO builds consensus on the future of transportation operations needs, providing stakeholders with a basis for productively participating in regional decisions and for critically evaluating whether the proposed investments support the operations vision.

Helping Operations Practitioners Engage in the Planning Process

An RCTO can prepare system management and operation practitioners to be effective contributors within the transportation planning process.

- An RCTO addresses a longer time horizon and a broader geographic range than is typical for operations strategies. As a result, the RCTO allows operations practitioners to link their programs with future capital investments and anticipated resource opportunities.

- An RCTO builds commitment among stakeholders for a common regional approach to operations (see Box 50 below). Operations managers will have greater influence in the planning process when diverse stakeholders have reached consensus on an operational objective for the region.

- Though longer than typical operations plans, the three- to five-year time frame of the RCTO is shorter than many planning documents. The RCTO is therefore more likely to maintain interest of operations-minded stakeholder groups that may not engage in the 20-year regional planning process. In this way, the RCTO serves as a bridge between stakeholders focused on very short-term operations needs and those focused on the long-term evolution of the regional transportation system.

Box 50: Developing the Regional Concept of Transportation Operations for the Phoenix Region

In the Phoenix metropolitan region, the need for an RCTO became clear during the process of developing the Regional ITS Architecture. The Maricopa Association of Governments (MAG) ITS Committee found that operations issues were being considered only at a very high level during the development of the architecture; there was little detailed discussion regarding how to get from the current way of doing business to the end points defined in the architecture. As a result, the committee viewed the architecture as a longer-term goal and committed to developing a shorter-term detailed regional plan for operations coordination.

When MAG's ITS Committee initiated the process of developing the Regional Concept of Transportation Operations in 2001, several organizations had already been involved in regional transportation operations coordination, including the MAG ITS Committee, AZTech™, and the East and West Valley Traffic Signal Timing Groups. A consulting agency and a group of stakeholders from city, county, regional, state, and federal agencies developed an initial RCTO. These stakeholders agreed on a common vision and mission for the region's transportation system operations. They then developed three- and five-year operational goals that would move the region toward this vision. To address these goals, the committee agreed on 11 initiatives and associated steps for action. For example, one initiative focuses on "transit signal priority" and the associated action is "plan, deploy, operate, maintain and evaluate a Transit Signal Priority pilot project." This group of stakeholders also agreed on common operational performance measures that would be used to track their progress.

The group took several steps to insure success of the newly formed initiatives:

- They developed a Memorandum of Understanding (MOU) to be signed by each participating agency. The intent of the MOU is to acquire commitment from the participants to work towards the initiatives and coordinate with one another in managing and operating the region's transportation system.
- Existing regional forums or committees and a champion were assigned responsibility for one or more initiatives. The champion's duties included being a leader for the area and reporting on the progress at the MAG ITS Committee meetings.
- They committed to developing a guidance document that will help agencies to implement the actions described in the RCTO (currently underway).

MAG's current RCTO and additional discussion of the development process are available on-line: http://www.mag.maricopa.gov/project.cms?item=1395

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Helping Planners Promote Management and Operations

An RCTO can help planners and decisionmakers by relating management and operations to broader regional goals and by describing individual operations programs within a broader regional operations strategy.

- An RCTO links management and operations strategies with regional goals and objectives. This helps planners see the benefits of regional operations investments and creates a common understanding of regional systems management and operations.

- An RCTO illustrates how individual management and operations projects and programs fit into a broader strategy for regional transportation efficiency (see Box 51 below). In this way,

an RCTO helps planners consider how capital projects can be implemented in a way that complements existing operations strategies.

- By providing a coherent operations strategy for consideration during the planning process, an RCTO enables decisionmakers to fund critical operations initiatives and understand how they support regional goals. In this way, an RCTO provides elected officials who must approve transportation plans and programs with justification for promoting regional benefits through local operations decisions.

Through the mechanisms outlined above, an RCTO enables regional planners and operations managers to be proactive about coordinating operations strategies to serve regional objectives.

Box 51: A Concept of Operations for Bay Area Freeways

The Metropolitan Transportation Commission (MPO for California's Bay Area Region) played a key role in developing a concept of operations to improve freeway management. They coordinated closely with the State DOT and the California Highway Patrol to develop the Bay Area Freeway Concept of Operations Project in 2001. This effort built-on existing coordination of freeway congestion management, incident management, and traveler information programs. The project pursued three objectives:

Identify potential improvements to policies, procedures, and practices would enhance regional agency coordination
Define roles, responsibilities, and resources for freeway operations.
Develop a plan of action for improving freeway operations.

The project received input from top agency executives, agency staff, and a range of public agency stakeholders. Immediate results have included a regional consensus defining what freeway operations should look like in the near future, definition of some measurable objectives, and a plan for how the participating agencies can meet these new expectations. Some of the recommended strategies include integrating incident detection, developing overall data and video sharing policy, and detailing a staffing and funding program.

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How Can an RCTO Support Linkage Opportunities Discussed in this Guide?

From the discussion above, it should be clear that the RCTO links planning and operations in ways similar to the strategies discussed in the previous sections of this reference guide (Sections 2.2 to 2.8). In fact, the RCTO can be a valuable tool for integrating all of these strategies to improve planning and operations coordination. The following discussion gives some examples of how the RCTO supports the linkage opportunities discussed in these previous sections.

- Data Sharing (Section 2.2): The RCTO is an opportunity to increase regional data sharing. As discussed in Section 2.2, incompatible or conflicting data between various agencies and jurisdictions frequently impede efforts to maximize the use of data for operations and planning. The RCTO can highlight the benefits of improved data consistency, awareness, and accessibility. This allows agencies to evaluate tradeoffs and consider compromises relating to data standards and protocols.

- Performance Measures (Section 2.3): An RCTO can provide a basis for developing management and operations performance measures. Because the RCTO defines regional operations objectives, physical needs, institutional relationships, and resource needs, it is the ideal place to define metrics to assess the region's progress in each of these areas.

- Congestion Management Systems (Section 2.4): The RCTO can help ensure that individual management and operations projects build towards integrated regional transportation objectives. Goals for management and operations may stretch beyond traditional congestion management to include objectives such as travel time reliability and intermodal coordination. The RCTO can provide a framework so that operations projects and programs within the CMS are not implemented in an ad-hoc fashion but, rather, contribute toward an integrated strategy.

- Funding and Resource Sharing (Section 2.5): The RCTO allows operations funding to be targeted toward more specific management and operations strategies and reveals opportunities for efficient resource sharing. Section 2.5 described how funding for operations is frequently allocated under broad categories (such as "management and operations") with little specific reference to the activities that are to be funded. An RCTO provides a more complete regional operations vision that helps define specific programs during the planning stage. This can raise the profile of management and operations programs among elected officials and the public.

  In addition, by defining some common operations goals among diverse stakeholders, the RCTO can identify equipment and other resource needs that are common to several agencies. This creates an opportunity to identify particular equipment that could be jointly purchased and shared by a number of agencies, or to coordinate common technology or software to enhance compatibility and efficiency. Raising such opportunities a year or two in advance is critical for developing coordinated strategies.

- Institutional Arrangements (Section 2.6): Regular stakeholder forums and interjurisdictional meetings are familiar to participants in the regional planning process. However, some operating agencies may be less accustomed to such practices, and may question whether they are a valuable use of time and resources. The RCTO provides an important framework for ensuring that such forums are directed toward clearly defined and pragmatic operations coordination. Initially, meetings to prepare and advance the RCTO may be the only forums where the participating stakeholders can focus on regional operations thinking. The RCTO also offers an opportunity to forge needed relationships with non-transportation agencies (such as emergency response and security agencies).

- Regional ITS Architecture (Section 2.7): Components of an RCTO correspond with components of the Regional ITS Architecture discussed in Section 2.7. For example, an RCTO's "relationships and procedures" section should relate closely to a regional ITS architecture's discussion of critical agency relationships and information sharing. Where a regional architecture exists, it should both inform and draw support from the RCTO. In regions where there is no regional ITS architecture, the RCTO will help ensure that the architecture is developed in a way that informs immediate operations decision-making and links to broad regional goals and objectives.

- RTSM&O Projects (Section 2.8): The RCTO is directly related to the implementation of RTSM&O projects. Section 2.8 describes the common practice of allocating authority for all operations to local jurisdictions. The RCTO offers a means by which local organizations can maintain control of their own management and operations projects and programs while increasing the likelihood that these programs will build toward an integrated regional management strategy.

THE FUTURE OF THE RCTO

Implementing an RCTO involves significant challenges. For example, there will be challenges in directing resources toward a new regional coordination effort. There will be challenges in identifying stakeholders with the technical knowledgeable necessary to develop the RCTO yet with sufficient decision-making authority to commit resources and formalize relationships. And of course, there will be challenges in building regional consensus on operations priorities. Based on the RCTO's potential for linking planning and operations and improving the efficiency of existing investments, these challenges are well worth facing. Existing experience with RCTOs offers reason to be optimistic.

3 SELF ASSESSMENT

The following table is designed as a self-assessment tool to help planning and operations practitioners consider their current level of coordination and identify linkage opportunities that can be exploited.[21] If the answers are “no” to many of the questions for a given opportunity area then this area may represent a good place to expand planning and operations coordination. The previous chapter described a wide range of strategies to help coordinate transportation planning with transportation management and operations, and these strategies can be used as a starting point for discussion within a region.

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[21] This self-assessment covers all of the linkage opportunities discussed in chapter 2 except for the regional concept for transportation operations (Section 2.9). The RCTO is not included in the self-assessment because this strategy is new and has been implemented in only a few regions.

Overall Planning Process	Data Sharing	Performance Measurement	Congestion Mgmt Systems
☐ Do planners and operators know one another and understand each other's roles? ☐ Do public safety, private sector, and other transportation operations practitioners participate in regional planning forums? ☐ Do goals and objectives address efficient systems management and operations? ☐ Do needs assessments address institutional coordination, system flexibility, and reliability? ☐ Does assessment of planning scenarios consider the effectiveness of operations strategies? ☐ Do plans articulate or refer to the future system of regional operations?	☐ Have any agencies identified and assessed opportunities to data sharing? ☐ Is there a place where agencies and jurisdictions can identify all available transportation-related data within the region? ☐ Have agencies explored or implemented specific data sharing partnerships where benefits are significant? ☐ Are universities within the region involved with data management and sharing? ☐ Do agencies apply available operations data to develop planning analysis tools and performance measures? ☐ Is the ITS architecture used to inform opportunities for sharing data?	☐ Does an MPO committee or task force have explicit responsibility for regional performance measurement? ☐ Are managers with day-to-day operations responsibilities involved in developing performance measures? ☐ Are regional performance measures that relate to operations included in strategic/long range plans? ☐ Is there an established schedule for performance reporting? ☐ Has the agency identified specific data and tools needed for implementation of improved performance measures? ☐ Is it clear to decisionmakers and the public how performance measures are used to prioritize operations and capital investments?	☐ Do CMS meetings involve operations managers and public safety officials? ☐ Are CMS findings explicitly discussed in the regional transportation plan and other planning reports? ☐ Are operators and planners aware of projects that are listed in the CMS? ☐ Do CMS strategies take non-recurring delay into account? ☐ Are CMS performance evaluations linked with a funding prioritization process?

Funding & Resource Sharing	Institutional Arrangements	Regional ITS Architecture	Regional TSM&O Projects
☐ Do planning and operations funding programs link clearly with planning goals and objectives? ☐ Are emergency response and emergency preparedness funds used appropriately to support transportation operations planning? ☐ Are there funding incentives to promote interjurisdictional coordination? ☐ Do planning documents identify funding for specific management and operations activities? ☐ Have agencies identified opportunities to share equipment or facilities? ☐ Are any funding sources used to leverage participation in management and operations coordination?	☐ Is there an active forum for regional management and operations? ☐ Do practitioners involved with specific operations activities participate in the planning process? ☐ Do practitioners involved with regional operations collaboration participate in the planning process? ☐ Has there been a strategic discussion about the appropriate MPO role in regional operations? ☐ Is there coordination between planning and operations divisions within State DOTs and transit agencies? ☐ Is there any staff exchange between planning and operations offices? ☐ Are management and operations strategies discussed during project design and delivery?	☐ Is the MPO actively involved with the ITS Architecture? ☐ Are operations managers involved with the ITS Architecture? ☐ Does the Regional ITS Architecture explicitly address regional planning goals and objectives? ☐ Do agencies that are sponsoring projects consider architecture consistency and opportunities early-on? ☐ Are regional planning agencies and operating agencies familiar with the ITS Architecture's operational concept? ☐ Do diverse stakeholders regularly participate in ITS Architecture meetings? ☐ Has the MPO or another regional body defined ITS architecture maintenance responsibilities & activities?	☐ Does the planning agency know who is engaged with regional TSM&O projects? ☐ Does the MPO get involved in any management and operations programs? (e.g., to facilitate public outreach, regional coordination, or the relationship with capital programs) ☐ Has there been any discussion of expanding existing TSM&O projects to address more management issues or additional jurisdictions? ☐ Are there any M&O projects recognized as a successful program by the broader public? Is this used to promote regional M&O?

4 RESOURCES

KEY WEB SITES

FHWA: Systems Management and Operations Planner's Resource
http://plan2op.fhwa.dot.gov/

The Institute of Transportation Engineers: Transportation Systems Management and Operations
http://www.ite.org/management/index.asp

FHWA: Regional Transportation Collaboration and Coordination
http://ops.fhwa.dot.gov/RegionalTransOpsCollaboration/note.htm

FHWA: ITS/Operations Resource Guide
http://www.its.dot.gov/guide.html

ITS Joint Planning Office Electronic Documents Library
http://www.its.dot.gov/itsweb/welcome.htm

National Associations Working Group for ITS
http://www.nawgits.com/

FHWA: Office of Operations
http://ops.fhwa.dot.gov/index.asp

FHWA: Office of Planning
http://www.fhwa.dot.gov/planning/index.htm

ITS America
http://www.itsa.org

ON-LINE TOOLS

National ITS Architecture
http://itsarch.iteris.com/itsarch/

Intelligent Transportation Systems Deployment Analysis System (IDAS)
http://idas.camsys.com/

ON-LINE FORUMS

Electronic National Dialogue on Transportation Operations
http://www.nawgits.com/opdialog/

ITS Forum
http://www.nawgits.com/itsforum/nawg/

ITS America Transportation Systems Operations and Planning Forum (membership forum)
http://www.itsa.org/new.nsf/vLookupForumIntro/Transportation+System+Operations+and+Planning!OpenDocument

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