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SYSTEMS MANAGEMENT AND OPERATIONS IN THE PLANNING PROCESS

REVIEW OF THE PORTLAND, OREGON METROPOLITAN AREA

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FOREWORD

This paper was prepared by the U.S. Department of Transportation's (U.S. DOT) John A. Volpe National Transportation Systems Center (Volpe Center) for the Federal Highway Administration's (FHWA) Office of Metropolitan Planning and Programs. Mr. David W. Jackson of the Volpe Center's Economic Analysis Division is the principal author. Mr. David Rutyna, EG&G Services, and Mr. Allan J. DeBlasio, the project leader, provided additional support. Mr. Brian Gardner and Mr. Douglas Laird of the Office of Metropolitan Planning and Programs provided the direction for this project. Mr. DeBlasio should be contacted concerning comments on this report at (617) 494-2032.

Systems Management and Operations in the Planning Process

Portland Metropolitan Area Summary

Introduction

The John A. Volpe National Transportation Systems Center (Volpe Center) is assisting the Federal Highway Administration's (FHWA) Office of Metropolitan Planning and Programs in assessing the level that management and operations (M&O) aspects of projects and programs are currently involved in the metropolitan transportation planning process. While the Intermodal Transportation Efficiency Act of 1991 (ISTEA) regulations identified M&O as one of nearly two dozen planning factors, the Transportation Equity Act for the 21st Century (TEA-21) places much more importance on M&O benefits and costs in the formulation of plans and programs. The goal of the legislation is improved regional decision making, resulting in the coordinated delivery of products and services that provide safer, more reliable travel.

The FHWA recognizes that there is no single blueprint for managing and operating complex transportation systems throughout the vast variety of U.S. metropolitan areas. Efforts must be tailored to meet the unique needs of each region. In turn, the region's goals and objectives for operating the system should stem from the consensus of a strong planning process. It is expected that the FHWA will work through the metropolitan planning organizations (MPOs) to lead the delivery of this TEA-21 provision and, once established, to follow its progress.

The Volpe Center team has already studied four metropolitan areas – Columbus, Ohio; Des Moines, Iowa; Portland, Oregon; San Diego, California – to ascertain how these areas are considering M&O within their project development and planning processes. All four of these areas were selected because they are notable as having a very strong regional focus, are deploying a significant level of intelligent transportation systems (ITS), transportation demand management (TDM), and transportation systems management projects that are very operations-intensive projects, and their transportation planning process are seen as progressive. This paper summarizes the findings from discussions with transportation professionals from the Portland Metropolitan Area.

Planning Documents

Although not explicitly referenced in many planning documents, M&O are included in various ways within the work and projects cited in the regional planning documents. Available planning documents were reviewed to assess if any analysis of post-deployment M&O were conducted, how M&O issues were being documented, and if there was any indication how much experience and understanding the MPO staffs had with M&O functions. This section describes the findings from the review of the planning documents.

Uniform Planning Work Program (UPWP) Fiscal Year (FY) 1997-98 - Based on this UPWP, Metro Council (Metro) staff have the capabilities to understand, analyze, and model for M&O impacts. They have chosen, however, to keep these functions separate within the operating agencies and focus on multi-modal and TDM initiatives, and land use connections. Metro is heavily involved in directing funds to transit and alternative mode projects and improving its extensive database. Metro is maintaining a database for the regional transportation plan that includes cost and revenue estimates. In addition, Metro is leading the development of the Intermodal Management System study. The Intermodal Management System is a tool that will be used to determine regional freight and intermodal needs and includes the development of performance measures for freight routes and intermodal facilities.

Transportation Improvement Program (TIP) FY2000-03 - This TIP, also known as "Priorities 2000," is a traditional document that lists each agency's project priorities. Staff from Metro and the area agencies that submit projects have conducted extensive analysis to compare and rank the projects, but this analysis was not included within the TIP. The TIP text does not indicate if there was any consideration of M&O impacts. There are TIP project categories that envision some M&O functions, such as Oregon Department of Transportation (ODOT) Operations, ODOT Safety Program, and Tri-Met Maintenance. However, these are still capital (rehabilitation or replacement) programs and not actual funds to be provided for daily applications.

Regional Transportation Plan (RTP) Draft 1999 Update - Much of the Portland Area RTP is land use and growth management policies tied to the transportation system. Environmental justice is also a strong theme within this document. The RTP does recommend design forms, and therefore, the Metro is involved in some project functions beyond planning. The RTP contains a section on transportation finance that emphasizes efficient operations, maintenance, preservation, and effective use of the transportation infrastructure. Metro is pushing the development of system and demand management strategies to improve how the transportation system operates. The objectives in the RTP are in the form of statements, with no quantifiable checks, although a great deal of text discuss developing and attaining improved (performance) measures regarding the design, function, and performance of the regional transportation system. As part of this RTP process, performance measures are being developed for safety, bridges, and facilities. There are no indications that projects will be examined for their life cycle, replacement, or M&O costs and impacts as part of the planning process.

Vancouver, Washington, Planning Documents - The Southwest Washington Regional Transportation Council (RTC), an MPO, works closely with the Metro. According to the RTC's FY2000 UPWP, the updated 2020 Metropolitan Transportation Plan for Clark County, Washington, will produce a financial plan that will include M&O costs, as well as capital costs. The FY2000-02 TIP will also have a financial plan with M&O costs. In addition, Clark County Transit (C-TRAN) has developed a Comprehensive Operational Analysis Plan and a Transit Development Plan, both of which have examined transit operations. The examination of M&O costs occurring in this area appears to be driven by intra-agency initiatives rather than a push from the RTC.

Discussion of M&O by Agency

Representatives from the MPO, the state DOT, the regional transit agency, and the principal local government were contacted for this study on M&O. Each agency has varied perspectives on what functions are included within M&O, the proper role of the MPO in M&O analysis and activities, and if the Federal Government should require M&O analysis in the planning process. This section discusses these and other thoughts regarding M&O activities that are specific to each public agency represented in this review.

MPO – Metro Council

The Metro Council, which is the Portland Area MPO, covers the area including Multnomah (Portland, Gresham), Clackamas (Oregon City), and Washington (Beaverton) Counties in Oregon and maintains a cooperative arrangement with Clark County (Vancouver) in Washington. The MPO representative said that M&O has been historically defined by funding. State gas tax revenues are primarily used for M&O functions; other state and federal funds are used for capital projects. Metro sees its principal role in M&O as managing how projects are selected and what projects are selected. While Metro has a “hands-off” policy towards operations and does not operate or dictate operations policies for cities, counties, ports, the ODOT, or other public agencies, Metro staff have been instrumental in using the region’s policies to emphasize the importance of efficient operations. In keeping with these policies, Metro highlights high return, but low publicity projects, such as signal optimization, and technology enhancements, such as ITS deployments. The MPO, through its authority to program and plan, tries to facilitate operations, maintenance, and preservation (OMP) activities over modernization (road construction) activities.

Since the implementation of ISTEA in 1991, the focus on M&O issues in the metropolitan area has increased dramatically. The Metro interviewee believes that the TEA-21 regulations should require some level of management. It would be difficult to force MPOs to address management if it is not their own initiative, but planners sometimes need a “bad cop” in the form of funding requirements to force them to do the right thing and examine management and operations of the systems they are funding. Short of mandating that MPOs assume some M&O review responsibilities, the existing federal planning regulations already contain some directives to improve M&O efficiencies. More explicit requirements may result in additional support for the MPO to ensure that system management is occurring and the enumerated improvements will be made during the planning period. This would give even greater support to the need for performance measures. The Metro official commented that it should not be required for MPOs to review M&O without an ironclad guarantee of additional staffing. It will take a larger and much more time-consuming effort than what is currently occurring to accurately determine what the full costs are for each project. The dirty little secret of management projects is that they require full-time equivalent (FTE) employees. Staffing needs must be known if M&O is to be addressed. Trade-offs in staffing levels and projects may be required, but at present, these trade-offs are not being honestly discussed at the MPO or agency level, in any metropolitan area.

In addition to presuming that staff are available for the additional responsibility, requirements for MPOs to review M&O presumes that the MPO understands operational functions. It is tough for

planners to set operating standards for the RTP or the TIP, such as one FTE for each signal optimization process, unless they are familiar with system operation needs. The Federal Government should develop training that familiarizes MPO staffs with basic engineering and operating concepts.

Metro managers are pleased, to a point, that there is now momentum to perform systems management. The MPO representative cautioned that there are two ways to look at management. Engineers see low-cost fixes (i.e., road geometrics, signal enhancements, turning lanes), while community activists and some jurisdictions see management as “cramming more cars through neighborhoods.” The activists question the value of speeding traffic rather than initiating new traffic calming activities. Metro planners themselves do not believe that management is always optimal. In areas where there is great growth, modernization is also needed. The role of the MPO, as the most regional agency and best able to see the big picture of management, is to balance the level of management and modernization. It is also important for the MPO to ensure that *systems optimization* is stressed over *systems management*. Many of the area agencies see *systems management* as synonymous with auto-maximization, but *systems optimization* addresses all modes and land use needs. Land use issues, above all, drive the region’s transportation planning.

State DOT –Oregon Department Of Transportation, Region 1

ODOT Region 1 includes all of the Metro (MPO) planning area and encompasses the City of Portland, and Washington, Clackamas, and Multnomah Counties. ODOT’s informal definition of M&O is “what is not capital.” There is no real definition of management, but ODOT does include ITS within the management of the systems. Maintenance, seen as an individual and unique part of management, is the repair of various items and keeping the electrical and mechanical devices running. The majority of ODOT’s budget is now directed at maintaining, not building. In fact, more of ODOT’s capital budget is directed towards making the existing system perform more efficiently and increasing capacity through systems rather than actually building new road capacity.

ODOT is leading the (Regional) Technical Advisory Committee for ITS (TAC), which is developing a cooperative plan for integrating and managing existing systems. Outside of the TAC, coordination among the area agencies is also very strong. Regional decisions are filtered from the local agencies up through the MPO structure where discussions about the region occur. The ODOT, MPO, and cities in the region are currently developing a ramp metering policy and a plan to manage the ramp metering system, which is now being expanded. The ODOT official sees the MPO staff becoming more involved in the planning of operations for existing and future systems because each operating agency cannot do all that is needed to examine long-term needs. The planners that are involved in this process must understand management. While a requirement may be necessary to ensure a minimum recognition of M&O costs, the ODOT representative fears that because there is already good cooperation to initiate and continue operations-intensive projects, a requirement that calls for funding obligations or in-depth analysis may be more burdensome than helpful. However, for less cooperative areas, requirements would help ensure there is more interaction and cooperation among agencies. The interviewee would

prefer instead that guidelines to include M&O in the planning process be developed and care taken that the “guidelines” do not become national “requirements.” The state transportation professional favors guidelines that would seek to resolve operating procedural issues rather than target staffing and funding issues. The ODOT official sees M&O guidelines addressed as regional policies that cover topics such as ramp metering operations and impacts along corridors at local roads that answer questions like “Do we want an arterial backup or freeway failure?”

ODOT supports some level of regional review and documentation that M&O impacts have been considered for each project. Internally, ODOT management has gone a step further by detailing costs for each individual component of the transportation infrastructure, which they own and operate. The Information Technology staff at ODOT Headquarters use capital costs plus maintenance crew documentation from each region to track life cycle and replacement costs for each piece of ODOT equipment and road segment within the state. This asset management database is used to allocate maintenance dollars to the ODOT regions, based on the number of roadway features and pavement miles in each region. Data from this large database are not currently being utilized in any regional planning process by the MPOs in Oregon. The ODOT official thinks that the state’s database can be modified to aid in assessing M&O costs for projects being proposed for RTP and TIP inclusion. The transportation manager believes that there are more data already being produced by each agency than can actually be used by the MPO or each agency. The next step is to figure out how to collect the data in formats that allow easy use by planners and operations professionals. After this determination is made, then costs for M&O components of each system should be tracked because the official sees this information eventually being needed on a regional level by the MPOs and each ODOT region.

Transit –Tri-County Metropolitan Transportation District

The Tri-Met service area covers three Oregon counties and 22 municipalities. Tri-Met also has an express bus route that crosses the bridge to Vancouver, Washington, where service connections with Clark County Transit (C-Tran) are made. Tri-Met differentiates between capital and operations and maintenance through its budget line items. Replacement buses are considered capital, while bus repairs are maintenance. The Tri-Met official said that management is a different function from operations and maintenance. Management is based in system performance and includes the review of costs to provide service and determining how best to allocate funds to cover the service. Management is a process, while operations and maintenance are specific functions within the budgets.

Tri-Met personnel have been examining operating and maintenance costs since the agency’s inception. The current Tri-Met Operating Plan examines all costs, including union-related labor and benefit costs, as part of its M&O costs, and compares the projected revenues with the long-term costs. In the past few years, Tri-Met administrators have increased their reliance on management functions. To aid in improving service and provide more data to conduct operational analysis, Tri-Met has relied heavily on service performance improvements that can be generated through ITS technologies, such as automatic vehicle location (AVL), automatic passenger counters (APC), and computer-aided dispatching (CAD) systems.

The transit official stated that ODOT has facilitated ITS development and the discussion of M&O issues in the region through the TAC, which ODOT management established in the early 1990s. The TAC developed the region's fiber optic cable infrastructure and is the forum for discussions regarding the sharing of the communications infrastructure. While Metro staff could have led the operation coordination efforts for the region, ODOT has been the most logical facilitator because they have a direct stake in operations. According to the interviewee, the MPO's role should be the administrators of the regional budget and the assignment of project priorities.

The Tri-Met representative would like to avoid any requirement that detailed M&O analysis be part of the planning process. Seldom are M&O impacts considered for individual transit projects. However, the MPO should ensure that the parties that maintain and operate the transportation system are plugged into the planning process. Because projects are becoming more technical and complex, it is increasingly important that all agencies involved know the full consequences of a project. The review of M&O impacts should be recommended as a standard process and as a best practice to document M&O impacts promoted through the federal requirements and guidelines. If an agency or a metropolitan area, as a whole, does not examine impacts, the appropriate party(ies) should state the reasons why they chose not to document these impacts for any project or group of projects as part of the planning process.

Municipality –Signals And Street Lighting Division, City Of Portland

Because of reorganization in 1999 within the City of Portland's Office of Transportation (Portland DOT), the Portland DOT is struggling with the definitions of M&O. The Signal and Street Lighting Group (formerly the traffic division) has been the test case to see if various functions will be more efficient and effective under one division rather than segregated. Previously, engineering had been separate from maintenance. It was realized that both functions had operational roles. The Signal and Street Lighting Group now encompass all aspects of signal and street lighting, including planning, design, construction, operations, and maintenance. The Portland DOT is still trying to better define the operations role. Even with the reorganization, a disconnect remains between capital and operations staff. The City representative said a checklist ultimately will be created to ensure that input from engineering and maintenance staffs occurs as part of the City's project development process.

The City of Portland feels that there should be some review of M&O, but they have not rationalized at what level within the City or by what agency in the region. The Portland DOT staff are already involved in some regional activities involving operational issues. Staff attend the ODOT's monthly TAC meetings. In addition, the ODOT Communications Engineer has created the Communications Subgroup from the TAC membership. The subgroup's current directive is to develop the region's fiber plant. The subgroup's work has focused heavily on the development of processes to coordinate the communication and other related operational needs for the multiple agencies that will rely on the communication network for M&O functions.

The City official sees the role of the MPO beyond the project development work that the ODOT is directing. The MPO's role should be to direct regional discussions regarding M&O impacts

when agencies are developing lists for capital projects. The Metro staff can advise other agencies as to what the requirements will be for M&O, not just on ITS projects, but other projects as well. The interviewee noted that the inclusion of M&O requirements into the planning process could be viewed positively (more operations will be funded) or negatively (unnecessary regulation that just adds work). However, the City representative believes it would be beneficial for staffs from local governments to point to some requirement for M&O analysis or for M&O funding commitments to alert politicians that there is a need for long-term funding for specific projects.

City staff have already had to examine the full costs of a number of multi-jurisdictional projects to obtain long-term commitments from the City of Portland and other jurisdictions that are partners on joint projects. The City of Portland currently operates and maintains 950 signals. Many of these signals are along common corridors and actually owned by other agencies but operated and maintained by the City of Portland through agreements between the agencies. Interagency agreements (IGAs) are the instrument used between the City and ODOT, and the City and Multnomah County to document procedural and financial arrangements. M&O costs assessed to each agency are prorated based on the number of agency signals on the system. The operational arrangement has worked out so well that there are plans for an IGA between City of Portland and ODOT concerning sharing signals outside the City's jurisdiction. Multnomah County shares 90 signals with the City on corridors on the east side of the City. In addition, the City of Portland has an agreement to share fiber optic cable communication space with ODOT. The City of Portland also shares an 800 MHz radio system with Tri-Met. The City of Portland and City of Gresham entered into an arterial management agreement to share Gresham's proprietary signal control operating system. Portland was able to use the Series 2000 proprietary software and avoided a \$500,000 computer use cost.

General Findings from Metropolitan Area Interviewees

A majority of the respondents from the metropolitan area were in agreement on a number of items related to M&O. Findings that apply broadly to M&O issues are summarized in this section. Other findings that are specific to data and federal requirements are listed within subparts to this section. Lastly, there are several successful actions that appear to have worked well to increase M&O consideration in the metropolitan area and could serve as models for other metropolitan areas to follow.

- Operating agencies wish to conduct their own operations analysis but with support from the MPO staff.

The agency representatives felt that analysis of M&O on a project-by-project basis was best left to the individual operating agency. All of the transportation professionals from the Portland area would also like the assistance of MPO staff and resources, but how much assistance would be given by the MPO is debatable. The general hope was that the MPO staff would be available to describe the details of any analysis needed and to pull together all of the operating agencies to discuss operating impacts in a regional context. In addition, the MPO databases and project and planning models should be available to assist agencies with their assessment of M&O impacts.

- There is a wide variation for what comprises management.

The City of Portland still uses the term “maintenance” rather than “management.” The reorganization within the City’s Transportation Department should lend itself to a greater understanding of the overarching role of and benefits from management. Tri-Met sees management very different from operations or maintenance. Management is a function, but does not have a budget category like operations or maintenance. Rather, it is the determination as to how best to allocate services and costs between the transit activities. The ODOT official stated that they do not have an agency definition of management, but system management is included within the operations and maintenance functions. Finally, the MPO distinguishes between system management and system optimization. This agency sees management policies favoring automobile travel, while optimization examines the relationship between all modes of travel and relates these modes to the area’s land use needs. Metro highlights both system management and optimization in the RTP.

- Replacement cost analysis, useful life analysis, or project evaluations are only informally performed.

Interviewees from each of the agencies said that their agencies have not developed any formal process to determine replacement costs, useful life costs, or to conduct project evaluations for any specific project. The representative from the Portland DOT noted that most replacement and useful life costs are determined by staff’s expertise and practical knowledge, but life cycle costs are not formally examined and documented. The City’s Communications Engineer/Systems Manager uses his practical knowledge to analyze systems and equipment as part of the procurement process. An ODOT official remarked that replacement costs have been factored into decisions regarding purchases of new emergency response vehicles. The representative from Tri-Met stated that the transit agency uses Federal Transit Administration standards to assign equipment replacement costs and useful timeframes to equipment to be procured. This process is coordinated through the agency’s finance department. Life cycle costs, though not used routinely, have been used by Tri-Met to determine and evaluate alternatives. In addition, the Metro participant revealed that regional roadway design objectives are for a 20-year life.

One interviewee noted that life cycle costs would be used if there were a political imperative to do so. Politicians, however, rarely have constituencies that inquire about the full costs of projects, allowing politicians to focus on short-term construction costs. Another interviewee saw value in examining the full costs of projects. Agencies must define true M&O costs, including incremental costs. The official added that a set amount to be used as a system or equipment upgrade fund should be included within the budget of each project.

- Operating agencies look to ODOT to take the lead regarding most regional operating and transportation issues.

ODOT is the lead agency in the metropolitan area for the development of transportation systems and their related issues, which include how to ascertain and fund M&O costs. There is already some thought within the operating agencies as to how they can determine M&O costs, but except

for ODOT's asset management system, this consideration is not large scale nor on a project-by-project basis. The interviewees understood that the deployment of ITS and regional systems would probably necessitate the determination of non-capital costs so these long-term costs could be equitably distributed amongst participating and benefiting agencies.

As a follow up to the 1995 Portland Early Deployment Planning Study, ODOT Region 1 staff are developing a short-term ITS Implementation Plan for the planned advanced traffic management system. The plan will include capital costs and the M&O costs for the next four years. This will include costs for vendors, identification of features, and new ITS device and activity tracking codes that will simplify the determination of cost allocation for future deployments.

- Metro is the lead agency for planning and land use issues.

Appropriately, Metro has assumed its role as the lead planning agency for the metropolitan area. Area interviewees, however, stressed that the MPO's planning responsibilities have not and should not cross over into operations. This regional responsibility is reserved for the ODOT staff and the ODOT-sponsored TAC, of which Metro is actively involved. Metro could be extremely effective by promoting M&O from its planning role and working toward getting ITS and other operations-intensive projects included within the federally mandated planning documents. One aspect of this task is to ensure that ITS projects can be equitably assessed and compared with conventional transportation construction projects.

Most of the new construction projects in the metropolitan area fall under the "modernization" category. Tri-Met relies primarily on regional funding sources for their bulk purchases, facility construction, and ITS applications (e.g., automated bus dispatch, train control, real-time traveler information). Therefore, the majority of federally funded ITS projects in the Portland Metropolitan Area are highway or arterial related and also fall under the "modernization" category. Metro staff's primary role with modernization projects are to work with the operating agencies to evaluate these projects and develop criteria that would enable "head-to-head" comparisons between ITS projects and traditional road construction projects. A simple methodology was developed that allows fair comparisons. The criteria developed to evaluate "modernization" projects are (1) congestion reduction; (2) cost efficiency; (3) reinforcement of regional land use goals; and (4) safety. Only the safety criterion includes the examination of operational procedures as well as projected outcomes.

The land use criterion has also increased the ranking of ITS projects. Metro has greater discretion over projects in the "operations, maintenance, and preservation" category than with "modernization" projects. The OMP projects tend to be smaller and more incremental than the modernization projects. Metro uses the OMP category to fund projects that will facilitate the regional land use goals of increased commercial and housing density.

- More operations-intensive projects are being developed.

The financial constraint requirements from the ISTEA have actually pushed ITS and other operations-intensive projects into the planning process and the mandated TIP and RTP. When it became clear that the area's transportation agencies would not have the funds to build out of the

current and projected congestion levels, ITS became an attractive investment to address its congestion issues with limited funds. Even with the realization of fiscal constraints, it was not until the 1996 TIP that discretionary federal funds from the Surface Transportation Program and the Congestion Mitigation/Air Quality Program were used for ITS system deployments. Since this time, there has been an increasing share of federal discretionary funds being used for ITS implementation.

- Maintenance, one function included within management, is seen as a distinct element by the transportation agencies in the Portland Metropolitan Area.

The representative from Metro reported that, as part of its planning responsibilities, the MPO staff review capital and management projects, but do not look at maintenance projects. Daily maintenance issues have not been seen as regional issues, but individual agency concerns and do not therefore enter into the planning process. From 1999 through 2002, TEA-21 has allocated approximately \$100 million to the area for maintenance. However, these TEA-21 projects are actually more rehabilitation projects than small day-to-day maintenance activities (e.g., litter collection, signal inspection, landscaping, repaving) that are necessary to keep the transportation network performing efficiently.

Area transportation officials believe that eventually typical and re-occurring maintenance costs should be included in any life cycle costs for each facility. Currently, only the ODOT is accounting for these costs. Statewide, ODOT has created an ITS Maintenance Plan (adopted December 1999) to address long-term technical, funding, and institutional issues associated with ITS maintenance through 2017. The ODOT representative said the state agency is aware that maintenance levels and associated funding can directly and indirectly affect the need for operational and capital support for regional systems, but is not sure how to apply maintenance policies and associate costs and impacts to individual projects.

Data

The interviewees were asked about data collection, coordination of data and information, and how data and information are being used by the transportation agencies in this metropolitan area. Responses to these questions can assist transportation professionals in understanding what data are needed to better analyze the M&O functions and impacts of the transportation networks.

- Operational data has been collected for almost two decades in the Portland area.

Ramp meters have been used in the Portland Metropolitan Area since 1981. Soon, 90 of the 150 on-ramps in the metropolitan area will be metered. The ODOT staff have used the loop detectors at the ramp meters and along the state's freeways as an effective way to collect data. ODOT freeway volumes are collected from loop detectors. In addition, the City of Portland gets good traffic flow (volume) counts from the 400 system loop detectors installed in the City. The detectors were usually placed in each lane and are now beneficial in providing two-way counts.

On the transit side, Tri-Met collects and uses an extensive transit operations data. A Tri-Met representative remarked that the transit agency is becoming dependent on operational data being supplied by advanced technologies, specifically AVL, global positioning satellite (GPS), and APC systems. These systems and other Tri-Met operational systems are used to generate bus data for the CAD system, boarding count data, driver input data (accidents, maintenance, vandalism), dispatch input data, maintenance management system data (vehicle diagnostics), links and modifications to the geographic information system (GIS), telephone information system data (requested information, service accommodations, service complaints), and other customer generated data, including attitude and awareness survey data.

- While still in the early stages, the agencies from the Portland Metropolitan Area are seeing benefits from the sharing of operations data.
 - Minute-by-minute congestion/traffic volumes and speeds
 - Metro base map and Tri-Met's AVL/GPS system
 - Tri-Met bus movement data for corridor traffic analysis

Similar to public agencies in other metropolitan areas, each Portland area agency had been generating a large volume of operations data for its own purposes. There appears to be several factors that have initiated discussions regarding the sharing of operations data between agencies. First, the development of a fiber optics cable system has simplified data flows. Second, the extensive deployment of ITS technologies by Tri-Met has expanded the volume and quality of the data being generated that could be used for multiple purposes. A final facilitating action has been the expansion of the ATMS in the region. Although data sharing is not yet widespread, technology and data sharing between agencies has shown some positive results and has led to discussions about how to share additional data.

Fiber optic cable already connects Metro, ODOT, City of Portland, and Tri-Met facilities. The MPO receives data from the collecting sources of each agency. A number of other public agencies are connected through wireless connections and are receiving traffic flow information. Managers from ODOT and the City have discussed what formats are best to share congestion, traffic speed and other real-time operational information. One data sharing arrangement proposed is for each agency to produce a flat file of their operational and static data. Any agency wishing to access that data could do so from the Internet. It would be the users responsibility to make information out of the data, store it, and decide what to do with it.

Metro initially shared its base map with Tri-Met and ODOT for their GIS applications. After deploying its AVL/GPS system, it became obvious with buses "running through buildings" that some of the GIS mapped streets were not positioned correctly. Using their location technology, Tri-Met was able to correct street coordinates on the base map for the benefit of all the agencies using the Metro-housed map.

The transit official recognized that Tri-Met generates data continuously, which would be ideal for other agency and regional applications. Internally, Tri-Met now uses data to plan bus stop locations, create better bus schedules, monitor stacking occurrences, and monitor on-time performance. This planning has led to stacking and performance improvements. The agency is now getting some facility performance characteristics from bus probe data. Tri-Met is sharing its

bus movement data generated by its AVL/GPS/GIS technologies with the City of Portland, Metro, and ODOT. These agencies are using the data as an indicator of corridor congestion. The bus movement data mirrors the traffic movement along the street. There are discussions with ODOT, the City of Portland, and Metro to expand this use of data to evaluate corridor congestion and traffic signal light cycles.

The City of Portland is looking to chart data trends from the bus movement data source for long-term analysis. A joint project between the City of Portland and Tri-Met will utilize similar transit operating data for analysis of traffic light cycles at 200 intersections where transit priority is being implemented and a four-block streetcar system is being deployed. Tri-Met is evaluating the operational trade-offs involved in Tri-Met's assumption of the management of the streetcar system and in return receiving signal priority from the City.

- Although the area agencies are producing large amounts and wide ranges of data, planners still have data needs to assist them in M&O examinations.
 - Planning software
 - Safety data
 - Facility characteristic data
 - Construction process data

A Metro representative reported that, as part of the planning and programming process, the MPO has worked with the operating agencies to develop credible data that would support quantitative analysis of ITS program benefits. Although the MPO developed a methodology that allowed comparisons of ATMS projects with traditional road expansion projects, this process could be further simplified with central planning software that could automatically change operations data to formats useable by MPO staff (planning data). Operations data is second-by-second, while planners require seasonal data (averages), not real-time data. It has proven difficult and time-consuming for planners to modify data from operations.

Safety data would be useful to planners because 20 of 100 total points in the TIP project prioritization review are based upon improvements to safety. Metro has received some bridge and safety data from ODOT, but need more to develop performance measures. The problem of incompatible databases from the agencies that provide safety information limits the ability to compare data.

Within the transportation network, there are many facilities that generate a wide range of impacts, including traffic, land use, and economic. The Metro staff see a need to be able to model these individual facilities (e.g., parking garages, transit stations, modal transfer points, toll collection sites, etc.) and determine what operational improvements can be made to existing facilities. Facility characteristic data would also enable the operating and planning agencies to create better designed, managed, and operated transportation facilities.

A Metro official added that the MPO would like better data regarding expected construction project lengths. Realistic construction timeframes would be beneficial to project programming for planners. Operating agencies would be able to determine when the M&O functions for a project would begin and budget accordingly. At present, Metro has received only limited

information on how long some of the modernization projects budgeted in the TIP have taken. MPO staff have not had the opportunity to compare the proposed project implementation timeframe versus actual schedules.

Federal Requirements

The transportation professionals interviewed from this metropolitan area were asked their opinions regarding the value of federal requirements to make M&O consideration part of the metropolitan planning process. As part of this inquiry, these interviewees discussed the type of review, if any, that should be required. The agency representatives also commented on any M&O issues that may result from related provisional changes, such as the impacts from the National ITS Architecture, standards development, and other major planning and environmental changes.

- Require documentation that M&O was reviewed
- Perform minimum M&O analysis for minimum impact on existing staff

All of the transportation professionals could see the value in some requirement for M&O review within the metropolitan transportation planning process. But, they were also in agreement that this requirement should not be a detailed analysis of M&O impacts, but rather a statement that M&O costs were considered as part of the project selection. It should be up to each operating agency to determine how much analysis of M&O should be performed, beyond a base level agreed upon by the agencies in the region. A consideration supporting a reduced baseline level of review is the workload impact on existing staff. The greater the required level of review, the more resource will be consumed.

One of the interviewees noted that the Portland area uses a four-year TIP period, so many of the capital-intensive projects will show high early year costs and operations-intensive projects will show higher later year costs. The individual also noted that it would be difficult to calculate full project cost beyond the TIP cycle. A second party remarked that planners should describe details of agency staffing and demonstrate revenues for staff to conduct M&O for projects listed in the TIP and RTP. Performance measures would likewise be used to determine M&O requirements necessary to maintain specified performance levels of projects, i.e., safety, bridge, or facility measures. An MPO official proposed a policy element for the RTP be required that states signal optimization will occur for all intersections and corridors where delay thresholds are exceeded. Optimization projects carry operational costs and any policy requiring optimization would likewise need to support the related M&O expenses.

- MPO staff require training to understand M&O issues

A couple of representatives conveyed that it would take more than just data for planners to be able to properly understand M&O. There are institutional and technical issues that cannot be resolved just through a requirement for quantitative analysis. In order for planners to be involved in M&O issues, they need to understand what operational impediments need to be overcome and procedures that the management and operations personnel must follow.

- National ITS Architecture may reduce M&O costs by minimizing duplicative systems
- National ITS Architecture consistency may require additional MPO staff or rearranging of staff duties

Most Portland area respondents were unsure if the federal requirement for regional consistency with the National ITS Architecture would have any bearing on M&O costs. An ODOT representative said that a consistent regional ITS architecture will be helpful in planning for the integration of systems with other agencies, minimize overlapping and duplicative systems, and assist agency management in anticipating future needs, which may save money in the long run. However, there were fears that the MPO would be required to demonstrate consistency with the National ITS Architecture. The Metro staff are already strapped to provide staff for additional regional work without adding this responsibility to the MPO.

- Standards development could help reduce the specialization of staff and mean quicker repair or replacement of system components

The representative from Tri-Met felt that the development of applicable standards has been very beneficial in the reduction of the capital and operational costs of the transit agency. Tri-Met has been using vehicle area network standards (J1708-1587), which are used for all support systems on transit vehicles, since they were adopted. Because of these standards, Tri-Met now purchases APC equipment from multiple vendors, and the APC technology is much more functional. When initially purchased by Tri-Met, the APC units cost \$5,000 per bus and were stand-alone systems. Now APC is a J1708 component. The technology is actually much more simplified as a plug into the Transit Management System access box. APC costs have now been reduced to \$900 per bus.

A representative from the City of Portland added that defining standards for products could mean that there would be fewer difficulties in incorporating a new piece of equipment into an existing system. Agencies would not need to purchase proprietary systems. Compatible systems mean reduced capital costs and more availability of system replacement parts. Specialized staff training on each component would not be as extensive or needed, therefore reducing M&O costs.

Successful Actions

This section examines what positive actions have occurred by public agencies within the metropolitan area to increase or introduce the examination of M&O issues. These successful actions by a single agency or the region as a whole demonstrate steps that accelerate movement toward the consideration of M&O issues.

1. Intergovernmental Agreements that examine sharing of M&O costs

IGAs have forced operating agencies to establish cost basis for the operations and maintenance of the equipment and facilities being shared. However, M&O clauses are one of the more problematic issues in finalizing IGAs. The City of Portland has a signed shared traffic signal

control system agreement with the Multnomah County. The City of Portland currently has about 550 signalized intersections on the system and Multnomah County has about 30 intersections on the system. The IGA, signed in 1997, outlined the cost sharing of the joint signal system:

The County will reimburse City for a pro rata share of the actual costs of operating and maintaining the Series 2000 central control system. The reimbursable costs will include personnel and material/services costs required for operating the Series 2000, including standard City overhead costs. ...The maximum cost to the County per intersection per year shall be limited to \$250, unless a higher reimbursement level is authorized by the County's representative.

The annual City personnel costs will be actual staff costs associated with operating and maintaining the S2000 central computer and the central communications infrastructure...staffed primarily by the Communications Engineer. ...This function will also include system operator time for system monitoring and dispatching of system errors. ...The annual other City costs include direct materials and services costs required for S2000 operations:...software maintenance contract costs, computer maintenance contract costs, RF cable modem maintenance costs, wide area network maintenance costs, power costs, and phone line costs.

The City of Portland is currently developing similar IGAs with the ODOT that would formally enable the City to operate ODOT signals both within and outside the City. Representatives from both the City and ODOT noted that the working relationships between the agencies are extremely good and the IGAs are only formalities.

While the MPO encourages consensual decision-making and long-term agreements, officials from Metro and other agencies see no role for Metro in the development or monitoring of IGAs. Those agencies that perform ongoing operations and that actually have funds invested in the infrastructure being shared should be the parties involved in the IGAs.

2. Technical Advisory Committee and Communications Subgroup efforts with the fiber optics infrastructure development and fiber sharing.

The Regional Technical Advisory Committee, led by the ODOT Region 1 Traffic Engineer, has been working to take the projects, services, and systems outlined in the 1995 EDP and develop a cooperative plan for managing and integrating the existing and proposed ATMS. The members of the TAC and the Communications Subgroup have taken advantage of the forum and are formulating agreements that involve the sharing of the 48-strand fiber optics system. It has already been determined that five to ten strands will be set aside for inter-jurisdictional use. The objective of the TAC and Subgroup are to maximize the capabilities of the fiber optics infrastructure.

3. Ramp metering policy and plan

Metro has placed a policy statement on ramp metering in the RTP that states that ramp metering is a traffic management tool. The MPO is expanding its modeling capabilities to include ramp metering impact and mitigation analysis. Shortly, ODOT will be adding 30 new ramp meters, making 90 metered on-ramps out of a total of 150 on-ramps in the metropolitan area. Metro staff are working with local and state professionals to expand the region's policy statement on ramp metering. Metro is also leading the effort to develop an accompanying plan that will address

how to operate the meter system to limit excess queuing on the locally-owned access roads when the meters are operating. As part of this effort, agreements between local jurisdictions and the ODOT may be required, which Metro may broker. This will present one of the first opportunities for Metro staff to be involved in the formulation of IGAs, principally because it involves multiple jurisdictions.

4. ODOT asset management of system

ODOT has developed an extensive database to track agency inventory and their related costs. The database for this cost tracking system is housed at the Salem, Oregon, headquarters. Maintenance activity codes are assigned and allocated to each piece of equipment and road segment when ODOT field crews enter their work logs into the system. The detailed system makes it fairly easy to track M&O costs. From this information, life cycle and replacement costs are used by ODOT to determine costs of each element of the transportation system (“x” feet and type of roadway, “x” feet of guardrail, each sign, each traffic signal, each loop detector, type and quantity of landscaping). The respondents believed that this database can be modified to provide accurate M&O costs for operations-intensive activities, such as ITS deployments.

5. Metro links to transportation efficiency and land use

According to the MPO representative, land use objectives direct the transportation expenditures in the Portland Metropolitan Area. Land use issues linked to transportation include livability of the environment, minimizing single-occupant vehicles, and increasing alternative mode selection and use. Evaluations of transportation projects primarily occur when there are conflicts with land use policies. Metro staff try to target funds under the MPO’s authority to projects that are consistent with the land use policies, such as TDM projects. These projects are more operations-intensive than traditional construction projects, and according to some of the interviewees, should have their M&O impacts examined more carefully. However, this is only 25% of the metropolitan transportation funds. The other 75% of the federal funds are collaboratively divided among the public agencies in the metropolitan area.

6. City of Portland Transportation Department reorganization bringing engineering and maintenance together

Administrators from the City of Portland’s Office of Transportation have realized for a number of decades that engineering and maintenance need to work together. Getting maintenance people more involved with the design and construction of systems is seen as a great benefit for the City’s M&O. Both functions were seen as having operations roles. While the City is trying to define how each function are to be involved in operations, each group is already involved in what the City sees as a prominent operations role – responding to citizens’ complaints and requests. A streamlined Transportation Department now allows maintenance crews to provide greater input and avoid the design problems that are later seen by the field crews. With the input of maintenance in project design, the Transportation Department will be producing a better, more maintainable product, which, optimistically, will reduce M&O costs.

U.S. DOT Actions

While much of the discussion with the transportation professionals centered on what they have done and what they may do, the interviewees were also asked what actions officials with the U.S. Department of Transportation could take to assist metropolitan areas with their consideration of M&O. The actions could range from meeting training needs, to providing funding, to providing legislation that is both practical and easy to understand. This section reviews those actions requested by the representatives of the transportation agencies from this metropolitan area.

1. Document best practices of processes used to assess M&O costs and needs

The U.S.DOT could help the public agencies throughout the metropolitan area by documenting what other metropolitan areas, MPOs, or other public agencies have done when they examined M&O impacts and issues. It would be very helpful for the Federal Government to provide opinions as to which processes have proven most useful and outline these processes so other areas could build on the successful efforts. As part of this U.S. DOT activity a professional capacity building program could also look at training to assess M&O costs and needs. An interviewee remarked that it would be hard to have a requirement, such as M&O consideration in the planning process, that no one knows how to fulfill. There is great variability in the comprehension of M&O issues from area to area.

2. Training for MPO staff (and planners in general) on basic engineering and maintenance concepts

MPO personnel should be trained to understand the traffic engineering discipline. Training should be developed that addresses the underlying processes, issues, and rationale behind traffic engineering functions and activities, such as traffic calming, street classification, etc. Planners associated with the transportation field need engineering training on the rudiments of signal timing, communications bandwidths, rotaries, and cutting edge theory. Planners need cultural development and cross-training that exposes them to the physical and political constraints in which traffic engineers design and operate. The Metro representative would want the “Engineering 101” training be focused on engineering for all modal (multi-modal) applications, not just auto-oriented applications.

3. Additional staff funding for MPOs if M&O analysis requirements occur

The area transportation professionals were unanimous in their statements that the MPO staff perform a wide range of tasks for the region, from land use to transportation to environmental to economic and demographic responsibilities. This work keeps the staff extremely busy. The MPO management is assuming that it will be Metro’s responsibility to ensure that the local projects that include advanced technologies will be consistent with the National ITS Architecture. Additional federal requirements to analyze M&O as part of the transportation planning process would impact the already overburdened MPO staff. This is one reason the operating agencies believed such analysis should be done by each operating agency, not the MPO. The operating agencies value the work currently being done by the MPO but see their limitation based on current resources. This limitation is one reason the MPO has not yet been

sought to be the repository of the operations data now being generated and being planned. The MPO representative was adamant that the Federal Government should provide additional funding if any requirements are developed that mandate extensive M&O analysis.

4. Federal Government needs to define what encompasses "management," "operations," and "maintenance" as part of any regulations or guidelines

Both the operating and planning agencies are unclear what activities are included within the management, operations, and maintenance functions. Management is a new, but growing concept within the Portland Metropolitan Area. Many of the roadway-oriented agencies are just beginning to be comfortable with some operations. Maintenance, which was the easiest for most public agencies to understand, is now blending with operations. The transportation professionals agreed that if these functions are defined as part of any regulations or guidelines, it may be easier to perform more in-depth M&O analysis.