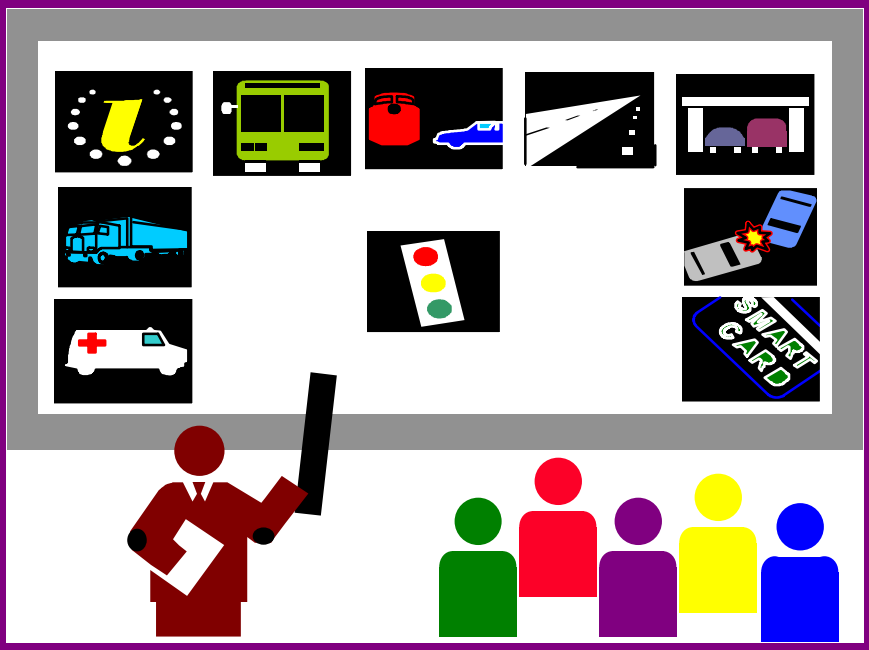
BUILDING PROFESSIONAL CAPACITY IN ITS:

GUIDELINES FOR STAFFING, HIRING, AND DESIGNING IDEAL PROJECT TEAMS



US Department of Transportation
ITS Joint Program Office
ITS PCB Program

April 1999

Foreword

This report summarizes a comprehensive effort conducted in the summer of 1998 to more systematically investigate the intelligent transportation systems (ITS) training and education needs of transportation professionals. A team of analysts conducted a series of nearly 200 interviews in an effort to obtain a more detailed understanding of the underlying fundamental knowledge and skills required in support of ITS applications and services. The interviewees spanned a range of ITS involvement from those actively engaged for several years, to those just beginning the process. Thus, the reported needs reflect an important "grass-roots" perspective obtained from the public-sector, private-sector, and the academic community.

This report documents the wide-ranging ITS training and education needs of transportation professionals. An analysis of those needs resulted in the development of a PCB Program strategy to meet those needs both now and in the future. Although the focus of this work is ITS, the analysis also revealed that the fundamental knowledge and skills are applicable to a wider audience of transportation professionals engaged in the operation and management of multimodal surface transportation systems.

The ITS PCB Program is comprised of a partnership or organizations which work cooperatively to provide ITS professional capacity building. That partnership encompasses the public sector, the private sector, and the academic community. It is hope that this report will be used as a foundation for ongoing dialogue with the multiple partners, stakeholders and transportation professionals everywhere about:

- The process of building professional capacity for ITS;
- The design and delivery of training and education programs that achieve the level of competency required for meeting the challenges of 21st century transportation systems; and
- The most effective and cooperative programmatic ways to meet training and education needs in ITS.

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- The Volpe National Transportation Systems Center (VNTSC)
- The Federal Transit Administration's ITS Program
- The Federal Highway's National Highway Institute (NHI) and Office of Personnel and Training.

The VNTSC project director was Suzanne M. Sloan, assisted by Mary Susan Sparlin of NHI. Key staff support from the Volpe Center was provided by Robert Brodesky, Joseph LoVecchio, Maureen Luna-Long, John O'Donnell, Douglas Rickenback, and Margaret Zirker.

The authors wish to thank the many individuals, located across the country, who took the time and made the substantial effort to arrange for the staff interviews that were so critical to this effort. Also, thanks is gratefully extended to the nearly 200 interviewees and the training and education experts who were willing to be interviewed and whose excellent contributions of information and guidance have greatly benefited our work.

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Overview: Introduction

Purpose of this Document

This document is a guide for decision makers within transportation agencies who are responsible for staffing, hiring, and designing project teams for ITS. These decision makers must consider not only the ITS competencies of current staff, but also the qualifications of future staff and of team members from other agencies. These issues compel decision makers to develop strategies and programs for building and maintaining *organizational professional capacity*.

This guide also highlights the current needs and concerns in building organizational professional capacity for ITS. It uses information gathered from nearly 200 interviews with transportation professionals engaged in ITS around the nation in the summer of 1998. These professionals represented a wide variety of responsibilities and functions in public– and private-sector transportation agencies and organizations. More detail on these interviews is published in a separate report entitled, ***Building Professional Capacity in ITS: Documentation and Analysis of ITS Training and Education Needs in Support of ITS Deployment*** (this report can be access on the PCB web page: www.its.dot.gov), which also documents how the U.S. Department of Transportation (DOT) and its PCB partners are addressing ITS professional capacity building needs.

This guide presents how different types of agencies tend to be involved in ITS. These categorizations are not meant to be prescriptive, nor to illustrate an ideal. Rather, the guidelines are intended to convey effective practices based on interviewees who described their agency's activities and projects, the type of team members that made the activities most successful, and the knowledge, skills, and abilities (i.e., competencies) that are needed to meet project goals.

This guide covers seven different types of federal, state, and local agencies and their involvement in twelve different "typical" ITS projects and activities. They are:

Exhibit I: Table of Transportation Agencies and "Typical" ITS Projects and Activities

Transportation Agencies	"Typical" ITS Projects and Activities
State Departments of Transportation (DOTs)	• Planning Activities • Deploying, Integrating, Operating, Maintaining, and Evaluating ITS Infrastructure
Transit Agencies	• Deploying and Operating Transit Automated Vehicle Location (AVL) Systems • Deploying and Operating Transit Automated Trip Planning Systems • Operating Transit Data Management Systems
Metropolitan Planning Organizations (MPOs)	• ITS Outreach and Coordination Activities • ITS Planning and Mainstreaming Activities • ITS Awareness and Policy Change • ITS Deployment Activities

(Table cont'd on next page)

Transportation Agencies	"Typical" ITS Projects and Activities
City/County Departments of Transportation (DOTs) [also known as Departments of Public Works or DPWs]	• Deploying and Operating Traffic Signal Control Systems
Transportation Management Centers (TMCs) [the mode-neutral version of Traffic Operations Centers, Operations Control Centers (OCCs), Traffic Management Centers, etc.]	• TMC Operations Using the ITS Infrastructure
Federal Transit Administration (FTA) Regional Offices	• ITS Education and Outreach
Federal Highway Administration (FHWA) Resource Centers and Division Offices.	• ITS Education and Outreach • ITS Technical Assistance Activities in Support of State

For each of the seven categories of agencies listed above, the following information is presented:

(1) **A definition of the agency' srole in ITS deployment and operations:** This discussion presents the primary role that the agency "typically" plays throughout deployment and as a part of ongoing operations. This includes a listing of the "typical" ITS projects and activities that were discussed during the interviews (some ITS projects and activities may have not been covered) and the top ten competencies for that agency.

(2) The agency role in relation to other agencies: This is a collection of comments by other agencies regarding how well the agency plays its role, what new roles it might consider, and how well it provides qualified staff for cross-agency team work.

(3) Guidelines for the "ideal" staffing of project teams: For each ITS project or activity listed in Exhibit I, a chart has been designed to present the "ideal" project team staffing , the roles and functions of each team members, and the essential competencies needed for various stages of ITS development and deployment.

(4) Other Issues: This discussion presents interviewees' concerns about some of the limitations faced by the agency in trying to achieve organizational professional capacity building.

It is hoped that the use of this guide assists agency decision makers to accomplish the following tasks in their efforts to build organizational professional capacity for ITS:

- To understand ideal project and team roles.
- To analyze existing expertise available on staff.
- To identify shortfalls in expertise among agency staff.
- To determine the critical and essential expertise required.
- To decide staffing requirements based on criticality, budgets, duration of projects for hiring new staff, retraining existing staff, or understanding qualifications for outsourcing and contractors.

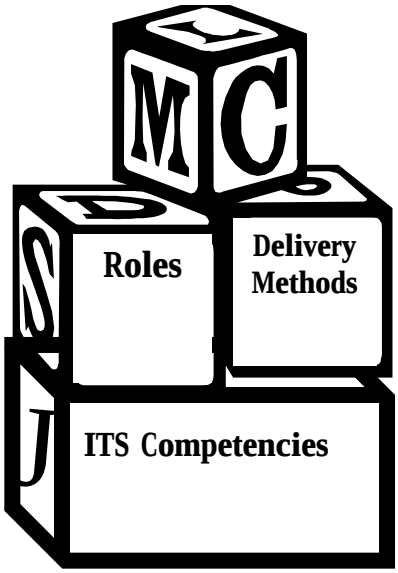
Overview: Background

Definition of ITS Professional Capacity Building (PCB)

Professional capacity building (PCB) is the process of developing new or enhancing existing knowledge and skills that are required for successful performance in one's job. ITS professional capacity building has been growing in importance since 1991 when Congress charted a new course for the modernization of the country's surface transportation system. The intent of ITS is to achieve greater operational safety and management efficiency by enhancing surface transportation systems with electronics, communications, computer and sensing technologies, known as Intelligent Transportation Systems or ITS.

The move towards applying ITS to surface transportation requires transportation professionals at all levels to incorporate and apply new competencies in their daily work activities. The recent technological revolution in the areas of electronics, telecommunications, and computer requires transportation professionals to search for, and access, education and training resources that will enable them to remain professionally current.

Building professional capacity in ITS relies upon the use of three "building blocks" that help determine the right mix and level of learning that is needed. The three PCB building blocks are:



- **ITS Roles** — the ideal ITS functions and job positions within a transportation agency and/or on an ITS project team.
- **ITS Competencies** — bundled sets of applied knowledge and skills that support successful job performance.
- **Delivery Methods** — the most accessible ways for professionals to learn about ITS; the ITS PCB Program relies on methods in four categories — training, education, technical assistance, and information dissemination.

Two of these building blocks are used in upcoming staffing charts within this guide — the ITS competencies and the ITS team roles. They are briefly described next in this document. (More detail on these building blocks is provided in a separate companion report, ***Building Professional Capacity in ITS: Guidelines for Designing an Individualized Training and Education Plan,*** which is available on the PCB web page: www.its.dot.gov).

After a quick introduction to the ITS competencies and roles, this report describes how the seven different types of federal, state, and local agencies "typically" engage in the twelve different types of ITS projects and activities listed in Exhibit I.

Range of ITS Roles

The PCB Program study cited above also defines a set of "ideal" ITS team roles that professionals perform in ITS. The range of roles is listed in Table 1 and uses the same general categories as the ITS competencies.

Table 1: Ideal ITS Roles

Roles in Developing a Regional ITS Concept of Operations and Planning for ITS	**Cross-Cutting Roles**
• Champions • Planners • Federal Field Staff	• Business Analysts • Data(base) Analysts and Managers • Contract Specialists • Legal Staff • Marketing / Public Relations Staff • Human Resources Staff • Systems Administrator/ Support Technicians
Roles in the Design, Procurement, Installation, Operations & Maintenance, and Evaluation Stages	**Creating Change: Roles for Mainstreaming ITS**
• Project Managers • Software Developers • Systems Designers / Integrators • Operators • Dispatchers • Drivers • Electronics Inspection and Maintenance Technicians • Operations Managers/Supervisors	• Program/Agency Manager • Inter-jurisdictional Coordinator

ITS Competencies

Twenty-seven ITS competency areas have been defined (Table 2) that encompass the fundamental technical and institutional knowledge and skills required across the ITS stages of project planning, design and deployment and through systems operations, maintenance, and ongoing management. (More detailed descriptions of each competency can be found in a companion needs assessment report, ***Building Professional Capacity in ITS: Guidelines for Designing an Individualized Training and Education Plan***.*)

Table 2 lists the ITS competencies. The ones that are bolded and ranked represent the top ten needs in ITS learning. The rankings derive from a series of nearly 200 interviews that were conducted as part of the above-mentioned needs assessment.

* This report can be accessed on the PCB web page: www.its.dot.gov

Table 2: Range of ITS Competencies

<table>
<tr>
<td><u>Competencies for Developing a Regional ITS Concept of Operations</u>
• ITS Awareness/ITS Topics (see below)
• Identifying Stakeholders/Building Coalitions (9)
• National ITS Architecture
• Partnerships
• Financing (6)
• ITS Planning (8)</td>
<td><u>Cross-Cutting Competencies</u>
• Project Management
• ITS Legal Issues
• Marketing/Public Relations
• Writing/Communications (7)
• Problem Solving
• Data Analysis & Management (10)
• Transportation Fundamentals</td>
</tr>
<tr>
<td rowspan="2"><u>Competencies for the Design, Procurement, Installation, Operations & Maintenance, and Evaluation Stages</u>
• Systems Analysis & Design (4)
• Technology Options (3)
• ITS Standards
• Software and Hardware Operations
• Software Development
• ITS Human Factors
• Procurement
• Managing Contractors (5)
• Systems Integration (1)
• Project Evaluation
• Operations
• Systems Support and Maintenance</td>
<td><u>Creating Change: Competencies for Mainstreaming ITS</u>
• Legislative and Policy Change
• Organizational/Institutional Change (2)</td>
</tr>
<tr>
<td><u>ITS Topics:</u>
• Freeway Management Systems
• Incident and Emergency Management Systems
• Advanced Traveler Information Systems
• Advanced Public Transportation Systems
• Advanced Traffic Signal Control Systems
• Electronic Fare Payment Systems
• Electronic Toll Collection Systems
• Highway-Rail Intersection Systems
• Commercial Vehicle Operations/CVISN
• Rural ITS systems</td>
</tr>
</table>

Using these two building blocks — the roles and the competencies — the remainder of this report will present a series of staffing charts that describe the composition of "ideal" teams for ITS projects and activities to guide staffing, hiring, and contracting decisions for each of the seven agencies and for designing cross-agency teams.

State Departments of Transportation

(1) Agency Role in ITS Deployment and Operations

The primary role of State DOTs is the planning, design, deployment, operation, evaluation and maintenance of ITS infrastructure as a part of state highways and major arterials. State DOTs work closely with government agencies, including Metropolitan Planning Organizations (MPO), City/County Departments of Transportaion [also known as Departments of Public Works (DPWs)], transit agencies, and police, emergency and fire departments.

The level of support varies depending on the stage or type of project deployment. For example, in planning and project selection, State DOTs work more closely with MPOs whereas in traffic signal coordination operations, they work more closely with city and county transportation agencies.

(1a) State DOT ITS Projects and Activities

"Typical" State DOT ITS projects include:

- Freeway Management Systems (FMS)
- Traffic Signal Control Systems (TSCS)
- Advanced Traffic Management Systems (ATMS)
- Advanced Traffic Information Systems (ATIS)
- Incident Management Systems (IMS)
- Emergency Management Systems (EMS)
- Road/Weather Information Service (R/WIS)
- Smart Corridors.

Other ITS deployments typically carried out by State DOTs, but not evaluated during the interviews, include Electronic Toll Collection Systems (ETC) and Highway-Rail Crossings. In addition, State DOTs often take the lead in management of data sharing among local agencies, research on ITS technologies, and integration of local and state Traffic Management Centers (TMCs).

What became apparent during the evaluation of these projects was the remarkable similarities in their team composition and functions, which tended to vary only by size of team and type of technology devices installed. All of these projects within a State DOT can be represented by three general sets of activities:

- State DOT Planning and Design Activities.
- Deploying, Integrating, Operating, Maintaining and Evaluating ITS Infrastructure.

(1b) Top Ten Competency Needs for State DOT ITS Staff

For the above listed projects and activities, State DOT ITS professionals identified the top ten competency areas as critical professional capacity building needs for agency:

- Systems Integration
- Systems Analysis & Design, especially cost/benefit analysis and determining operations center staffing requirements
- Managing Contractors
- Organizational/Institutional Change
- Technology Options, especially training on ITS devices
- Writing/Communications, especially writing ITS specifications
- Identifying Stakeholders/Building Coalitions
- Project Evaluation
- Financing, especially identifying sources of funding
- Partnerships.

(2) State DOT Role in Relation to other Agencies

Given their central role in ITS deployments, the State DOTs work closely with MPOs and City/County DOTs on smart corridor initiatives to ensure that capital and ITS projects are mutually beneficial and integrated. State DOTs also feed traffic data to MPOs for project evaluation and future planning for Transportation Improvement Plans (TIP). This data is can be distributed to private traffic information disseminators, such as Metro Networks or Smart Route Systems, for real-time traffic reports. State DOTs work closely with transit agencies on HOV lanes and traffic signal synchronization to give buses and trains priority right-of-way. As the typical operator of the TMC, State DOTs serve as a centralized dispatcher for law enforcement and emergency personnel for freeway incidents. They work closely with city and county DOTs in integrating freeways with arterial systems, ensuring traffic signals synchronize with ramp meters, and integrating State DOT TMCs with local event TMCs.

(3) Guidelines for "Ideal" Staffing of ITS Project Teams

The following charts outline State DOT ITS project teams, functions and competencies required to successfully perform the described functions for the following activities:

(1) State DOT Planning and Design Activities.
(2) Deploying, Integrating, Operating, Maintaining, and Evaluating ITS Infrastructure.

(1) Project: State DOT Planning and Design Activities

Ideal Team Members	Functions and Responsibilities	Recommended ITS Competencies
Program/Agency Manager	• Provide outreach and education to senior decision makers and appointed and elected officials. • Work to diminish agency and institutional barriers. • Build coalitions among agencies and with the private sector. • Form working groups and task forces.	*Awareness Level:* ITS Awareness, Technology Options, Systems Analysis and Design, ITS Planning, Data Analysis and Management, National ITS Architecture, ITS Standards, Procurement, ITS Legal Issues, Project Management, Software and Hardware Operations, Operations *Specialized Level:* Organizational/Institutional Change, Managing Contractors, Financing, Writing/Communications, Identifying Stakeholders/Building Coalitions, Legislative and Policy Change, Partnerships, Marketing/Public Relations, Problem Solving
DOT Agency Planner	• Understand funding mechanisms and processes, and be able to leverage financial resources in a strategic way for multiple agency benefit. • Work cooperatively within a regional and political environment to build consensus on an ITS vision; help write Early Deployment Plans or ITS Plans. • Compile ITS benefits; market ITS to senior decision makers and elected officials. • Incorporate ITS projects into existing transportation planning documents, including Regional Transportation Plans, TIP, CMS, MIS, etc. • Provide technical expertise in incorporating ITS into the planning process, GIS mapping, modeling, and forecasting. • Help plan current and future expansion of operations. • Research technology options and educate senior decision makers, elected officials, and project managers. • Track ITS infrastructure already deployed. • Assist in promoting multi-jurisdictional, multi-agency, multi-discipline, and project integration; help form partnerships among transportation agencies and between the public and private sector. • Conduct studies on capacity, flow, and impact of ITS projects on surrounding jurisdictions.	*Awareness Level:* ITS Awareness, Systems Integration, Organizational/ Institutional Change, Technology Options, Systems Analysis and Design, ITS Standards, Marketing and Public Relations, Project Evaluation, Legislative and Policy Change, ITS Legal Issues, Operations *Specialized Level:* Managing Contractors, Financing, Writing/ Communications, ITS Planning, Identifying Stakeholders/ Building Coalitions, Data Analysis and Management, National ITS Architecture, Project Management, Partnerships, Procurement, Problem Solving, Software and Hardware Operations, Transportation Fundamentals

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(1) Project: State DOT Planning and Design Activities

Ideal Team Members	Functions and Responsibilities	Recommended ITS Competencies

Project Manager	• Manage ITS project deployments from design to operations, including:
	  • Identify and involve all stakeholders in the system conceptualization and design, including other transportation agencies, non-traditional transportation agencies, and other concerned groups.
	  • Conduct/oversee user needs assessment as part of design process; understand data needs.
	  • Involve necessary staff and eventual users in design decision making such as electronics technicians, operators, dispatchers, systems maintenance and support staff, and external agency team members.
	  • Determine scope of deployment using analysis tools such as investment analysis, impact analysis, or cost/benefit analysis.
	  • Apply National ITS Architecture and Standards to project design.
	  • Participate in technology selection and procurement; help prepare RFPs; determine specifications.
	  • Design and plan for operations staff, functions, and support and maintenance crew.
	• Ensure that the project is being planned for in tandem with other projects.
	• Work with inter-jurisdictional coordinator to account for impact on surrounding jurisdictions
		Awareness Level:
		ITS Awareness, Systems Integration, Systems Analysis and Design, ITS Planning, Data Analysis and Management, National ITS Architecture, ITS Standards, Software Development, Software and Hardware Operations, ITS Human Factors, Legal Issues, Marketing/Public Relations
		
		Specialized Level:
		Organizational/Institutional Change, Technology Options, Managing Contractors, Financing, Writing/ Communications, Identifying Stakeholders/Building Coalitions, Project Management, Procurement, Project Evaluation, Partnerships, Legislative and Policy Change, Problem Solving, Operations

Systems Designer/ Integrator	• Analyze existing infrastructure. • Conduct a user needs assessment; map out data flows to users; apply the National ITS Architecture. • Design a system; ensure compatibility with existing infrastructure. • Analyze technology options and participate in the decision making for the various devices, computers, and software applications.	*Awareness Level:* ITS Awareness, Writing/Communications, ITS Legal Issues, Project Management, Procurement, Transportation Fundamentals, Operations *Specialized Level:* Systems Integration, Organizational/Institutional Change, Technology Options, Systems Analysis and Design, Data Analysis and Management, National ITS Architecture, ITS Standards, Software Development, ITS Human Factors, Software and Hardware Operations, Problem Solving, Project Evaluation

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(2) Project: Deploying, Integrating, Operating, Maintaining and Evaluating ITS Infrastructure

Ideal Team Members	Functions and Responsibilities	Recommended ITS Competencies

Project Manager	• Manage ITS project deployments from design to operations, including:
	  • Provide project oversight of software development; work closely with developers.
	  • Staff/contract for and schedule project deployment activities; coordinate work with ongoing construction activities.
	  • Select and manage contractors, their schedules and delivery milestones.
	  • Secure financing/funding, prepare budgets, track expenses.
	  • Manage installation and integration, including prototyping, testing and evaluation.
	  • Conduct periodic evaluations throughout the project cycle and lead final project inspection, testing and evaluation.
	  • Design and plan for operations staff, functions, and support and maintenance staff.
	• Ensure that the project is being deployed in tandem with other projects and assist with integration, including defining tests and performance measures that provide evidence of proper integration.
	• Keep senior Policy/Agency Managers informed of progress and engage their assistance for institutional/organizational or legislative changes.
	• Work with inter-jurisdictional coordinator to account for impact on surrounding jurisdictions.
		Awareness Level:
		ITS Awareness, Systems Integration, Systems Analysis and Design, ITS Planning, Data Analysis and Management, National ITS Architecture, ITS Standards, Software Development, Software and Hardware Operations, ITS Human Factors, Legal Issues, Marketing/ Public Relations
		
		Specialized Level:
		Organizational/Institutional Change, Technology Options, Managing Contractors, Financing, Writing/Communications, Identifying Stakeholders/Building Coalitions, Project Management, Procurement, Project Evaluation, Partnerships, Legislative and Policy Change, Problem Solving, Operations

(2) Project: Deploying, Integrating, Operating, Maintaining and Evaluating ITS Infrastructure (cont' d)

Ideal Team Member	Functions and Responsibilities	Recommended ITS Competencies
System Designer/ Integrator	• Provide designs for systems integration; connect devices through telecommunications wiring or wireless media. • Install ITS technologies, ensuring functionality and quality control; bring together components to function as one system. • Integrate technologies with existing system. • Participate in the design of performance measures; participate in the testing and evaluation throughout project and at end (part of the testing is ensuring that the right data is flowing in the right direction without corruption). • Train operators, maintenance, and support staff on system functions, operations, maintenance and management; ensure maintenance procedures and operations manuals are available.	*Awareness Level:* ITS Awareness, Writing/Communications, ITS Legal Issues, Project Management, Procurement, Transportation Fundamentals, Operations *Specialized Level:* Systems Integration, Organizational/Institutional Change, Technology Options, Systems Analysis and Design, Data Analysis and Management, National ITS Architecture, ITS Standards, Software Development, ITS Human Factors, Software and Hardware Operations, Problem Solving, Project Evaluation
Software Developer	• Understand and design software to meet the needs of the system characteristics, such as existing compatibility, expandability, and maintenance issues. • Understand and design software to meet the needs of end users. • Write or adapt off-the-shelf/existing software to collect transportation system information for decision-making in real-time. • Manage the software development process to meet contract agency's milestones. • Communicate frequently with public-sector project manager regarding the development process, schedule, software's abilities, and compatibility issues with hardware, other software, and other systems. • Work with systems designers to adapt software to meet the needs of the whole system. • Participate in defining performance measures for acceptance testing of software and system.	*Awareness Level:* ITS Awareness, Technology Options, Writing/ Communications, ITS Human Factors, Project Management, ITS Legal Issues, Project Evaluation, Transportation Fundamentals, Operations *Specialized Level:* Systems Integration, Systems Analysis and Design, Data (base) Analysis and Management, National ITS Architecture, ITS Standards, Software Development, Software and Hardware Operations, Problem Solving.
Legal Staff	• Review project specifications for liability issues in design. • Review contracts for clauses and language supportive of ITS.	*Awareness Level:* ITS Awareness, Technology Options, Financing, Software Development, Transportation Fundamentals *Specialized Level:* Writing/Communications, especially ITS specifications, ITS Legal Issues, Legislative and Policy Change, Partnerships, Procurement

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(2) Project: Deploying, Integrating, Operating, Maintaining and Evaluating ITS Infrastructure (cont' d)

Ideal Team Member	Functions and Responsibilities	Recommended ITS Competencies
Contract Specialist	• Help prepare contracts. • Incorporate clauses in contracts to address ITS issues including software ownership and Intellectual Property Rights. • Help shape contract language based on the RFP and the negotiated agreement; help ensure that the final contract reflects the planned scope of work, not simply the RFP wording. • Help ensure that value-added services are reflected in contracts, if appropriate, e.g., vendor training on purchased equipment, ongoing maintenance, provision of operations and maintenance procedures manuals, etc.	*Awareness Level:* ITS Awareness, Technology Options, Financing, Partnerships, Legislative and Policy Change, Software Development, Software and Hardware Operations *Specialized Level:* Writing/Communications, especially writing ITS specifications, Procurement, ITS Legal Issues
Business Analyst	• Provide suggestions for making project and investment decisions. • Perform cost/benefit and other related analyses on technologies and systems. • Suggest organizational changes for project deployment. • Help in forming financial partnerships for projects such as smart card partnerships. • Supply input on project evaluation.	*Awareness Level:* ITS Awareness, Technology Options, Writing/Communicaitons, Data Analysis and Management, ITS Legal Issues, Project Evaluation, Legislative and Policy Change, Procurement, Software and Hardware Operations, Transportation Fundamentals *Specialized Level:* Organizational/Institutional Change, Financing, Partnerships, Project Evaluation
Human Resources Staff	• Work with Project Managers to hire or develop ideal team. • Facilitate new job descriptions. • Provide or arrange for training. • Hire and train operators on automated system use. • Promote the acceptance of required operating changes.	*Awareness Level:* ITS Awareness, Transportation Fundamentals, Software and Hardware Operations, Operations *Specialized Level:* Organizational/Institutional Change, Identifying Stakeholders/Building Coalitions, Legislative and Policy Change, Marketing/Public Relations

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(2) Project: Deploying, Integrating, Operating, Maintaining and Evaluating ITS Infrastructure (cont' d)

Ideal Team Members	Functions and Responsibilities	Recommended ITS Competencies
Data Manager/ Analyst	• Help define data standards to enable cross agency data sharing; help define and support data sharing across agencies. • Design, maintain and manage relational databases for decision making. • Turn raw data into usable information. • Design report formats and run queries (SQL) and reports; perform analysis as requested, generate useful and timely reports, coordinate data sharing with other agencies and monitor data security and storage. • Analyze data for patterns and trends; interpret data and use it for problem solving and decision making. • Report and disseminate data throughout organization; disseminate data results to other agencies. • Responsible for overall quality and integrity of data generated and used by the system. • Keep project management well-informed of potential uses of data for planning, project evaluation and other purposes. • Assist with studies: for example in highway agencies, speed and volume studies;. in transit agencies, performance reports that support the scheduling, fleet management, and service planning staff functions. • Ensure databases comply with standard communications protocols.	*Awareness Level:* ITS Awareness, Organizational/Institutional Change, Technology Options, ITS Planning, Identifying Stakeholders/Building Coalitions, National ITS Architecture, ITS Standards, ITS Human Factors, Transportation Fundamentals, Operations *Specialized Level:* Systems Integration, Systems Analysis and Design, Data Analysis and Management, Software Development, Software and Hardware Operations, Problem Solving, Systems Support and Maintenance
Marketing/Public Relations Staff	• Summarize ITS benefits and "lessons learned" in presentations targeted at high level decision makers and officials. • Disseminate educational and promotional material to the public to enhance informed decision making by travelers. • Segment, understand, and provide outreach to audiences that need to know about ITS. • Inform travelers and other agencies about new ITS systems and their benefits; demonstrate benefits.	*Awareness Level:* ITS Awareness, Organizational/Institutional Change, Technology Options, Identifying Stakeholders/Building Coalitions, Legislative and Policy Change, Transportation Fundamentals, National ITS Architecture *Specialized Level:* Writing/Communications, Marketing/Public Relations

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(2) Project: Deploying, Integrating, Operating, Maintaining and Evaluating ITS Infrastructure (cont' d)

Ideal Team Members	Functions and Responsibilities	Recommended ITS Competencies
Systems Administrator/Support Technician	• Work with systems designers to ensure technical and technological feasibility of design as well as on technology selection and physical placement. • Maintain network and server, including data archiving and backups. • Assist systems integrators with installation and testing. • Maintain and troubleshoot systems hardware and software problems. • Assist with the evaluation of ITS deployments. • Maintain and update hardware and software. • Manage network; manage user accounts. • In cooperation with electronic maintenance technicians, repair and replace ITS technologies. • Maintain data networks and servers.	*Awareness Level:* ITS Awareness, Systems Integration, Technology Options, Systems Analysis and Design, Writing/ Communications, Data Analysis and Management, Software Development, ITS Legal Issues, Project Evaluation, Transportation Fundamentals , Operations *Specialized Level:* Software and Hardware Operations, Problem Solving, Systems Support and Maintenance
Electronic Inspection and Maintenance Technician	• Test and inspect construction and integration work, especially fiber optic splices and connections. • Work with system designers on technology selection and physical placement. • Evaluate project operations. • Troubleshoot problems in the field, including repairing and replacing ITS technologies (electronic devices) and hardware. • Troubleshoot hardware and software problems. • Install new equipment and integrate with existing systems. • Supervise and inspect contractor installations. • Maintain and repair traffic signal control systems. • Work with systems designers to establish a proper cabinet and equipment placement within the infrastructure, as the human factors and safety considerations are particularly important for future repair and expansion.	*Awareness Level:* ITS Awareness, Systems Integration, Organizational/ Institutional Change, Systems Analysis and Design, Managing Contractors, Writing/Communications, National ITS Architecture, ITS Standards, ITS Human Factors, Project Evaluation, Transportation Fundamentals *Specialized Level:* Technology Options, Electronics, Software and Hardware Operations, Problem Solving, Systems Support and Maintenance

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(2) Project: Deploying, Integrating, Operating, Maintaining and Evaluating ITS Infrastructure (cont' d)

Ideal Team Members	Functions and Responsibilities	Recommended ITS Competencies
Inter-jurisdictional Coordinator	• Facilitate integration across jurisdictions and agencies. • Track regional ITS deployments to identify opportunities for integration, leveraging resources, and elimination of redundancies. • Bring stakeholders from various agencies on board. • Assist with policy, rules, and regulations changes when needed.	*Awareness Level:* ITS Awareness, National ITS Architecture, ITS Standards, Partnerships, Procurement, Transportation Fundamentals, Operations *Specialized Level:* Organizational/Institutional Change, Writing/ Communications, ITS Planning, Identifying Stakeholders/ Building Coalitions, Legislative and Policy Change, ITS Legal Issues

(4) Other State DOT Issues

In addition to needed professional capacity building in these competencies, State DOTs face a number of barriers that affect their ITS activities.

- It was noted that State DOTs often have *less flexible organizational structures* than desired for incorporating ITS. For example, senior management with considerable experience in deploying capital projects who are typically risk-adverse, may hesitate to consider ITS. In addition, procurement personnel and lawyers not familiar with advanced technology purchases might try to use standard contracts that often are less appropriate for ITS procurements.

- *Sharing data among agencies* can also be an obstacle. Issues regarding who own the data and who is responsible for its maintenance, storage and validity need to be worked out beforehand, and well documented in Memoranda of Understanding.

- *Legal issues* can arise among agencies and the private sector concerning video of incidents on freeways and arterials. Sometimes turf wars over traffic information dissemination occur especially if there is a TMC and TIC operated by different agencies at the same site.

- There is a need for *improved communication* between State DOT field personnel and TMC operators and dispatchers. For example, when DOT construction or maintenance is completed at roadway work sites, the TMC should be contacted immediately to pass on more accurate real-time traffic information. There should also be a standard method of reporting traffic information to avoid inconsistencies. For example, a State DOT might report traffic information by overpasses whereas ATIS provides and transportation users prefer to have information by off-ramps.

- Finally, State DOTs depend upon state legislation and bonds for *funding* which are not always reliable. This, as well as changes in regulatory legislation, can cause project delays or cancellations.

TRANSIT AGENCIES

(1) Transit Role in ITS Deployment and Operations

The transit agencies interviewed provided bus, subway (light rail) and paratransit services. These agencies had a wide range of experience with the deployment of advanced ITS technologies. Several agencies had used state-of-the art technology, whereas others were just beginning to assess the potential impact of ITS deployments on service performance and internal operations. ITS is understood to have great potential as a tool for assisting in the success of welfare-to-work programs.

A more in-depth discussion of the transit role in ITS deployment can be found in a companion report entitled, An Assessment of ITS Training and Education Needs: The Transit Perspective.*

* This report can be accessed on the PCB web page: www.its.dot.gov

(1a) Transit ITS Deployments

Transit ITS deployments evaluated included:

- Automatic Vehicle Location (AVL) using Global Positioning Systems (GPS),
- Traveler Information Systems (ATIS), including Automated Trip Planning (ATP)
- Data Management Systems, including the use of Automatic Passenger Counters (APC).

Data from these systems can be used by Transit Operations Centers for operations and maintenance scheduling, introducing a more complex data element into transit operations. Traffic signal priority for buses on city streets, freeway HOV lanes, Automated Service Coordination (ASC), and Computer-Aided Dispatch (CAD), and Electronic Fare Payments (EFP) were also discussed with transit agencies and State DOTs, but not in great detail.

(1b) Top Ten Competency Needs for Transit ITS Staff

Transit agencies identified the top ten knowledge areas required to deploy and operate ITS technologies within their agency.

- Technology Options, especially training on ITS devices
- Organizational/Institutional Change
- Writing/Communications, especially writing ITS specifications
- Systems Integration
- Managing Contractors
- Financing, especially locating sources of funding for perations and maintenance
- ITS Planning, especially developing a regional concept of operations
- Project Management, especially developing business plans for deployment
- Systems Design and Analysis, especially cost/benefit analysis
- Data Analysis and Management.

(2) Transit Role in Relation to Other Agencies

In certain instances, transit agencies had a history of working cooperatively with other transportation agencies in the planning, design and operation of ITS projects. Most often, the ITS projects were within the agency itself, and the only outside relationship was with the Federal Transit Agency (FTA). In instances where there was inter-agency coordination, transit agencies were most likely to work with State DOTs on the use of HOV lanes, and with City/County DOTs on traffic signal prioritization for buses and light rail on city streets. In one instance, the paratransit CAD operation was actually managed from the office of the State DOT.

(3) Guidelines for "Ideal" Staffing of ITS Project Teams

The following charts outline transit agency roles, functions and competencies needed on typical transit projects:

(1) Automatic Vehicle Location (AVL) using Global Positioning Systems (GPS),
(2) Traveler Information Systems (ATIS), including Automated Trip Planning (ATP)
(3) Data Management Systems, including the use of Automatic Passenger Counters (APC).

(1) Project: Deploying and Operating Transit AVL Systems

Ideal Team Members	Functions and Responsibilities	Recommended ITS Competencies

Project Manager	• Manage ITS project deployments from design to operations, including:
	  • Identify and involve all stakeholders in the system conceptualization and design, including other transportation agencies, non-traditional transportation agencies, and other concerned groups.
	  • Conduct/oversee user needs assessment as part of design process; understand data needs.
	  • Involve necessary staff and eventual users in design decision making such as electronics technicians, operators, dispatchers, systems maintenance and support staff, and external agency team members.
	  • Determine scope of deployment using analysis tools such as investment analysis, impact analysis, or cost/benefit analysis.
	  • Apply National ITS Architecture and Standards to project design.
	  • Participate in technology selection and procurement; help prepare RFPs; determine specifications.
	  • Provide project oversight of software development; work closely with developers.
	  • Staff/contract for and schedule project deployment activities; coordinate work with ongoing construction activities.
	  • Select and manage contractors, their schedules and delivery milestones.
	  • Secure financing/funding, prepare budgets, track expenses.
	  • Manage installation and integration, including prototyping, testing and evaluation.
	  • Conduct periodic evaluations throughout the project cycle and lead final project inspection, testing and evaluation.
	  • Design and plan for operations staff, functions, and support and maintenance crew.
	• Ensure that the project is being deployed in tandem with other projects and assist with integration, including defining tests and performance measures that provide evidence of proper integration.
	• Keep senior Policy/Agency Managers informed of progress and engage their assistance for institutional/organizational or legislative changes.
	• Work with inter-jurisdictional coordinator to account for impact on surrounding jurisdictions.
		Awareness Level:
		ITS Awareness, Systems Integration, Systems Analysis and Design, ITS Planning, Data Analysis and Management, National ITS Architecture, ITS Standards, Software Development, Software and Hardware Operations, ITS Human Factors, Legal Issues, Marketing/Public Relations
		
		Specialized Level:
		Organizational/Institutional Change, Technology Options, Managing Contractors, Financing, Writing/Communications, Identifying Stakeholders/ Building Coalitions, Project Management, Procurement, Project Evaluation, Partnerships, Legislative and Policy Change, Problem Solving, Operations

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(1) Project: Deploying and Operating Transit AVL Systems

Ideal Team Members	Functions and Responsibilities	Recommended ITS Competencies
Operations Manager/ Supervisor	Managers • Responsible for operations center. • Determine operating procedures including scheduling and dispatching based on congestion and incident data. • Establish decision making procedures in cooperation with police, emergency staff, and other agency dispatchers. • Responsible for staffing: writing job descriptions; hiring and training in-house and contracted staff; negotiating staff conflicts. • Responsible for operations center budget development and monitoring. • Interacts with media on both marketing and incident reporting to the general public. Supervisors: • Manage staff and schedule shifts. • Provide on-the-job staff training. • Resolve day-to-day staff and equipment problems.	*Awareness Level:* ITS Awareness, Writing/Communications, ITS Planning, Identifying Stakeholders/Building Coalitions, Data Analysis and Management, ITS Standards, Partnerships, Marketing/Public Relations, Project Management, Project Evaluation, ITS Human Factors *Specialized Level:* Organizational/Institutional Change, Technology Options, especially training on devices, Managing Contractors, Software and Hardware Operations, Systems Support and Maintenance, Problem Solving, Operations
Operations Center Operator	• Monitor system capacity and flow. • Help to make real-time decisions and communicate those to the public. • Help to diagnose incidents and provide coordinated quick-response to traffic and incident problems by dispatching appropriate assistance. • Broadcast status information; possibly interact with media. • Be well-versed in agency policies and procedures for disseminating information • Be able to utilize ITS technologies such as variable message signs for broadcast to and management of the traveling public. • Identify and report/repair minor communications/computing system problems; understand the system well enough technically to troubleshoot minor problems with hardware/equipment functionality. • Be able to clearly communicate with the information system support professionals (I/S or MIS or System Maintenance and Support Technicians) about minor and major problems. • For transit and traveler information operators, provide automated trip planning services; determine caller needs; offer suggestions for travel options.	*Awareness Level:* ITS Awareness, Organizational/Institutional Change, Technology Options, Data Analysis and Management, Operations *Specialized Level:* Writing/Communications, Software and Hardware Operations, Transportation Fundamentals, Problem Solving

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(1) Project: Deploying and Operating Transit AVL Systems (cont' d)

Ideal Team Members	Functions and Responsibilities	Recommended ITS Competencies
Dispatcher	• Manage location devices to track fleet. • Dispatch and scheduling procedures. • Determine caller needs. • Provide coordinated quick-response to traffic and incident problems by dispatching appropriate assistance. • Identify and report/repair system problems.	*Awareness Level:* ITS Awareness, Organizational/Institutional Change, Technology Options, Data Analysis and Management, Operations, ITS Legal Issues *Specialized Level:* Transportation Fundamentals, Software and Hardware Operations, Problem Solving
Electronic Inspectors / Maintenance Technicians	• Test and inspect construction and integration work, especially fiber optic splices and connections. • Work with system designers on technology selection and physical placement. • Evaluate project operations. • Troubleshoot problems in the field, including repairing and replacing ITS technologies (electronic devices) and hardware. • Troubleshoot hardware and software problems. • Install new equipment and integrate with existing systems. • Supervise and inspect contractor installations. • Maintain and repair traffic signal control systems. • Work with systems designers to establish a proper cabinet and equipment placement within the infrastructure, as the human factors and safety considerations are particularly important for future repair and expansion.	*Awareness Level:* ITS Awareness, Systems Integration, Organizational/Institutional Change, Systems Analysis and Design, Managing Contractors, Writing/Communications, National ITS Architecture, ITS Standards, ITS Human Factors, Project Evaluation, Transportation Fundamentals *Specialized Level:* Technology Options, Software and Hardware Operations, Problem Solving, Systems Support and Maintenance
Drivers	• Report information and observations back to the management/ operations center to supplement the data from the vehicle devices or the system network. • Respond to dispatcher requests. • Follow agency/company procedures in incident and emergency management. • Download data at shift's end.	*Awareness Level:* ITS Awareness, Transportation Fundamentals, Data Analysis and Management, Operations *Specialized Level:* Technology Options, especially training on devices, ITS Topics

(2) Project: Deploying and Operating Transit Automated Trip Planning Systems

Ideal Team Members	Functions and Responsibilities	Recommended ITS Competencies

Project Manager	• Manage ITS project deployments from design to operations, including:
	  • Conduct/oversee user needs assessment as part of design process; understand data needs.
	  • Involve necessary staff and eventual users in design decision making such as electronics technicians, operators, dispatchers, systems maintenance and support staff, and external agency team members.
	  • Determine scope of deployment using analysis tools such as investment analysis, impact analysis, or cost/benefit analysis.
	  • Apply National ITS Architecture and Standards to project design.
	  • Participate in technology selection and procurement; help prepare RFPs; determine specifications.
	  • Provide project oversight of software development; work closely with developers.
	  • Staff/contract for and schedule project deployment activities; coordinate work with ongoing construction activities.
	  • Select and manage contractors, their schedules and delivery milestones.
	  • Secure financing/funding, prepare budgets, track expenses.
	  • Manage installation and integration, including prototyping, testing and evaluation.
	  • Conduct periodic evaluations throughout the project cycle and lead final project inspection, testing and evaluation.
	  • Design and plan for operations staff, functions, and support and maintenance crew.
	• Ensure that the project is being deployed in tandem with other projects and assist with integration, including defining tests and performance measures that provide evidence of proper integration.
	• Keep senior Policy/Agency Managers informed of progress and engage their assistance for institutional/organizational or legislative changes.
	• Work with inter-jurisdictional coordinator to account for impact on surrounding jurisdictions
		Awareness Level:
		ITS Awareness, Systems Integration, Systems Analysis and Design, ITS Planning, Data Analysis and Management, National ITS Architecture, ITS Standards, Software Development, Software and Hardware Operations, ITS Human Factors, Legal Issues, Marketing/ Public Relations
		
		Specialized Level:
		Organizational/Institutional Change, Technology Options, Managing Contractors, Financing, Writing/ Communications, Identifying Stakeholders/Building Coalitions, Project Management, Procurement, Project Evaluation, Partnerships, Legislative and Policy Change, Problem Solving, Operations

(Cont'd on next page)

(2) Project: Deploying and Operating Transit Automated Trip Planning Systems

Ideal Team Members	Functions and Responsibilities	Recommended ITS Competencies
Data Manager/ Analyst	• Help define data standards to enable cross agency data sharing; help define and support data sharing across agencies. • Design, maintain and manage relational databases for decision making. • Turn raw data into usable information. • Design report formats and run queries (SQL) and reports; perform analysis as requested, generate useful and timely reports, coordinate data sharing with other agencies and monitor data security and storage. • Analyze data for patterns and trends; interpret data and use it for problem solving and decision making. • Report and disseminate data throughout organization; disseminate data results to other agencies. • Responsible for overall quality and integrity of data generated and used by the system. • Keep project management well-informed of potential uses of data for planning, project evaluation and other purposes. • Assist with studies: for example in highway agencies, speed and volume studies;. in transit agencies, performance reports that support the scheduling, fleet management, and service planning staff functions. • Ensure databases comply with standard communications protocols.	*Awareness Level:* ITS Awareness, Organizational/ Institutional Change, Technology Options, ITS Planning, Identifying Stakeholders/ Building Coalitions, National ITS Architecture, ITS Standards, ITS Human Factors, Transportation Fundamentals, Operations *Specialized Level:* Systems Integration, Systems Analysis and Design, Data Analysis and Management, Software Development, Software and Hardware Operations, Problem Solving, Systems Support and Maintenance
Systems Administrator/ Support Technician	• Work with systems designers to ensure technical and technological feasibility of design. • Maintain network and server, including data archiving and backups. • Assist systems integrators with installation and testing. • Maintain and troubleshoot systems hardware and software problems. • Assist with the evaluation of ITS deployments. • Maintain and update hardware and software. • Manage network; manage user accounts. • In cooperation with electronic maintenance technicians, repair and replace ITS technologies. • Follow maintenance procedures for prevention. • Work with systems designers on technology selection and physical placement.	*Awareness Level:* ITS Awareness, Systems Integration, Technology Options, Systems Analysis and Design, Writing/Communications, Data Analysis and Management, Software Development, ITS Legal Issues, Project Evaluation, Transportation Fundamentals, Operations *Specialized Level:* Software and Hardware Operations, Problem Solving, Systems Support and Maintenance

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(2) Project: Deploying and Operating Transit Automated Trip Planning Systems (cont' d)

Ideal Team Members	Functions and Responsibilities	Recommended ITS Competencies
Agency Planner	• Understand funding mechanisms and processes, and be able to leverage financial resources in a strategic way for multiple agency benefit. • Compile ITS benefits; market ITS to senior decision makers and elected officials. • Incorporate ITS projects into existing transportation planning documents, including Regional Transportation Plans, TIP, CMS, MIS, etc. • Provide technical expertise in incorporating ITS into the planning process, GIS mapping, modeling, and forecasting. • Help plan current and future expansion of operations. • Assist in promoting multi-jurisdictional, multi-agency, multi-discipline, and project integration; help form partnerships among transportation agencies and between the public and private sector. • Conduct studies on capacity, flow, and impact of ITS projects on surrounding jurisdictions.	*Awareness Level:* ITS Awareness, Systems Integration, Organizational/ Institutional Change, Technology Options, Systems Analysis and Design, ITS Standards, Marketing and Public Relations, Project Evaluation, Legislative and Policy Change, ITS Legal Issues, Operations *Specialized Level:* Managing Contractors, Financing, Writing/ Communications, ITS Planning, Identifying Stakeholders/Building Coalitions, Data Analysis and Management, National ITS Architecture, Project Management, Partnerships, Procurement, Problem Solving, Software and Hardware Operations, Transportation Fundamentals

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(3) Project: Operating Transit Data Management Systems

Ideal Team Members	Functions and Responsibilities	Recommended ITS Competencies
Data Manager/Analyst	• Help define data standards to enable cross agency data sharing; help define and support data sharing across agencies. • Design, maintain and manage relational databases for decision making. • Turn raw data into usable information. • Design report formats and run queries (SQL) and reports; perform analysis as requested, generate useful and timely reports, coordinate data sharing with other agencies and monitor data security and storage. • Analyze data for patterns and trends; interpret data and use it for problem solving and decision making. • Report and disseminate data throughout organization; disseminate data results to other agencies. • Responsible for overall quality and integrity of data generated and used by the system. • Keep project management well-informed of potential uses of data for planning, project evaluation and other purposes. • Assist with studies: for example in highway agencies, speed and volume studies;. in transit agencies, performance reports that support the scheduling, fleet management, and service planning staff functions. • Ensure databases comply with standard communications protocols.	*Awareness Level:* ITS Awareness, Organizational/Institutional Change, Technology Options, ITS Planning, Identifying Stakeholders/Building Coalitions, National ITS Architecture, ITS Standards, ITS Human Factors, Transportation Fundamentals, Operations *Specialized Level:* Systems Integration, Systems Analysis and Design, Data Analysis and Management, Software Development, Software and Hardware Operations, Problem Solving, Systems Support and Maintenance

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(3) Project: Operating Transit Data Management Systems (cont' d)

Ideal Team Members	Functions and Responsibilities	Recommended ITS Competencies
Traveler Information Center Operators	• Monitor system capacity and flow. • Help to make real-time decisions and communicate those to the public. • Help to diagnose incidents and provide coordinated quick-response to traffic and incident problems by dispatching appropriate assistance. • Broadcast status information; Possibly interact with media. • Be well-versed in agency policies and procedures for disseminating information • Be able to utilize ITS technologies such as variable message signs for broadcast to and management of the traveling public. • Identify and report/repair minor communications/computing system problems; **u**nderstand the system well enough technically to trouble shoot minor problems with hardware/equipment functionality. • Be able to clearly communicate with the information system support professionals (I/S or MIS or System Maintenance and Support Technicians) about minor and major problems. • For transit and traveler information operators, provide automated trip planning services; Offer suggestions for travel options; Determine caller needs.	*Awareness Level:* ITS Awareness, Organizational/Institutional Change, Technology Options, Data Analysis and Management, Operations *Specialized Level:* Writing/Communications, Software and Hardware Operations, Transportation Fundamentals, Problem Solving
Electronics Inspection and Maintenance Technicians	• Troubleshoot problems in the field, including repairing and replacing ITS technologies (electronic devices) and hardware. • Troubleshoot hardware and software problems. • Install new equipment and integrate with existing systems. • Supervise and inspect contractor installations. • Work with systems designers to establish a proper equipment placement on the infrastructure, as the human factors and safety considerations are particularly important for future repair and expansion.	*Awareness Level:* ITS Awareness, Systems Integration, Organizational/ Institutional Change, Systems Analysis and Design, Managing Contractors, Writing/Communications, National ITS Architecture, ITS Standards, ITS Human Factors, Project Evaluation, Transportation Fundamentals *Specialized Level:* Technology Options, Software and Hardware Operations, Problem Solving, Systems Support and Maintenance

(3) Project: Operating Transit Data Management Systems (cont' d)

Ideal Team Members	Functions and Responsibilities	Recommended ITS Competencies
Human Resources Staff/Training	• Work with Project Managers to hire or develop ideal team. • Facilitate new job descriptions. • Provide training. • Hire and train operators on automated system use. • Promote the acceptance of required operating changes.	*Awareness Level:* ITS Awareness, Transportation Fundamentals, Software and Hardware Operations, Operations *Specialized Level:* Organizational/Institutional Change, Identifying Stakeholders/Building Coalitions, Legislative and Policy Change, Marketing/Public Relations

(4) Other Transit Issues

There are a number of important issues that present barriers to ITS deployment at transit agencies.

- First is the *resource* issue; transit agencies are consistently under-funded. Many ITS deployments are grant-driven ITS projects with specific limitations that can create problems for the agencies. Grant-driven ITS projects tend to be isolated organizationally. Frequently there is no communication with other parts of the organization and linkages are hard to set-up. This also inhibits long-term planning.
- Another problem is that *grant funding does not include funds for operations and maintenance*. In general, the constraint on available finances has a great impact on the selection of ITS projects that are implemented.
- In addition, *union issues* dominate transit environments so staffing, salary and promotion flexibility is limited.

METROPOLITAN PLANNING ORGANIZATIONS

(1) MPO Role in ITS Deployment and Operations

Metropolitan Planning Organizations (MPOs) are federally mandated to provide a continuing, comprehensive, and cooperative transportation planning process for urbanized areas with populations greater than 50,000. MPO staff work with the MPO policy board and state and local levels of government to ensure cooperation and coordination within the metropolitan area. (It is important to distinguish between the MPO's policy board and staff. Staff may be in-house, contracted out, or a combination of both.) Organizations within the area work with the MPO staff to adopt multi-modal transportation plans, and to prepare transportation improvement programs (TIP). This is the minimum set of activities that all MPOs perform.

(1a) MPO ITS Activities

The role of the MPO in ITS spans a range of involvement, to a greater extent than the other agencies described in this document. On one end of the spectrum are MPOs which have gained a general and basic awareness of ITS as an important consideration in transportation planning and programming.

At the opposite end of the spectrum, there are a few MPOs which engage in participation and leadership of the planning, design and deployment of ITS. Many MPOs fall in between with a wide variety of ITS activities but with a greater emphasis on the planning functions and less on the operational activities. Thus, the challenge in presenting the MPO organizaitonal role, ITS activities and staff roles is a bit more complex than for the other agencies covered in this document.

An important caveat: The interviews conducted for the PCB Program's needs assessment provided *limited* insight into the activities that span this range due to the small number of interviews (17 out of 183) and nature of sites visited (larger metropolitan areas actively engaged in ITS deployment and operations.)

Four out of five interview sites were selected because of their experience with ITS and their high level of deployment. Thus, many of the MPO activities reported on in these interviews reflect a significant involvement that is *not typical* of MPOs in most areas. Even within these four areas the role of the MPO varied widely.

A more comprehensive understanding of the range of MPO ITS activities is available from other reports:

- A 1998 NCHRP Synthesis (252) entitled, ***Response of Small Urbanized Area MPOs to ISTEA***. The focus of this report was on how the ISTEA legislation changed, or did not change, the role of the MPO in transportation planning and programming. It provided some specific insight into ITS activities at small, urbanized area MPOs. In summary, it noted that these MPOs tended to be aware of ITS and consider it an alternative tool to solving their local problems. These MPOs have engaged in ITS to the extent that some of them have conducted ITS pilot studies. Although the overall focus was on the planning process and ISTEA, many of the MPO needs described in this report regarding training and technical assistance are very similar to those desired by the larger group of interviewees for the ITS PCB needs assessment.
- An upcoming U.S. DOT report on MPOs and mainstreaming entitled***, Mainstreaming ITS Within the Transportation Planning Process: A Summary of Strategies in Ten Metropolitan Areas,*** was a second report used to supplement this analysis. This report also focused on larger metropolitan MPOs that were situated in areas where a more significant amount of ITS was occurring. The focus of the report is on successful mainstreaming strategies, which are not limited to MPOs. However, the MPO role is highlighted, and a review of the "raw" interview responses did provide a discussion of MPO ITS involvement and activities, staffing issues and training needs. Also, this report provides similar information as the PCB needs assessment report regarding how other agencies view the role of the MPO and their expectations of how the MPO role could expand to better support them.

Using these reports and the interviews, the following is an attempt to outline the categories of MPO ITS activities with the understanding that the range of MPO involvement varies greatly. MPO decision makers who are responsible for staffing, hiring, and designing project teams for ITS must modify the following charts to reflect the level of involvement of their organization.

MPO staff can be involved in four types of ITS activities:

ITS Outreach and Coordination Activities with local transportation agencies **(A more typical role)**	• Endorsing ITS and demonstrating ITS benefits. • Taking the lead on ITS research and studies. • Serving as a forum to develop a regional ITS vision. • Serving as a forum to resolve inter-jurisdictional issues and mediating conflicts. • Bringing planning and operations functions together. • Sponsoring multi-jurisdictional, multi-agency, and multi-discipline ITS committees. • Providing a liaison to local officials and agencies and the private sector. • Develop transportation plan. • Identify ITS projects to enhance regional system performance.

ITS Planning and Mainstreaming Activities	• Integrate ITS within regional planning documents (RTP/LRP, TIP, CMS, MIS, etc.) • Design new/modify existing project prioritization criteria to aid in selection of ITS-type projects. • Determine data needs for the area. **If possible based on size of staff and local involvement:** • Provide guidance on how ITS projects can be proposed to compete with traditional projects. • Seek funds for ITS projects, leverage CMAQ funds for multi-jurisdictional work, utilize flexible funding. • Collect and use data for planning prior to deployment and after deployment. • Develop and refine ITS benefit-cost analysis. • Conduct studies on multi-jurisdictional impacts of ITS deployments, including environmental impacts, societal equity and benefits, and environmental justice. • Help develop ITS Early Deployment Plans.
ITS Awareness and Policy Activities **(If possible based on size of staff and local involvement)**	• Provide information to senior transportation agency officials and elected officials on ITS. • Provide information to legislators on ITS and recommend changes to local and regional legislation, if necessary. • Provide information to MPO staff including contracted staff and staff at other transportation agencies (e.g., State DOTs) who work with MPO board members and staff. • Provide information to other, non-transportation stakeholders such as public safety officials, emergency response providers, and trucking industry (tourist bureau, seaport, airport). • Provide an information clearinghouse to keep local jurisdictions informed of new technologies.
ITS Deployment Activities **(At this point, only a small number of MPOs are engaged in these activities)**	• Design and manage the deployment of ITS projects such as Ridesharing, Traveler Information Centers, smart transit corridor projects, or Traffic Signal Systems Improvement Plans. • Act as lead project manager in cooperation with other transportation agencies to design the systems, procure technologies, install and integrate the technologies into a system, and evaluate and test the system. Help plan for the operations staffing, training, and scheduling. • Determine project requirements, develop specifications, prepare RFPs, evaluate proposals, manage contractors.

(1b) Top Ten ITS Competency Needs for MPO Staff

Based upon the limited amount of interviews with atypical MPOs, the following top ten competencies were identified:

- Organizational/Institutional Change
- Managing Contractors
- Technology Options, especially understanding the range of devices available
- Financing, especially locating sources of funding
- Systems Analysis & Design
- ITS Planning, especially developing a regional concept of operations
- Project Management, especially developing business plans for deployment
- Systems Integration
- Data Analysis & Management
- Procurement, especially different contracting options.

This list is reflective of larger, more involved MPOs which have the capacity to hire a large and diverse staff. Most MPOs have a smaller staff who are focused on the traditional planning activities. Some MPOs do not have staff; instead, their policy board obtains staff in other ways — contracting work out, forming working relationships with state DOTs to use their staff, or using consultants.

This list, then, presents a challenge for most MPOs given the level of staff that they employ. The challenge concerns expanding the staff capabilities beyond basic MPO planning. MPOs which choose to engage in ITS activities will find it important to find ways to obtain ITS competencies, e.g., systems analysis and design or procurement. Some of the other ways of obtaining staff listed above may be appropriate. But, it is important to find a way to access staff who have ITS competencies and can perform the less traditional, but necessary, ITS functions such as marketing or understanding ITS legal issues.

(2) MPO Role in Relation to Other Agencies

The MPO is a forum for a systems development focus where operating agencies and local jurisdictions can cooperatively envision an ITS concept and coordinate deployments. The MPO is a pivotal entity in ensuring that each of its member organizations is communicating with one another. Technical advisory and policy-making committees, established by the MPOs, provide the operating agencies and local governments with a means for building consensus.

Based upon the interviews with other agencies in large metropolitan areas, interviewees expressed a desire for MPO staff to expand their role to include the following activities, recognizing constraints in funding that would limit such activities:

- Provide technical ITS assistance to non-technical local staffs that will aid in getting started with ITS deployments.
- Organize, analyze and archive data generated by the ITS devices.
- Take prototype projects that have been successful and market them to other transportation agencies to engage these agencies and then develop regionwide systems.
- Develop a regional transportation plan with a vision that includes ITS and then fit the projects, submitted by the MPO members to the vision in the plan.
- Coordinate regionwide integration.

It is recognized that smaller urbanized areas may not have the same interest in their MPO performing such activities. Also, smaller MPOs may not find it possible to include such activities due to the limited size of staff.

(3) Guidelines for the "Ideal" Staffing of ITS Projects and Activities

The following charts have been designed to illustrate the "ideal" MPO roles, functions and competencies needed to support ITS activities both within the MPO and in cooperation with other transportation agencies. Again, it must be noted that these charts are not meant to be prescriptive and that they best represent the staffing and activities performed at larger MPOs that are more heavily engaged in ITS. The charts present "ideal teams" for:

- **ITS Outreach and Coordination Activities with local transportation agencies**
- **ITS Planning and Mainstreaming Activities**
- **ITS Awareness and Policy Activities**
- **ITS Deployment Activities.**

(1) Project: MPO ITS Outreach and Coordination Activities

Ideal Team Members	Functions and Responsibilities	Recommended ITS Competencies
Facilitators and Educators who function at the level of: • **Program/Agency Managers** • **Planners**	• Endorsing ITS and demonstrating ITS benefits • Taking the lead on ITS research and studies • Serving as a forum to develop a regional ITS vision • Serving as a forum to resolve inter-jurisdictional issues and mediating conflicts • Bringing planning and operations functions together • Sponsoring multi-jurisdictional, multi-agency, and multi-discipline ITS committees • Providing a liaison function to political and local links and the private sector	*Awareness Level:* ITS Awareness, Technology Options, Systems Analysis and Design, ITS Planning, Data Analysis and Management, National ITS Architecture, ITS Standards, Procurement, ITS Legal Issues, Project Management, Software and Hardware Operations, Operations *Specialized Level:* Organizational/Institutional Change, Managing Contractors, Financing, Writing/Communications, Identifying Stakeholders/Building Coalitions, Legislative and Policy Change, Partnerships, Marketing/Public Relations, Problem Solving

(2) Project: MPO ITS Planning and Mainstreaming Activities

Ideal Team Members	Functions and Responsibilities	Recommended ITS Competencies
Planning Staff	• Integrate ITS within regional planning documents (Regional Transportation Plans, TIP, CMS, MIS, etc.). • Design new/modify existing project prioritization criteria to aid programming of ITS-type projects. • Provide guidance on how ITS projects can be proposed to compete with traditional projects. • Seek funds for ITS projects; leverage CMAQ funds for multi-jurisdictional work; utilize flexible funding. • Determine data needs for the area. • Collect and use data for planning and evaluation prior to deployment and after deployment. • Develop and refine ITS benefit-cost analysis. • Conduct studies on multi-jurisdictional impacts of ITS deployments, including environmental impacts, societal equity and benefits, and environmental justice.	*Awareness Level:* ITS Awareness, Systems Integration, Organizational/Institutional Change, Technology Options, Systems Analysis and Design, ITS Standards, Marketing and Public Relations, Project Evaluation, Legislative and Policy Change, ITS Legal Issues, Operations *Specialized Level:* Managing Contractors, Financing, Writing/Communications, ITS Planning, Identifying Stakeholders/Building Coalitions, Data Analysis and Management, National ITS Architecture, Project Management, Partnerships, Procurement, Problem Solving, Software and Hardware Operations, Transportation Fundamentals

(3) Project: MPO ITS Education and Policy Changes

Ideal Team Members	Functions and Responsibilities	Recommended ITS Competencies
Marketing staff **(most MPOs do not have marketing staff; these functions are either contracted out, conducted by staff at partner agencies, e.g., a State DOT, or assumed by a planner on staff)**	• Provide awareness to senior transportation agency officials and elected officials on ITS. • Provide awareness to legislators on ITS and recommend changes to local and regional legislation to include ITS if needed. • Provide awareness to MPO staff including contracted staff and staff at other transportation agencies (e.g., State DOTs) who work with MPO board members and staff. • Provide awareness to other, non-transportation stakeholders such as public safety officials, emergency response providers, and trucking industry (tourist bureau, seaport, airport). • Provide an information clearinghouse to keep local jurisdictions informed of new technologies.	*Awareness Level:* ITS Awareness, Organizational/Institutional Change, Technology Options, Identifying Stakeholders/Building Coalitions, Transportation Fundamentals, National ITS Architecture *Specialized Level:* Writing/Communications, Marketing/Public Relations
Legal Staff **(most MPOs do not have legal staff; these functions are either contracted out, conducted by staff at partner agencies, e.g., a State DOT, or assumed by a planner on staff)**	• Provide awareness to senior transportation agency officials and elected officials on ITS and legal issues. • Educate the MPO policy board, staff, and senior transportation agency officials on ITS legal issues. • Identify legal issues with other, non-transportation stakeholders such as public safety officials, emergency response providers, and trucking industry (tourist bureau, seaport, airport) and structure agreements and MOUs for sharing data and agency cooperation.	*Awareness Level:* ITS Awareness, Technology Options, Financing, Software Development, Transportation Fundamentals *Specialized Level:* Writing/Communications, ITS Legal Issues, Partnerships, Procurement

(4) Project: MPO ITS Deployment Activities

Ideal Team Members	Functions and Responsibilities	Recommended ITS Competencies
Project Manager (typically a planner) **(***only a small number of MPOs are engaged in these activities)**	• Design and manage the deployment of ITS projects such as Ridesharing, Traveler Information Centers, smart transit corridor projects, or Traffic Signal Systems Improvement Plans. • Act as lead project manager in cooperation with other transportation agencies to design the systems, procure technologies, install and integrate the technologies into a system, and evaluate and test the system. Help plan for the operations staffing, training, and scheduling. • Determine project requirements, develop specifications, prepare RFPs, evaluate proposals, manage contractors.	*Awareness Level:* ITS Awareness, Systems Integration, Systems Analysis and Design, ITS Planning, Data Analysis and Management, National ITS Architecture, ITS Standards, Software Development, Software and Hardware Operations, ITS Human Factors, Legal Issues, Marketing/Public Relations *Specialized Level:* Organizational/Institutional Change, Technology Options, Managing Contractors, Financing, Writing/Communications, Identifying Stakeholders/ Building Coalitions, Project Management, Procurement, Project Evaluation, Partnerships, Legislative and Policy Change, Problem Solving, Operations
Remainder of the Team is typically a staff from other agencies, e.g., State DOTs, who work with the MPO staff through inter-agency working agreements, or contracted staff.	• See State DOT or transit agency ITS projects to determine the required team members and associated competencies based on project type. • Most teams will generally require specialized professionals to develop ITS specifications and contracts, write software, integrate systems, procure technologies, manage funding, coordinate partnerships, and transition to operations. The MPOs involved at this level work with a team that reflects a mix of staff from other agencies and privately contracted firms.	

(4) Other MPO Issues

The interviewees revealed that transportation operating agencies are beginning to recognize the importance of MPO involvement in this ITS process, particularly in the preliminary stages, to perform cost-benefit analyses, model the impact of ITS technology on improving regional mobility, evaluate prototypes and test results. In addition, MPOs have the committee structure in place to facilitate cooperation among agencies and jurisdictions for implementing and integrating systems and transmitting data. MPOs also have an understanding of available funding sources to get projects moving.

CITY/COUNTY DOTS (DEPARTMENTS OF PUBLIC WORKS)

(1) City/County DOTs Role in ITS Deployment and Operations

Cities and counties typically are involved with localized deployments, primarily traffic signal coordination for local arterial streets and coordination with freeway ramp metering systems.

(1a) City/County DOTs ITS Deployments

Traffic Signal Control Systems (TSCS) is the primary ITS deployment of City/County DOTs. Other deployments that were not covered during the interviews included:

- Event Traffic Management Centers (TMCs),
- Incident Management Systems (IMS),
- Emergency Management Systems (EMS), and Smart Corridors.

(1b) Top Ten Competencies for City/County DOT ITS Staff

City/County DOTs identified the top ten knowledge areas required to deploy and operate ITS technologies within their agency:

- Systems Integration
- Identifying Stakeholders/Building Coalitions
- National ITS Architecture and Standards
- Technology Options, especially training on ITS devices and the range of options
- Operations, especially the management of an Operations Center and the ability to identify its staffing requirements
- Hardware and Software Operations, especially data and software maintenance
- Financing, especially locating sources of funding
- Managing Contractors
- Procurement
- ITS Planning, especially developing a regional concept of operations
- Data Analysis and Management.

(2) City/County DOT Role in Relation to Other Agencies

Local DOTs often work closely with State DOTs, MPOs, and other regional partners to coordinate and manage the arterial components of a regional transportation plan. For example, local DOTs will work closely with State DOT agencies on arterial signalization for feeder streets to freeway on and off ramps. They may provide data to TMCs for traffic information dissemination as well as for IMS and EMS response. They also cooperate with MPOs on regional transportation initiatives such as Smart Corridor projects.

(3) Guidelines for the "Ideal" Staffing of ITS Projects and Activities

The following charts outline City/County DOT roles, functions and competencies needed to deploy and operate ITS technologies.

(1) Project: Deploying and Operating Traffic Signal Control Systems

Ideal Team Members	Functions and Responsibilities	Recommended ITS Competencies

Project Manager	• Manage ITS project deployments from design to operations, including:
	  • Identify and involve all stakeholders in the system conceptualization and design, including other transportation agencies, non-traditional transportation agencies, and other concerned groups.
	  • Conduct/oversee user needs assessment as part of design process; understand data needs.
	  • Involve necessary staff and eventual users in design decision making such as electronics technicians, operators, dispatchers, systems maintenance and support staff, and external agency team members.
	  • Determine scope of deployment using analysis tools such as investment analysis, impact analysis, or cost/benefit analysis.
	  • Apply National ITS Architecture and Standards to project design.
	  • Participate in technology selection and procurement; help prepare RFPs; determine specifications.
	  • Provide project oversight of software development; work closely with developers.
	  • Staff/contract for and schedule project deployment activities; coordinate work with ongoing construction activities.
	  • Select and manage contractors, their schedules and delivery milestones.
	  • Secure financing/funding, prepare budgets, track expenses.
	  • Manage installation and integration, including prototyping, testing and evaluation.
	  • Conduct periodic evaluations throughout the project cycle and lead final project inspection, testing and evaluation.
	  • Design and plan for operations staff, functions, and support and maintenance staff
	• Ensure that the project is being deployed in tandem with other projects and assist with integration, including defining tests and performance measures that provide evidence of proper integration.
	• Keep senior Policy/Agency Managers informed of progress and engage their assistance for institutional/organizational or legislative changes.
	• Work with inter-jurisdictional coordinator to account for impact on surrounding jurisdictions.
		Awareness Level:
		ITS Awareness, Systems Integration, Systems Analysis and Design, ITS Planning, Data Analysis and Management, National ITS Architecture, ITS Standards, Software Development, Software and Hardware Operations, ITS Human Factors, Legal Issues, Marketing/Public Relations
		
		Specialized Level:
		Organizational/Institutional Change, Technology Options, Managing Contractors, Financing, Writing/Communications, Identifying Stakeholders/Building Coalitions, Project Management, Procurement, Project Evaluation, Partnerships, Legislative and Policy Change, Problem Solving, Operations

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(1) Project: Deploying and Operating Traffic Signal Control Systems

Ideal Team Members	Functions and Responsibilities	Recommended ITS Competencies
Agency Planner	• Understand funding mechanisms and processes, and be able to leverage financial resources in a strategic way for multiple agency benefit. • Work cooperatively within a regional and political environment to build consensus on an ITS vision; help write Early Deployment Plans or ITS Plans. • Compile ITS benefits; market ITS to senior decision makers and elected officials. • Incorporate ITS projects into existing transportation planning documents, including Regional Transportation Plans, TIP, CMS, MIS, etc. • Provide technical expertise in incorporating ITS into the planning process, GIS mapping, modeling, and forecasting. • Help plan current and future expansion of operations. • Research technology options and educate senior decision makers, elected officials, and project managers. • Track ITS infrastructure already deployed. • Assist in promoting multi-jurisdictional, multi-agency, multi-discipline, and project integration; help form partnerships among transportation agencies and between the public and private sector. • Conduct studies on capacity, flow, and impact of ITS projects on surrounding jurisdictions.	*Awareness Level:* ITS Awareness, Systems Integration, Organizational/Institutional Change, Technology Options, Systems Analysis and Design, ITS Standards, Marketing and Public Relations, Project Evaluation, Legislative and Policy Change, ITS Legal Issues, Operations *Specialized Level:* Managing Contractors, Financing, Writing/ Communications, ITS Planning, Identifying Stakeholders/Building Coalitions, Data Analysis and Management, National ITS Architecture, Project Management, Partnerships, Procurement, Problem Solving, Software and Hardware Operations, Transportation Fundamentals
Software Developer	• Understand and design software to meet the needs of the system characteristics, such as existing compatibility, expandability, and maintenance issues. • Understand and design software to meet the needs of end users. • Write or adapt off-the-shelf/existing traffic control software and/or related packages to collect transportation system information for decision-making in real-time. • Manage the software development process to meet contract agency's milestones. • Communicate frequently with public-sector project manager regarding the development process, schedule, software's abilities, and compatibility issues with hardware, other software, and other systems. • Work with systems designers to adapt software to meet the needs of the whole system. • Participate in defining performance measures for acceptance testing of software and system.	*Awareness Level:* ITS Awareness, Technology Options, Writing/ Communications, ITS Human Factors, Project Management, ITS Legal Issues, Project Evaluation, Transportation Fundamentals, Operations *Specialized Level:* Systems Integration, Systems Analysis and Design, Database Management and Analysis, National ITS Architecture, ITS Standards, Software Development, Software and Hardware Operations, Problem Solving

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(1) Project: Deploying and Operating Traffic Signal Control Systems

Ideal Team Members	Functions and Responsibilities	Recommended ITS Competencies
Electronics Inspector and Maintenance Technician	• Test and inspect construction and integration work, especially fiber optic splices and connections. • Work with system designers on technology selection and physical placement. • Evaluate project operations. • Troubleshoot problems in the field, including repairing and replacing ITS technologies (electronic devices) and hardware. • Troubleshoot hardware and software problems. • Install new equipment and integrate with existing systems. • Supervise and inspect contractor installations. • Maintain and repair traffic signal control systems. • Work with systems designers to establish a proper cabinet and equipment placement within the infrastructure, as the human factors and safety considerations are particularly important for future repair and expansion. • Cabinet and equipment placement	*Awareness Level:* ITS Awareness, Systems Integration, Organizational/ Institutional Change, Systems Analysis and Design, Managing Contractors, Writing/Communications, National ITS Architecture, ITS Standards, ITS Human Factors, Project Evaluation, Transportation Fundamentals *Specialized Level:* Technology Options, Electronics, Software and Hardware Operations, Problem Solving, Systems Support and Maintenance
Inter-jurisdictional Coordinator **(typically, only with the larger jurisdictions)**	• Facilitate integration across jurisdictions and agencies. • Track regional ITS deployments to identify opportunities for integration, leveraging resources, and elimination of redundancies. • Bring stakeholders from various agencies on board. • Assist with policy, rules, and regulations changes when needed.	*Awareness Level:* ITS Awareness, National ITS Architecture, ITS Standards, Partnerships, Procurement, Transportation Fundamentals, Operations *Specialized Level:* Organizational/Institutional Change, Writing/ Communications, ITS Planning, Identifying Stakeholders/Building Coalitions, Legislative and Policy Change, ITS Legal Issues
Marketing/Public Relations Staff **(typically, only with the larger jurisdictions)**	• Summarize ITS benefits and "lessons learned" in presentations targeted at high level decision makers and officials. • Disseminate educational and promotional material to the public to enhance informed decision making by travelers. • Segment, understand, and provide outreach to audiences that need to know about ITS. • Inform travelers and other agencies about new ITS systems and their benefits; demonstrate benefits.	*Awareness Level:* ITS Awareness, Organizational/Institutional Change, Technology Options, Identifying Stakeholders/Building Coalitions, Legislative and Policy Change, Transportation Fundamentals, National ITS Architecture *Specialized Level:* Writing/Communications, Marketing/Public Relations

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(1) Project: Deploying and Operating Traffic Signal Control Systems

Ideal Team Members	Functions and Responsibilities	Recommended ITS Competencies
Systems Designer/ Integrator **(typically, only with the larger jurisdictions; in many cases, this role is provided through the State DOT.)**	• Understand and design software to meet the needs of the system characteristics, such as existing compatibility, expandability, and maintenance issues. • Understand and design software to meet the needs of end users. • Write or adapt off-the-shelf/existing software to collect transportation system information for decision-making in real-time. • Manage the software development process to meet agency contract's milestones. • Communicate frequently with public-sector project manager regarding the development process, schedule, software's abilities, and compatibility issues with hardware, other software, and other systems. • Work with systems designers to adapt software to meet the needs of the whole system. • Participate in defining performance measures for acceptance testing of software and system.	*Awareness Level:* ITS Awareness, Writing/Communications, ITS Legal Issues, Project Management, Procurement, Transportation Fundamentals, Operations *Specialized Level:* Systems Integration, Organizational/Institutional Change, Technology Options, Systems Analysis and Design, Data Analysis and Management, National ITS Architecture, ITS Standards, Software Development, ITS Human Factors, Software and Hardware Operations, Problem Solving Project Evaluation
Operations Manager/Supervisor **(typically, only with the larger jurisdictions; in many cases, this role is provided through the State DOT.)**	Managers • Responsible for operations center. • Determine operating procedures including scheduling and dispatching based on congestion and incident data. • Establish decision making procedures in cooperation with police, emergency staff, and other agency dispatchers. • Responsible for staffing: writing job descriptions; hiring and training in-house and contracted staff; negotiating staff conflicts. • Responsible for operations center budget development and monitoring. • Interacts with media on both marketing and incident reporting to the general public. Supervisors: • Manage staff and schedule shifts. • Provide on-the-job staff training. • Resolve day-to-day staff and equipment problems.	*Awareness Level:* ITS Awareness, Writing/Communications, ITS Planning, Identifying Stakeholders/Building Coalitions, Data Analysis and Management, ITS Standards, Partnerships, Marketing/Public Relations, Project Management, Project Evaluation, ITS Human Factors *Specialized Level:* Organizational/Institutional Change, Technology Options, especially training on devices, Managing Contractors, Software and Hardware Operations, Systems Support and Maintenance, Problem Solving, Transportation Fundamentals, Operations

(4) Other City/County DOT Issues

Local DOT interviewees noted that they have *difficulty hiring and retaining skilled staff* since private industry often lures them away. Thus, they are continually short staffed and pressed for time on projects. Interviewees also noted that *federal grants are restricted to planning and deploying systems* but not in operating and maintaining them. Since operations and maintenance costs can be substantial, this can be a real obstacle. In addition, interviewees noted *managing expectations of legislators and the general public is especially critical* for local DOTs. Project Managers must demonstrate the benefits of ITS to maintain "buy-in" from these constituents.

TRANSPORTATION MANAGEMENT CENTERS (TMCs)

(1) TMC Role in ITS Deployment and Operations

TMCs are the central hub of many ITS deployments and are often planned, designed, constructed, operated and maintained by State DOTs.

TMC's interviewed ranged from small, special event centers to large, integrated multi-modal, 24/7 operations. Staffing varied from part-time students who monitored functions to full-time trained operators responsible for active coordination with field staff.

(1a) TMC ITS Activities

TMCs function as a centralized operations center for many ITS deployments including Advanced Traffic Management Systems (ATMS), Advanced Traffic Information Systems (ATIS), Incident Management Systems (IMS), and Emergency Management Systems (EMS). For ATMS, TMCs monitor freeway and arterial traffic patterns, collect and manage traffic data, and adjust control devices such as traffic signals and Variable Message Signs. For ATIS, TMCs supply traffic information directly to the public or via private ATIS providers. For IMS and EMS, TMC operators dispatch police, emergency services and tow truck drivers to incident sites.

The TMC usually houses the server(s) that collect traffic data from freeways and arterials. Data collection devices include loop detectors, acoustic sensors, roadside beacons, freeway ramp metering, closed circuit television cameras (CCTV) toll transponders, and roaming vehicle probes. Operators/dispatchers monitor real time traffic conditions from the TMC and dispatch police and emergency vehicles to incident sites. They also operate freeway Changeable Message Signs/Variable Message Signs (CMS/VMS) and ramp meter timing to aid traffic flow. A TMC may also house a Traffic Information Center (TIC), which relies on the real time monitoring capabilities of the TMC to provide up to the minute information to the traveling public through ATIS devices.

(1b) Top Ten Competency Needs for TMC ITS Staff

TMCs identified the top ten knowledge areas required to deploy and operate ITS technologies within their agency:

- Organizational/Institutional Change
- Systems Integration
- Systems Analysis & Design
- Technology Options, especially training on ITS devices, and understanding the range of options
- Operations, especially the management of an Operations Center and the ability to identify its staffing requirements
- Identifying Stakeholders/Building Coalitions
- Financing, especially locating sources of funding
- ITS Planning
- Data Analysis & Management
- Partnerships.

(2) TMC Role in Relation to Other Agencies

The TMC serves as a centralized dispatcher for law enforcement and emergency personnel for freeway incidents. It works closely with city and county transportation agencies to ensure traffic signal synchronization.

(3) Guidelines for the "Ideal" Staffing of Projects and Activities

The following charts outline TMC roles, functions and competencies needed to deploy and operate ITS technologies.

(1) Project: TMC Operations Using ITS Infrastructure

Ideal Team Members	Functions and Responsibilities	Recommended ITS Competencies
Operator	• Monitor system capacity and flow. • Help to make real-time decisions and communicate those to the public. • Help to diagnose incidents and provide coordinated quick-response to traffic and incident problems by dispatching appropriate assistance. • Broadcast status information; possibly interact with media. • Be well-versed in agency policies and procedures for disseminating information • Be able to utilize ITS technologies such as variable message signs for broadcast to and management of the traveling public. • Identify and report/repair minor communications/computing system problems; understand the system well enough technically to trouble shoot minor problems with hardware/equipment functionality. • Be able to clearly communicate with the information system support professionals (I/S or MIS or System Maintenance and Support Technicians) about minor and major problems. • For transit and traveler information operators, provide automated trip planning services; determine caller needs; offer suggestions for travel options.	*Awareness Level:* ITS Awareness, Organizational/Institutional Change, Technology Options, Data Analysis and Management, Operations *Specialized Level:* Writing/Communications, Software and Hardware Operations, Transportation Fundamentals, Problem Solving
Dispatcher	• Manage location devices to track fleet • Dispatch and scheduling procedures. • Determine caller needs. • Provide coordinated quick-response to traffic and incident problems by dispatching appropriate assistance. • Identify and report/repair system problems.	*Awareness Level:* ITS Awareness, Organizational/Institutional Change, Technology Options, Data Analysis and Management, Operations *Specialized Level:* Transportation Fundamentals, Software and Hardware Operations, Problem Solving

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(1) Project: TMC Operations Using ITS Infrastructure

Ideal Team Members	Functions and Responsibilities	Recommended ITS Competencies
Driver	• Report information and observations back to the management/operations center to supplement the data from the vehicle devices or the system network. • Respond to dispatcher requests. • Follow agency/company procedures in incident and emergency management. • Download data at shift's end.	*Awareness Level:* ITS Awareness, Transportation Fundamentals, Data Analysis and Management, Operations *Specialized Level:* Technology Options, especially training on devices, ITS Topics
Systems Administrator/Support Technician	• Work with systems designers to ensure technical and technological feasibility of design and physical placement. • Maintain network and server, including data archiving and backups. • Assist systems integrators with installation and testing. • Maintain and troubleshoot systems hardware and software problems. • Assist with the evaluation of ITS deployments. • Maintain and update hardware and software. • Manage network; manage user accounts. • In cooperation with electronic maintenance technicians, repair and replace ITS technologies. • Follow maintenance procedures for prevention.	*Awareness Level:* ITS Awareness, Systems Integration, Technology Options, Systems Analysis and Design, Writing/Communications, Data Analysis and Management, Software Development, ITS Legal Issues, Project Evaluation, Transportation Fundamentals, Operations *Specialized Level:* Software and Hardware Operations, Problem Solving, Systems Support and Maintenance
Field Electronics Inspectors and Maintenance Technicians	• Test and inspect construction and integration work, especially fiber optic splices and connections. • Work with system designers on technology selection and physical placement. • Evaluate project operations. • Troubleshoot problems in the field, including repairing and replacing ITS technologies (electronic devices) and hardware. • Troubleshoot hardware and software problems. • Install new equipment and integrate with existing systems. • Supervise and inspect contractor installations. • Maintain and repair traffic signal control systems. • Work with systems designers to establish a proper cabinet and equipment placement within the infrastructure, as the human factors and safety considerations are particularly important for future repair and expansion.	*Awareness Level:* ITS Awareness, Systems Integration, Organizational/ Institutional Change, Systems Analysis and Design, Managing Contractors, Writing/Communications, National ITS Architecture, ITS Standards, ITS Human Factors, Project Evaluation, Transportation Fundamentals *Specialized Level:* Technology Options, Electronics, Software and Hardware Operations, Problem Solving, Systems Support and Maintenance

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(1) Project: TMC Operations Using ITS Infrastructure

Ideal Team Members	Functions and Responsibilities	Recommended ITS Competencies
Data Manager/ Analyst	• Help define data standards to enable cross agency data sharing; help define and support data sharing across agencies. • Design, maintain and manage relational databases for decision making. • Turn raw data into usable information. • Design report formats and run queries (SQL) and reports; perform analysis as requested, generate useful and timely reports, coordinate data sharing with other agencies and monitor data security and storage. • Analyze data for patterns and trends; interpret data and use it for problem solving and decision making. • Report and disseminate data throughout organization; disseminate data results to other agencies. • Responsible for overall quality and integrity of data generated and used by the system. • Keep project management well-informed of potential uses of data for planning, project evaluation and other purposes. • Assist with studies: for example in highway agencies, speed and volume studies;. in transit agencies, performance reports that support the scheduling, fleet management, and service planning staff functions. • Ensure databases comply with standard communications protocols.	*Awareness Level:* ITS Awareness, Organizational/Institutional Change, Technology Options, ITS Planning, Identifying Stakeholders/ Building Coalitions, National ITS Architecture, ITS Standards, Transportation Fundamentals, Operations *Specialized Level:* Systems Integration, Systems Analysis and Design, Data Analysis and Management, Software Development, Software and Hardware Operations, Problem Solving, Systems Support and Maintenance

(4) Other TMC Issues

In addition to needed professional capacity building in these competencies, TMCs face a number of barriers that affect ITS deployments.

There is a need for *improved communication* between State DOT field personnel and TMC operators/ dispatchers. For example, when construction or maintenance is started or completed at roadway sites, the TMC should be contacted immediately to pass on more accurate real-time traffic information. There should also be a *standard method of reporting traffic information to avoid inconsistencies*. For example, a State DOT might report traffic information b overpasses whereas ATIS providers and transportation users prefer to have information by off-ramps.

FTA REGIONAL OFFICE

(1) The Role of FTA Regional Office ITS Staff in ITS Deployment

ITS specialists in the FTA regional offices typically juggle a number of roles. They act as the liaison with Headquarters and translate the federal policy for the field. Additionally, regional staff provides funding information and processes grant applications for transit agencies. The specialist also acts as a regional program development officer, who conducts planning certification reviews. Last, regional staff operates as the transportation interface for welfare-to-work issues.

While these are important roles for staff to play, they also constitute very full-time responsibilities. Therefore, FTA regional staffs typically have only limited time available to spend on specific ITS-oriented tasks. More importantly, staffs in these positions do not have time to learn ITS specialties. Because breadth and depth in ITS is critical for technical assistance, regional staff need a greater level of technical expertise.

(1b) *Top Ten Competency Needs for the FTA Regional Office ITS Staff*

The FTA field staff identified seven top knowledge areas that they felt were required for ITS deployments. Their perspective covered both their own needs as well as the needs of their constituencies in the transit field:

- Regional Concept of Operations
- Organizational/Institutional Change
- Identifying Stakeholders/Building Coalitions
- ITS Planning, especially ITS projects in the TIP and using the National ITS Architecture for planning
- National ITS Architecture and Standards
- Data Analysis & Management
- Financing, especially locating sources of funding.

2) FTA Regional Office's ITS Role in Relation to Other Agencies

The policy (softer) side of ITS has been the primary focus of the regional ITS specialist — institutional, political, programming and funding issues, including transit planning — yet customers tend to be more technically oriented and focused. In general, the interviews revealed that customers do not typically turn to the regional office for expertise in technical ITS areas.

Many suggestions were offered for modifying the role of the FTA regional specialist so that it would be more responsive to the ITS audience. The research indicated that FTA staff competencies in the following areas are critical:

- Breadth of ITS issues
- A solid grounding in Architecture and Standards
- Experience in transportation systems and modes
- Knowledge of the planning process (regional concept of operations)
- Project evaluation methods and acceptance testing
- Legal issues
- Procurement issues
- Focus on the deployment process competencies
- Knowledge of “best practices”
- Catalogue of “tried and true” technologies.

Regional responsibilities could also include providing training, technical assistance and expertise to transit agencies, using the PCB program and other ITS materials. In this respect, a critical need exists for FTA staff to provide information on policy, standards, and architectural conformity to the transit industry.

Recently, an additional source of knowledge has been provided, in some cases, by a working liaison with FHWA regional staff to further project integration. However, the FHWA reorganization and the creation of the new FHWA Resource Centers will make the coordination more difficult, in part, due to the decrease in the number of FHWA offices, and the reassignment of FHWA regional staff.

Other ideas from the field included the ability, by acting regionally, to leverage transit procurement funding by enhancing group purchasing power. This would require different transit agencies within an FTA region coordinating their equipment and service needs as they move forward with deployments. The FTA regional office would be the logical focal point for this coordination.

The field is also looking for additional assistance from FTA staff with qualifying contractors, establishing peer-to-peer connections, providing best practices information, and distributing cost/benefit evaluations of existing deployments.

(3) Guidelines for “Ideal” Staffing of FTA Regional ITS Project Specialist

The following chart outlines the FTA ITS Specialist role, functions and competencies needed to support transportation agencies who are deploying and operating ITS technologies.

Project: ITS Education, Outreach and Technical Assistance

Ideal Team Members	Functions and Responsibilities	Recommended ITS Competencies
ITS Specialist	• Advise on the federal funding and the grants process as it applies to ITS projects; identify sources of funding. • Work with state, regional, and local transportation agency staff to identify local stakeholders, to form coalitions and private-sector partnerships, and establish peer-to-peer connections and mentoring opportunities; provide marketing support to engage non-traditional stakeholders as part of the conceptual design process. • Have familiarity with state/local procurement requirements to help leverage local technology purchases; facilitate coordination of equipment and service needs of different agencies within a region as they move forward with deployments. • Provide information for evaluating technology options including "tried-and-true" versus "leading-edge"; form relationships with vendors to provide information on costs, benefits, functionality; distribute cost/benefit evaluations of existing deployments; • Provide ITS training with best practices, successful approaches, and lessons learned in cooperation with local PCB partners such as universities and LTAP centers. • Track regional, state and local deployments; track changes in project funding and scope. • Participate in design of performance measures with transportation agencies for project testing and evaluation. • Promote and market ITS to senior decision makers at state and local agencies, other federal transportation staff, local elected officials, and planners. • Provide guidance on National ITS Architecture conformity and standards as part of the planning and design process for ITS projects. • Develop/maintain working relationships among FHWA, FTA, and OMC field offices to further project integration. • Identify contractor's expertise and provide assistance with qualifying them for state, regional, and local transportation agencies. • Provide guidance and assistance on flexible funding, for example with FHWA and FTA transfers for joint projects. • Extend audiences to include municipal and county transportation agencies; work in closer partnership with MPOs on promoting ITS and regional coordination among operating agencies.	*Awareness Level:* ITS Awareness, Systems Integration, Technology Options, Systems Analysis and Design, Financing, Writing/Communications, ITS Planning, Data Analysis and Management, Procurement, Project Evaluation, Operations *Specialized Level:* Organizational/Institutional Change, Identifying Stakeholders/Building Coalitions, National ITS Architecture, ITS Standards, ITS Legal Issues, Specialty in an ITS technology area such as software development, telecommunications, electronics, or systems engineering

(4) Other FTA Issues

FTA staff responsibilities must include overall regional oversight on ITS deployment and integration. This includes tracking the status of projects as well as accessing resources or information on ITS for transit. This oversight function would provide the regional staff with additional knowledge about projects, their schedules and budgets, which could then be shared with other interested transit providers.

If the FTA opts for new focus on enhancing the technical capability of the regional staff, this will require a marketing effort to the industry.

One important point to make about the federal grants, managed by FTA staff, is that their limitations are frequently cited as an impediment for ITS deployment. Because of their timing restrictions, coupled with the lack of budget for operations and maintenance, these grants hinder transportation agencies from ITS implementation. To the extent that the FTA wants to evaluate their effectiveness in promoting ITS, the limitations of FTA grants should be explored in greater depth.

FHWA RESOURCE CENTER AND DIVISION OFFICE ITS STAFF

(1) The Role of FHWA Resource Center and Division Office ITS Staff in ITS Deployment

The FHWA Regional and Division Offices serve in similar roles with different audiences. Their current role includes translating policy from Headquarters as well as providing programming, resources and technical assistance in support of the implementation of federal policy. They also provide oversight and tracking of the various ITS projects within their jurisdictions to capture synergies and transfer lessons learned. It is important to note that this is a critical time for the agency, as it completely reorganizes its functions and staff. New ITS specialist staffing positions have been created and the intent is to offer a greater depth and breadth of ITS technical "know-how" to the constituents of the agency.

This description was similar between customers of FHWA field offices as well as FHWA field office staff. Both recognized the importance of these roles as well as identifying ways to enhance these roles. The Federal field staff were referred to somewhat generically, making it hard to distinguish between Regional and Division except (1) a greater responsibility by Regional staff to coordinate and leverage experiences across the multiple deployments within a region, and (2) a greater and more detailed focus by the Division office staff on State and local matters.

(1b) Top Ten Competency Needs for the FHWA Resource Center and Division Office ITS Staff

FHWA staff identified the top ten knowledge areas that both they and their constituencies felt were required to deploy and operate ITS technologies:

- Procurement options, especially different contract options
- ITS Planning, especially developing a regional concept of operations and getting ITS projects in the TIP
- Project Management, especially requirements management
- Technology Options, especially understanding the range of options and training on ITS devices, and inspection procedures
- Identifying Stakeholders/Building Coalitions
- Financing, especially locating sources of funding
- National ITS Architecture and Standards
- Project Evaluation
- Writing/Communications, especially writing ITS specifications

(2) FHWA's Role in Relation to Other Agencies

The field's perceptions of FHWA field offices are that they are primarily occupied with planning and programming issues. They are the translation link between Washington policy and State needs for application. They track ITS projects and changes in funding and scope. They are sources of information on and technical assistance for ITS. They are capable of providing guidance and assistance on flexibility with funding. There are some examples of FHWA to FTA transfers for joint projects, for instance. There were many positive examples of particular Regional and Division staff who "made ITS deployment happen because of their specific competencies."

However, the customers of FHWA offices desire more and different ITS support. They believe that the FHWA field offices should provide them with:

- "best practices" including information about "tried and true" technologies versus leading-edge solutions;
- peer mentoring opportunities and the availability of accessing these peers;
- an identification of consulting firms' areas of expertise and potentially, some idea of their qualifications; (note this might reflect a change in policy)
- accepted standards;
- importance of systems integration;
- evaluation of technology options;
- performance evaluation methods.
- marketing support to get the word out and convince other agencies to come on board.
- provide funding for forums on ITS.

In terms of working partnerships, there is a need for FHWA field offices to extend their audience to include municipal and county transportation agencies who are not as familiar with FHWA services. Also, they need to work in closer partnerships with MPOs on promoting ITS and regional coordination among operating agencies.

(3) Guidelines for "Ideal" Staffing of FHWA Regional ITS Project Specialist

The following chart outlines the FHWA ITS Specialist role, functions and competencies needed to support transportation agencies who are deploying and operating ITS technologies.

Project: ITS Education, Outreach and Technical Assistance

Ideal Team Members	Functions and Responsibilities	Recommended ITS Competencies
ITS Specialist	• Advise on the federal funding and the grants process as it applies to ITS projects; identify sources of funding. • Work with state, regional, and local transportation agency staff to identify local stakeholders, to form coalitions and private-sector partnerships, and establish peer-to-peer connections and mentoring opportunities; provide marketing support to engage non-traditional stakeholders as part of the conceptual design process. • Have familiarity with state/local procurement requirements to help leverage local technology purchases; facilitate coordination of equipment and service needs of different agencies within a region as they move forward with deployments. • Provide information for evaluating technology options including "tried-and-true" versus "leading-edge"; form relationships with vendors to provide information on costs, benefits, functionality; distribute cost/benefit evaluations of existing deployments; • Provide ITS training with best practices, successful approaches, and lessons learned in cooperation with local PCB partners such as universities and LTAP centers. • Track regional, state and local deployments; track changes in project funding and scope. • Participate in design of performance measures with transportation agencies for project testing and evaluation. • Promote and market ITS to senior decision makers at state and local agencies, other federal transportation staff, local elected officials, and planners. • Provide guidance on National ITS Architecture conformity and standards as part of the planning and design process for ITS projects. • Develop/maintain working relationships among FHWA, FTA, and OMC field offices to further project integration. • Identify contractor's expertise and provide assistance with qualifying them for state, regional, and local transportation agencies. • Provide guidance and assistance on flexible funding, for example with FHWA and FTA transfers for joint projects. • Extend audiences to include municipal and county transportation agencies; work in closer partnership with MPOs on promoting ITS and regional coordination among operating agencies.	*Awareness Level:* ITS Awareness, Systems Integration, Technology Options, Systems Analysis and Design, Financing, Writing/Communications, ITS Planning, Data Analysis and Management, Procurement, Project Evaluation, Operations *Specialized Level:* Organizational/Institutional Change, Identifying Stakeholders/Building Coalitions, National ITS Architecture, ITS Standards, ITS Legal Issues, Specialty in an ITS technology area such as software development, telecommunications, electronics, or systems engineering

(4) Other FHWA Issues

Ideally, staff would like their roles to match well with the ideal role of the customers. However, current staff recognized a lack of time and resources to fulfill this need. Across field offices, there is a wide range of skills and knowledge. Programming and funding issues take up much of their time, limiting their ability to learn about ITS. The desire is to become more like a customer service organization and offer the most relevant assistance.

Internally, FHWA should also focus on training needs and career tracks. Other specialists need a basic ITS awareness. Transit integration into traffic management is also more important as intermodalism becomes the norm.

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