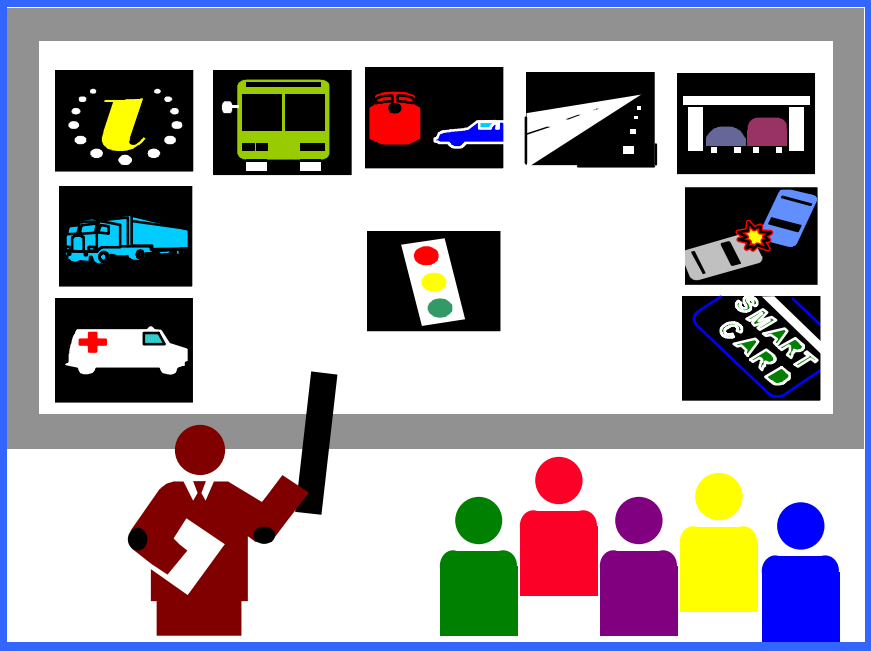
BUILDING PROFESSIONAL CAPACITY IN ITS:

GUIDELINES FOR DESIGNING AN INDIVIDUALIZED TRAINING AND EDUCATION PLAN



US Department of Transportation
ITS Joint Program Office
ITS PCB Program

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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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Where to find Your Role (cont'd):

Overview: Introduction

Purpose of this Document

This document is a guide for transportation professionals on how to create an individualized training and education plan for enhancing their knowledge and skills for working with ITS. The guide identifies the twenty "ideal" roles that professionals play in ITS and the ITS competencies required for successful performance in each role. Based on these roles and competencies, the guide then presents a curriculum that has been designed to build the competencies recommended for each individual role.

The twenty sets of ITS Curricula recommend training and education courses that are available from three categories of sources: the U.S. DOT training programs, the academic community, and private sector professional associations and vendors. The guide relies upon the reader to make some personal determinations for future development either on his/her own, with a supervisor, and/or with human resources staff:

(1) The first determination is what role or roles the reader plays in ITS. Many people function in more than one role and therefore need to build a cross-section of ITS competencies.

(2) The second determination is the level — awareness or specialized — at which the reader currently possesses an understanding of one or more of the ITS competencies. Many professionals have already acquired some level of ITS competence through:

- Previous education or background experience;
- Involvement in planning or deployment activities;
- Self-development by attending conferences, reading journals or participating in ITS committees; or
- Attending some of the ITS PCB training courses or other courses.

(3) The third determination is how to go about building the required ITS professional capacity. This will require the reader to develop an individualized plan for learning. It requires the commitment of the reader to determine his/her existing strengths, identify what knowledge areas require further exploration, and pursue those resources which will help bridge his/her knowledge gaps.

The guide is intended to satisfy the needs of professionals who are in search of a greater understanding and awareness of ITS, and for those who want to develop a specialized area of knowledge that will advance their contribution to ITS-related projects. It does not provide recommendations for building professional expertise that comes only through years of study and experience. Instead, the guide is intended to help professionals who have discovered that the requirements of their jobs have changed, want to successfully meet the technological and institutional demands of ITS-related projects, and are interested in advancing their careers in ITS. It also recognizes that the level of knowledge or the extent of any one's contribution will vary depending on the person's role and the composition of the team that is gathered during the different stages of the ITS project.

Overview: Background

What Is ITS Professional Capacity Building

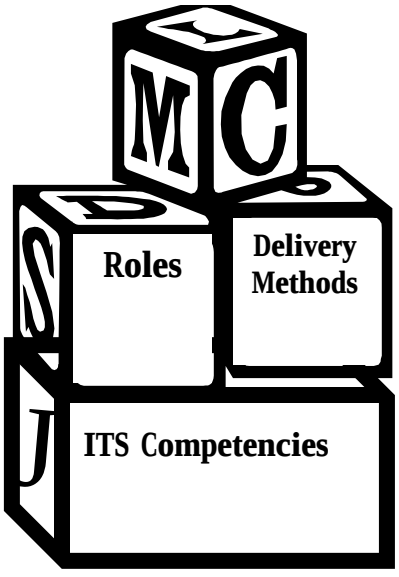
Professional capacity building (PCB) is the process of developing new or enhancing existing knowledge and skills that are required for successful performance in one's job. ITS professional capacity building has been growing in importance since 1991 when Congress charted a new course for the modernization 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 computing requires transportation professionals to search for, and access, education and training resources which will enable them to remain professionally current.

This guide highlights the process of building 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*** (available on the ITS PCB web site at http://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.

The PCB Building Blocks

For a professional who wants to determine how to build his/her own ITS professional capacity, he/she will need to begin with an understanding of the three PCB "building blocks". Briefly, they are:



- **ITS Roles** — the range of 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 in ITS.
- **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 designing the individualized ITS training and education plans — the roles and the ITS competencies. The third, delivery methods, is described in this report to help professionals identify the most accessible means for

them to receive PCB, and then to request that form of delivery from the PCB program and other PCB providers. The following describes each building block in greater detail.

Range of ITS Roles

The needs assessment study cited above defines twenty "ideal" ITS team roles that professionals perform in ITS. Frequently, professionals play more than one role in their jobs. Additionally, the scope of each role varies among agencies and ITS projects.

The interviews revealed that, in deploying ITS, the most effective performance resulted from dividing the competencies among a team of people and employing them with a strategy similar to the use of a football team's members throughout a game. In this respect, no one person has to know it all. Instead, each role varies in its competency mix to allow professionals to focus on those areas that are most important for their job functions.

Unfortunately, the majority of transportation agencies are not always in a position to staff these roles due to limitations on hiring, salary caps, and the move toward privatization. A separate companion guide entitled, ***Building Professional Capacity in ITS: Guidelines for Staffing, Hiring, and Designing Ideal Project Teams,*** is available on the ITS PCB web site (http://www.its.dot.gov) to help managers and agency decision makers identify and decide how to staff the role(s) of the intra- and inter-agency team members.

The ITS roles are listed in Table 1. In structuring an individualized ITS training and education plan, the reader should either individually or with his/her supervisor and/or human resource development personnel, identify the role(s) played. To help, more detail on each role and its responsibilities in provided at the beginning of each curriculum, located on pages 9-55 of this guide.

Table 1: Range of 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 Administrators/ 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

An ITS competency is a *bundled set of knowledge and skills* that support successful job performance. Knowledge provides the fundamental principles associated with the competency area, and skills help one learn how to apply the knowledge.

Table 2 presents the competencies in four general categories, which characterizes when ITS competencies are needed and why. The competencies in bold and that are 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 needs assessment. Twenty-seven ITS competency areas have been defined 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.

Detailed descriptions of each of these competencies can be found beginning on page 57 of this guide.

Table 2: Range of ITS Competencies

Competencies for Developing a Regional ITS Concept of Operations and Planning for ITS

- ITS Awareness/ITS Topics (see below)
- **Identifying Stakeholders/Building Coalitions (9)**
- National ITS Architecture
- Partnerships
- **Financing (6)**
- **ITS Planning (8)**

Cross-Cutting Competencies

- Project Management
- ITS Legal Issues
- Marketing/Public Relations
- **Writing/Communications (7)**
- Problem Solving
- **Data Analysis & Management (10)**
- Transportation Fundamentals

Competencies for the Design, Procurement, Installation, Operations & Maintenance, and Evaluation Stages

- **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

Creating Change: Competencies for Mainstreaming ITS

- Legislative and Policy Change
- **Organizational/Institutional Change (2)**

ITS Topics:

- 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

Range of Delivery Methods for Learning ITS

The four primary means of delivering professional capacity building are **training, formal education**, **technical assistance**, and **information outreach**. Professionals need to consider what means of learning is most accessible to them. Table 3 provides a more comprehensive list of the methods available for delivering ITS learning that are used by the U.S. DOT and its PCB partners.

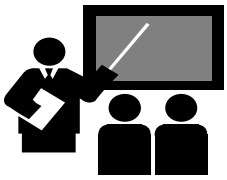
The interviews revealed that *the method by which one learns is equally as important as identifying one's role and what one needs to learn*. In today's fast-paced business environment, the more traditional methods of learning, such as training courses or pursuing educational classes, don't always meet the needs of professionals who need information and instruction on-the-job and just-in-time.

In addition, the interviewees made it evident that professionals who were most successful at learning about ITS did so through a wide variety of learning methods. They mixed night-time courses at local universities (education) with constant reading of journals, attendance at conferences, and participation on committees (information outreach). They participated in ITS Scanning Reviews, arranged their own visits to sites with ITS deployments, and called peers about problems, solutions, and experiences (technical assistance). In fact, many of the interviewees were some of the first attendees of the U.S. DOT's PCB Program's ITS courses and seminars (training).

Table 3: Range of ITS Delivery Methods

Training

- Traditional classroom style
- Computer-based training (CBT)
- Satellite broadcast of a course presentation
- Web-based training (WBT)
- Job rotation or exchange program through/with agencies, professional associations, or private sector firms.



Education

- University and college semester lecture courses, labs and degree programs.
- Certificate programs for continuing education
- Technical and vocational school courses, labs, and degree programs
- Journeyman and apprenticeship programs

Technical Assistance

- Assistance from Federal Field Staff
- Mentoring
- Peer-to-Peer Network
- Consultant/Contractor assistance
- Scanning Reviews

Information Outreach

- Web site with reports, information and access to technical assistance
- Papers on best practices, lessons learned, and successful approaches
- Vendor sponsored programs: displays, exhibits, training, Electronic Data Library, Electronic newsletters.

It is the goal of the ITS PCB Program to utilize the delivery method that most effectively allows the learning to be ***tailored to, targeted for***, and ***accessible to*** professionals.

> **"**The goal of a 21st century professional capacity building program should be to provide ***the right information to the right people at the right time and place, as quickly and conveniently as possible."***
>
> ***An interviewee***

Steps For Building ITS Professional Capacity

What competencies are needed and at what level, is unique to each individual. Also, the level at which a professional will need to learn an ITS competency is dependent upon the role, or roles, that he/she plays within a transportation agency and/or on an ITS project. The remainder of this document provides tools for individual transportation professionals to determine how to build their own professional capacity in ITS. These tools are:

- A series of ***ITS curricula*** that recommend, for each role, a sequence of learning.
- A ***set of definitions for each competency*** that also lists the training, education, technical assistance, and information references that are available to build professional capacity in each competency area.

This document recommends a four step process using these tools for professionals to follow in determining for themselves their own unique mix and learning sequence of professional capacity building in ITS competencies:

1) **Step One: Identify your role(s)**
2) **Step Two: Determine your current level of ITS competencies**
3) **Step Three: Use the ITS Curricula to develop a learning plan**
4) **Step Four: Use the definition pages to learn of additional training resources and opportunities**

Step One: Identify Your Role(s)

To begin, use the chart on page 3 to identify what role or roles you perform for your transportation agency or on your ITS project. You may play more than one role and will thus need to combine the curricula when forming a learning plan.

Step Two: Determine Your Current Level of Competencies

After identifying your role, turn to the ITS Curricula listed on pages 9 through 55. For each role, a description of the functions and responsibilities is provided for the reader to ensure the right match to the role. A list of competencies is then recommended to build the ITS competence needed for that role.

At this point, the reader will need to determine his/her current level of ITS competence. It may be that through experience or through education, the reader already possesses the recommended level of one or more competencies. It may also be that the recommended competencies need to be expanded or minimized based on the reality of the reader's role. The key to this step is for the reader to determine the gap that still needs to be filled through further ITS training and education.

Step Three: Use the ITS Curricula to Develop a Learning Plan

The next step is for the reader to consider the curriculum associated with his/her role. If the reader plays more than one role, the curricula will need to be combined. The curricula are designed around U.S. DOT training and education courses and seminars, including those developed by the ITS PCB Program, the National Highway Institute (NHI) and the National Transit Institute (NTI). They also include courses from PCB Program partners such as universities, ITS America (ITSA) and the Institute of Transportation Engineers (ITE).

The curricula provides a sequence for learning at the awareness level and at the specialized level, which are associated with the competency recommendations. The **Awareness Level** provides training to build a basic sense of awareness with an ITS topic or an associated topic, and an overview of the issues and experiences-to-date. The **Specialized level** provides more in-depth knowledge to build a fundamental foundation to many of the principles involved in ITS, and skill-building instruction to provide "how-to" learning for many of the skills needed for ITS.

When using the curricula, it is important to consider how much ITS learning you may already have acquired either on-the-job or in training. The new entrant to ITS will want to begin with the Awareness Training Curricula. Those professionals who have been engaged in ITS for a while may find it more appropriate to begin at the Specialized Level.

Step Four: Use the Definition Pages to Learn of Additional Resources and Opportunities

Other learning resources and opportunities are available. These resources are a mix of training, education, technical assistance and information that can be accessed through the U.S. DOT and its Electronic Document Library (EDL), local universities and LTAP Centers, professional associations, and private sector vendors.

Other resources that complement this learning are listed according to competency areas on pages 57 through 113. These pages list the type of courses one should seek out at local universities, Technical Assistance programs that are available and accessible, and information resources both on the Internet and by hard copy.

Not every resource is listed due to time limitations on identifying them. Thus, the reader is expected to explore other catalogs that are available that provide additional and up-to-date information. These other catalogs can be found through professional associations, local universities, State DOT training programs, or vendors and also on web sites. The definition pages include the more obvious opportunities as a way to provide direction for thinking about other opportunities.

*** It should be noted that, what is missing from both the ITS Curricula and the definition pages, is a level of learning that qualifies a professional to be an expert. For most roles, this expert, "nitty-gritty" background is inherent within the job requirements for the role. For instance, success comes easier if you hire a Marketer for marketing or a Systems Designer for designing your system. The training and education recommended through Awareness and Specialized training would not provide these skills at that level. Instead, the ITS curricula introduce, establish and provide a sound foundation for professionals to enhance their knowledge and skills for working with ITS.

Conclusion

This guide has been developed so that it is practical and easy to use in developing individualized ITS training and education plans. The professional who is seeking a greater ITS awareness, as well as the individual seeking more specialized ITS knowledge and skills can follow the steps outlined in this guide to develop an action plan for securing the training and education required by ITS projects and activities.

The curricula are provided in this guide to assist professionals in building a foundation in ITS. They are not meant as a checklist, nor a certification. ITS competence evolves as the training and education recommended here is supplemented with practical, hands-on knowledge and experience. However, to begin building that foundation, this guide provides the following tools:

- ITS roles to help the reader identify his/her functions and responsibilities;
- ITS competencies to help the reader determine what knowledge and skills are needed;
- A set of ITS Curricula to assist the reader in developing a plan for learning;
- Competency definitions that also describes further opportunities to access learning through training, education, technical assistance, and information outreach.

The ITS Curricula

The remainder of this guide contains the ITS curricula for each ITS role and the definition pages. They both utilize the following set of symbols to identify training and education opportunities:

- ✓ **Specific ITS training courses** that have been developed and are known to be available through the following ITS PCB Program partners: U.S. DOT, the National Highway Institute (NHI), the Federal Highway Administration (FHWA), the National Transit Institute (NTI), the Federal Transit Administration (FTA), the Institute of Transportation Engineers (ITE), and ITS America (ITSA). These courses are noted through the document with a checkmark (✓). A notation is also made to denote suggested reading materials that are available on the ITS EDL.
- ∗ **Suggested general training and education** courses that have been identified as available through universities, vendors, professional associations, and/or available through other U.S. DOT programs. These courses are identified throughout the document with a star (✳).
- ◇ **Recommendations for training courses that have not yet been identified** as available. These courses may exist, or may still need to be developed. These courses are identified by an unfilled diamond (◇). The listing of these courses also provide direction for PCB Program partners who are planning to develop new training and education.

The curricula are designed to be broad enough to include staff at both public sector highways and transit agencies and the private sector contractors. If courses have already been targeted for a highway or transit perspective, both are noted in the same box with an "or" to signify that either course will accomplish the same objective. When the public highway or transit role or private sector role differs enough, separate curriculum are provided.

ITS Curriculum — ITS Champions

Role Description: ITS Champions are also known as Advocates. They are individuals who promote the benefits of ITS to decision makers — both elected (legislators) and appointed (agency heads), to the internal staff at their agency and at other agencies, and to the public. In some respect, everyone involved in ITS needs to play this role. There are many documented examples of why this role is so important. To play this role effectively, it requires an in-depth awareness of ITS, and an ability to communicate effectively with political, executive, management and technical staff. Champions frequently have to spearhead organizational/institutional and legislative and policy changes to allow ITS deployments to occur.

The Champion role has been formalized within the ITS Commercial Vehicle Operations program, though the role exists informally within the ITS Metropolitan deployment program. It was noted throughout interviews that at leading-edge sites, there was a champion who was continually referred to as having promoted a guiding vision of ITS deployment. It was also noted that many project managers played the champion role within their agencies or on their projects. Across the interviews, this was described as a critical role.

Once the decision to deploy ITS has been made, the Champion plays an important role in building awareness and mainstreaming ITS. The typical background of a Champion is many years of experience in the transportation industry. This is important to be able to understand how all the various agencies, officials, and decision-makers play roles and have opportunities and limitations to their roles. Champions are charismatic, good communicators and negotiators, and usually politically well connected.

Functions and Responsibilities:

- Acts as a visionary who recognizes ITS as a tool for better operations and management of the transportation system, and meeting customer needs.
- Plays a role in building ITS awareness in other professionals who will make decisions.
- Is actively involved in planning and deploying ITS.
- Promotes and markets the benefits of ITS to other professionals; builds awareness in other transportation decision makers outside of the ITS deployment process in an effort to mainstream ITS concepts and terminology.
- Facilitates building a regional ITS vision among the various stakeholders.
- Helps identify roles that agencies and professionals will play in deployment, and provides information for deployment and operating decisions.

The following is a list of the recommended competencies to build the breadth required for an ITS Champion:

Competency Recommendations at the Awareness Level	Competency Recommendations at the Specialized Level
ITS Awareness **Systems Integration (1)** **Technology Options (3)** **System Analysis and Design (4)** National ITS Architecture ITS Standards Partnerships Marketing/Public Relations	**Organizational/Institutional Change (2)** **Writing/Communications (7)** **ITS Planning (8)** **Identifying Stakeholders/Building Coalitions (9)** Legislative and Policy Change Problem Solving Transportation Fundamentals

Recommended Core Training and Education for ITS Champions

Awareness Training	
	✓ ITS Awareness Seminar (NHI or internet: http://www.nawgits.com/nawg/itsaware/) or ✓ ITS in Transit (FTA)
	✓ An Introduction: National ITS Architecture and Interim Guidance on Conformity (U.S. DOT) or ✓ The National ITS Architecture: An Introduction for FTA Senior Staff (FTA)
	✓ Deploying Integrated ITS — Metropolitan (NHI or internet: http://www.its.dot.gov/pcb/deploygd.htm) ✓ Deploying Integrated ITS — Rural (NHI)
	✓ ITS Public/Private Partnerships (NHI)
	Technology Options: Depends on the type of ITS project
	* Course in marketing/public relations basics (universities, junior colleges)
	✓ Recommended reading in ITS Institutional and Legal Issues (EDL)
	◇ Case studies on how local areas worked with legislators and appointed officials to change policies to incorporate ITS.

Specialized Training	
	✓ Using the National ITS Architecture for Deployment for the Public Sector (U.S. DOT) or ✓ Using the National ITS Architecture for Deployment for the Private Sector (U.S. DOT)
	✓ ITS and the Transportation Planning Process (NHI)
	✓ Planning the Integration of Transit and Traffic ITS Applications (NTI)
	ITS Topic Specific: Depends on project type
	* Advanced course in negotiations (U.S. DOT, universities, professional associations)
	* Advanced course in writing business plans/ project plans, writing specifications (U.S. DOT, universities, professional associations)
	* Course in transportation engineering to learn vocabulary and fundamentals of traffic and/or transit (universities, transportation professional associations)
	* Course in change management (business schools, universities, professional associations)

ITS Curriculum — Planners

Role Description: The role of the Planner exists both within transportation agencies and at Metropolitan Planning Organizations (MPO). Although these roles embody slightly differing functions and perspectives, the competencies are similar. Planners must be able to identify ITS opportunities, and evaluate them in the context of regional and agency goals and objectives, and determine the potential for their integration in capital improvement projects.

Planners at MPOs play an important role in integrating ITS projects into regional planning documents, thereby mainstreaming ITS into ongoing transportation planning. The most common ITS functions of the MPO planner role is to provide outreach and coordination with local transportation agencies to: demonstrate ITS and its benefits; promote the MPO as a forum for developing a regional ITS vision; sponsor multi-jurisdictional, multi-agency, and multi-discipline ITS committees; and serve as a link to policy makers and the private sector. **Planners at transportation agencies** play a role in integrating ITS projects into an agency's yearly transportation plans. ITS from this perspective is frequently mode-specific. Agency planners play a role in representing agency needs when building the regional ITS vision. They work with Project Managers to plan and design the agency's ITS projects and activities and they assist in ensuring that ITS projects have funding. They assist the agency with their familiarity with all applicable planning and environmental regulations.

Functions and Responsibilities:

- 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.

The following is a list of the recommended competencies to build the breadth required for Planners:

Competency Recommendations at the Awareness Level	Competency Recommendations at the Specialized Level
ITS Awareness **Systems Integration (1)** **Organizational/Institutional Change (2)** **Technology Options (3)** **Systems Analysis and Design (4)** ITS Standards Marketing and Public Relations Project Evaluation Legislative and Policy Change ITS Legal Issues Operations	**Managing Contractors (5)** **Financing (6)** **Writing/Communications (7)** **ITS Planning (8)** **Identifying Stakeholders/Building Coalitions (9)** **Data Management and Analysis (10)** National ITS Architecture Project Management Partnerships Procurement Problem Solving Software and Hardware Operations

Recommended Core Training and Education for ITS Planners

Awareness Training

- ✓ ITS Awareness Seminar (NHI or internet: http://www.nawgits.com/nawg/itsaware/) or
- ✓ ITS in Transit (FTA)

- ✓ An Introduction: National ITS Architecture and Interim Guidance on Conformity (U.S. DOT) or
- ✓ The National ITS Architecture: An Introduction for FTA Senior Staff (FTA)

- ✓ Deploying Integrated ITS — Metropolitan (NHI or internet: http://www.its.dot.gov/pcb/deploygd.htm)
- ✓ Deploying Integrated ITS — Rural (NHI)

- ✓ NTCIP and ITS Standards – What Do They Mean for You? (ITE)

Technology Options: Depends on the type of ITS project

For Transit Planners:
- ✓ Transit Performance Evaluation: Using Information-Based Strategies (NTI)

- ✓ ITS Telecommunications Overview (NHI)

- * Introductory course on the software development process (U.S. DOT, vendors and universities)

- * Introductory course on systems engineering, installing and integrating hardware and software, and testing methodologies (vendors, universities, technical/vocational schools)

- * Introductory courses on operating and maintaining networks and software, and inspection and testing of systems (vendors, technical/vocational schools)

- * Course in marketing/public relations basics (universities, junior colleges)

- ✓ Recommended reading in ITS Institutional and Legal Issues (EDL)

- ◇ Case studies on how local areas worked with legislators and appointed officials to change policies to incorporate ITS.

- ◇ Workshop on ITS project evaluation, setting performance measures, acceptance testing of devices and systems, and cost/benefit analysis after deployment.

- * ITS America's Legislative Affairs web-site. (http://www.itsa.org/legislative.html)

Specialized Training

- ✓ Using the National ITS Architecture for Deployment for the Public Sector (U.S. DOT)

- ✓ ITS and the Transportation Planning Process (NHI)

- ✓ ITS Public/Private Partnerships (NHI)

- ✓ Shared Resources for Telecommunications (NHI)

- ✓ Planning the Integration of Transit and Traffic ITS Applications (NTI)

For Transit Planners:
- ✓ Intelligent Transportation Systems for Transit: Solving Real Problems (NTI) and
- ✓ Reinventing Transit: Planning Information-Based Transit Services (NTI)

- ✓ Managing Systems Integrators (ITSA)

- ✓ Lessons Learned in ITS Procurement (NHI)

- ✓ ITS Telecommunications Analysis (NHI)

- ✓ ITS Software Acquisition (NHI)

- ✓ Use of CORSIM Computer Traffic Simulation Model (U.S. DOT)
- ◇ Other models as they become available

- * Courses in public sector financial management: cost/benefit analysis, investment analysis, risk analysis, budgeting and accounting (U.S. DOT, universities, junior colleges)

- * Course in procurement and legal issues (U.S. DOT)

- * Courses on data analysis, management and databases (universities)

- * Course in writing business plans/ project plans, writing specifications (U.S. DOT, universities, professional associations)

- * Courses on project management (U.S. DOT, universities and junior colleges)

- * Advanced course in negotiations (U.S. DOT, universities, professional associations)

- * Courses on software applications such as word processing, spreadsheets, databases, or internet applications (junior colleges, universities, agency training programs, professional associations, software vendors)

- ◇ Seminar on ITS Legal Issues.

ITS Curriculum — Federal Field Staff

Role Description: The primary role of Federal Field Staff is to transfer information on ITS policy and ITS funding availability, and to provide technical assistance to state, regional, and local public sector transportation agencies. Both FHWA and FTA have designated individuals as ITS field specialists, many of whom have or are developing a technological background that will allow them to take a proactive advisory role when providing technical assistance to state, regional and local agency staff. FHWA has recently reorganized its nine regional offices into four Resource Centers with four ITS specialist positions at each center. FHWA Division Offices have a designated ITS staff member but it varies as to whether they function in full- or part-time capacity. The predominant difference between these two offices is that there appears to be a greater responsibility for Regional staff to coordinate and leverage experiences across the multiple deployments within a region, and a greater and more detailed focus by the Division office staff on State and local matters. FTA has designated one person in each of its ten Regional Offices to act as point-person for ITS questions and issues. This is in addition to other duties and frequently the FTA ITS Specialist functions on a part-time basis.

Functions and Responsibilities:

- 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 deployment; 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 funding 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.

The following competencies are recommended to build the breadth required for Federal Field Staff:

ITS Curriculum — Federal Field Staff (cont'd)

Competency Recommendations at the Awareness Level	Competency Recommendations at the Specialized Level
ITS Awareness **Systems Integration (1)** **Organizational/Institutional Change (2)** **Technology Options (3)** **Systems Analysis and Design (4)** **Financing (6)** **Writing/Communications (7)** **ITS Planning (8)** **Data Analysis and Management (10)** Procurement Project Evaluation Operations	**Building Coalitions (9)** National ITS Architecture ITS Standards ITS Legal Issues A specialty in an ITS technology area such as software development, telecommunications, electronics, or systems engineering

Recommended Core Training and Education for FHWA Resource Center and Division Office ITS Specialists

Awareness Training	✓ ITS Awareness Seminar (NHI or internet: http://www.nawgits.com/nawg/itsaware/)
	✓ An Introduction: National ITS Architecture and Interim Guidance on Conformity (U.S. DOT)
	✓ Deploying Integrated ITS — Metropolitan (NHI or internet: http://www.its.dot.gov/pcb/deploygd.htm) ✓ Deploying Integrated ITS — Rural (NHI)
	✓ NTCIP and ITS Standards – What Do They Mean for You? (U.S. DOT)
	✓ ITS and the Transportation Planning Process (NHI)
	✓ ITS Public/Private Partnerships (NHI)
	* Course in writing business plans/project plans, writing specifications (U.S. DOT, universities, professional associations)
	* Course on data analysis, management and databases (U.S. DOT, universities)
	* Courses in public sector financial management: contracts, cost/benefit analysis, investment analysis, risk analysis, budgeting and accounting (U.S. DOT, universities, junior colleges)
	* Course in marketing/public relations basics (universities, junior colleges)
	✓ Recommended reading in ITS and Human Factors (JPO)
	* Introductory course on software and human factors (universities)
	◇ Workshop on ITS project evaluation, setting performance measures, acceptance testing of devices and systems, and cost/benefit analysis after deployment.
	◇ Workshop on using and writing ITS contracts and ITS specifications
	◇ Case studies on how local areas worked with legislators and appointed officials to change policies to incorporate ITS.

Specialized Training	✓ Using the National ITS Architecture for Deployment for the Public Sector (U.S. DOT)
	✓ Standard Training Modules (U.S. DOT)
	✓ Advanced Transportation Management Technology Workshop (FHWA)
	✓ Managing Systems Integrators (ITSA)
	✓ ITS Software Acquisition (NHI)
	✓ Shared Resources for Telecommunications (NHI)
	✓ Planning the Integration of Transit and Traffic ITS Applications (NTI)
	✓ Lessons Learned in ITS Procurement (NHI)
	ITS Topic Specific: ✓ Freeway Management Systems (NHI) ✓ Incident and Emergency Management Systems (NHI) ◊ Advanced Traveler Information Systems ✓ Advanced Signal Control Systems (NHI) ◊ Electronic Toll Collection Systems ◊ Highway-Rail Crossings
	Advanced Technology Options: ✓ Traffic Surveillance Systems (ITSA) ✓ Freeway Traffic Operations (NHI) ✓ Traffic Control Software and Signalization (NHI) ✓ Computerized Traffic Signal Systems (NHI) ✓ Advanced Traffic Signal Controllers (NHI) ✓ HOV Facilities (NHI) ✓ Advanced Sensors (ITSA)
	✓ Use of the CORSIM Computer Traffic Simulation Model (U.S. DOT) ◇ Use of other models as they become available.
	* Advanced course in writing business plans/ project plans, writing specifications (U.S. DOT, universities, professional associations)
	* Advanced course in negotiations (U.S. DOT, universities, professional associations)
	* Advanced course in procurement and legal issues (U.S. DOT)
	✓ Recommended reading: Reports from ITS Federal Operational Tests and their evaluation strategies (EDL)
	◇ Seminar on ITS legal issues

Recommended Core Training and Education for FTA Regional Office ITS Specialists

Awareness Training

- ✓ ITS in Transit (FTA)
- ✓ The National ITS Architecture: An Introduction for FTA Senior Staff (FTA)
- ✓ Deploying Integrated ITS — Metropolitan (NHI or internet: http://www.its.dot.gov/pcb/deploygd.htm)
- ✓ Deploying Integrated ITS — Rural (NHI)
- ✓ NTCIP and ITS Standards – What Do They Mean for You? (U.S. DOT)
- ✓ ITS and the Transportation Planning Process (NHI)
- ✓ ITS Public/Private Partnerships (NHI)
- * Course in writing business plans/project plans, writing specifications (U.S. DOT, universities, professional associations)
- * Course on data analysis, management and databases (U.S. DOT, universities)
- * Courses in public sector financial management: contracts, cost/benefit analysis, investment analysis, risk analysis, budgeting and accounting (U.S. DOT, universities, junior colleges)
- * Course in marketing/public relations basics (universities, junior colleges)
- ✓ Recommended reading in ITS and Human Factors (JPO)
- * Introductory course on software and human factors (universities)
- ◇ Workshop on ITS project evaluation, setting performance measures, acceptance testing of devices and systems, and cost/benefit analysis after deployment.
- ◇ Workshop on using and writing ITS contracts and ITS specifications
- ◇ Case studies on how local areas worked with legislators and appointed officials to change policies to incorporate ITS.

Specialized Training

- ✓ Transit Management Course (FTA)
- ✓ Using the National ITS Architecture for Deployment for the Public Sector (U.S. DOT)
- ✓ Standard Training Modules (U.S. DOT)
- ✓ Procuring New Technologies for Transit (NTI)
- ✓ Managing Systems Integrators (ITSA)
- ✓ ITS Software Acquisition (NHI)
- ✓ Shared Resources for Telecommunications (NHI)
- ✓ Planning the Integration of Transit and Traffic ITS Applications (NTI)
- ✓ Lessons Learned in ITS Procurement (NHI)
- ITS Topic Specific:
  - ✓ Advanced Public Transportation Systems (FTA)
  - ◊ Advanced Traveler Information Systems
  - ◊ Electronic Fare Payment Systems
  - ◊ Fleet Operations and Maintenance Systems
- Advanced Technology Options:
  - ✓ Intelligent Transportation Systems for Transit: Solving Real Problems (NTI)
  - ✓ NTI Workshops on Advanced Technologies and Innovative Practices for Transit (NTI)
  - ✓ Geographic Information Systems: Transit Applications (NTI)
- ✓ Use of the CORSIM Computer Traffic Simulation Model (U.S. DOT)
- ◇ Use of other models as they become available.
- ✓ Reinventing Transit: Planning Information-Based Transit Services (NTI)
- ✓ Transit Performance Evaluation: Using Information-Based Strategies (NTI)
- * Advanced course in writing business plans/project plans, writing specifications (U.S. DOT, universities, professional associations)
- * Advanced course in negotiations (U.S. DOT, universities, professional associations)
- * Advanced course in procurement and legal issues (U.S. DOT)
- ✓ Recommended reading: Reports from ITS Federal Operational Tests and their evaluation strategies (EDL)
- ◇ Seminar on ITS legal issues

ITS Curriculum — Project Managers

Role Description: The role of the Project Manager is a primary and significant role in ITS deployment. It requires one of the more comprehensive ranges of breadth and depth in ITS competencies.

ITS Project Managers activities frequently begin in their role at the planning and design stages of ITS projects and continue through the selection of staff and contractors, procurement, deployment and installation activities. Some Project Managers begin in the Champion role and are instrumental in the decision to deploy. Others begin once the decision to deploy has been made by senior Policy/Agency Managers. Once deployed and functional, Project Managers either transfer the working system's operations to an Operations Managers or become the Operations Manager.

ITS Project Managers must have a solid understanding of the transportation industry and the goals and functions of their agency. They must understand the problems that deployed systems are expected to resolve, and a detailed knowledge of how to apply ITS technologies. They are responsible for ensuring the deployment is carried out effectively and successfully through staff and contractors, which requires an understanding of how ITS fits into the on-going capital improvement construction process and existing operations.

Functions and Responsibilities:

- 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 such as police, emergency and tow truck personnel, and other concerned groups.
  - Conduct/oversee user needs assessment as part of design process; understand data needs and flows.
  - Involve non-traditional but necessary staff and eventual users in the design and decision making , e.g., 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 technology and systems 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, manage grants, prepare budgets, track expenses.
  - Manage installation and integration, including prototyping, testing and evaluation stages.
  - Conduct periodic evaluations throughout the project cycle and lead final project inspection, testing and evaluation.
  - Design and plan for operations staff, 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.

The current Project Manager role differs markedly from the past. First, ITS planning, deployment and installation activities require different staff and staffing qualifications. Second, ITS projects tend to be less discrete than capital improvement projects; they tend to follow an iterative prototyping and testing process and frequently "bleed" into ongoing operations, thus requiring staff to work interdependently. In addition, ITS projects typically do not have clearly identified measures of performance that signify success.

The Project Manager plays a key role in helping to define those measures of performance. Each project requires a team of managers, engineers, analysts and technicians to envision what is feasible, what the requirements are, and what the results should be.

For the most part, the public and private sector Project Managers require similar competencies and backgrounds. Some of the more pronounced differences are:

- Private sector Project Managers are expected to have a more well-developed technical expertise in one or more of the competency areas of information technologies, systems integration and engineering, telecommunications, or software development. As such, the private sector Project Manager curriculum recommends advanced courses in these technical competencies under specialized training and introductory courses in institutional topics. However, it is assumed that most private sector Project Managers will have this technical expertise as part of their background.
- Public sector Project Managers are expected to have a more well-developed institutional expertise, including a comprehensive view of ITS deployment to coordinate with other ITS activities. As such, the public sector Project Manager curriculum recommends advanced courses in these institutional competencies under specialized training with introductory courses in the technical competencies. However, it is assumed that most public sector Project Managers will contain this institutional expertise as part of their background.
- Private sector Project Managers must ensure that they and their staff have an understanding of transportation fundamentals, such as vocabulary, traffic/transit engineering basics, and analysis of flow and capacity. They must be able to understand and meet contracted goals and objectives, and understand the statutory limitations of using public funds. Frequently, the private sector's lack of transportation experience creates a communications problem with public sector Project Managers, as does the public sector's lack of experience with information technologies, systems engineering, and software development.
- A contracted project manager is expected to have a solid level of commitment to the project to ensure that turnover does not hamper the deployment schedule, delivery milestones, or communications with the public sector client.

The following competencies are recommended to build the breadth and depth required for ITS Project Managers:

Competency Recommendations at the Awareness Level	Competency Recommendations at the Specialized Level
ITS Awareness **System Integration (1)** **Systems Analysis and Design (4)** **ITS Planning (8)** **Data Analysis and Management (10)** National ITS Architecture ITS Standards Software Development Software and Hardware Operations ITS Human Factors ITS Legal Issues Marketing /Public Relations	**Organizational/Institutional Change (2)** **Technology Options (3)** **Managing Contractors (5)** **Financing (6)** **Writing/Communications (7)** **Identifying Stakeholders/Building Coalitions (9)** Project Management Procurement Project Evaluation Transportation Fundamentals Partnerships Legislative and Policy Change Problem Solving Operations

Recommended Core Training and Education for Public Sector State DOT and City/County DOT ITS Project Managers

Awareness Training

- ✓ ITS Awareness Seminar (NHI or internet: http://www.nawgits.com/nawg/itsaware/)
- ✓ An Introduction: National ITS Architecture and Interim Guidance on Conformity (U.S. DOT)
- ✓ Deploying Integrated ITS — Metropolitan (NHI or internet: http://www.its.dot.gov/pcb/deploygd.htm)
- ✓ Deploying Integrated ITS — Rural (NHI)
- ✓ NTCIP and ITS Standards – What Do They Mean for You? (ITE)
- ✓ ITS and the Transportation Planning Process (NHI)
- ✓ ITS Public/Private Partnerships (NHI)
- ✓ ITS Telecommunications Overview (NHI)
- ✓ Lessons Learned in ITS Procurement (NHI)
- * Introductory courses on the software development process (U.S. DOT, vendors and universities)
- * Introductory courses on software integration (vendors and universities)
- * Introductory courses on systems engineering, installing and integrating hardware and software (vendors, universities, technical/vocational schools)
- * Introductory courses on data analysis, management and databases (U.S. DOT, universities)
- * Introductory courses on operating and maintaining networks and software, and inspection and testing of systems (vendors, technical/vocational schools)
- * Courses in public sector financial management: contracts, cost/benefit analysis, investment analysis, risk analysis, budgeting and accounting (U.S. DOT, universities, junior colleges)
- * Course in marketing/public relations basics (universities, junior colleges)
- ✓ Recommended reading in ITS Institutional and Legal Issues (EDL)
- ✓ Recommended reading in ITS and Human Factors (JPO)
- ◇ Workshop on ITS project evaluation, setting performance measures, acceptance testing of devices and systems, and cost/benefit analysis after deployment.
- ◇ Workshop on using and writing ITS contracts and ITS specifications
- ◇ Case studies on how local areas worked with legislators and appointed officials to change policies to incorporate ITS.

Specialized Training

- ✓ Using the National ITS Architecture for Deployment for the Public Sector (U.S. DOT)
- ✓ Standards Training Modules (U.S. DOT)
- ✓ Advanced Transportation Management Technology Workshop (FHWA)
- ✓ Managing Systems Integrators (ITSA)
- ✓ ITS Software Acquisition (NHI)
- ✓ ITS Telecommunications Analysis (NHI)
- ✓ Shared Resources for Telecommunications (NHI)
- ✓ Planning the Integration of Transit and Traffic ITS Applications (NTI)

ITS Topic Specific:

- ✓ Freeway Management Systems (NHI)
- ✓ Incident and Emergency Management Systems (NHI
- ◊ Advanced Traveler Information Systems
- ✓ Advanced Signal Control Systems (NHI)
- ◊ Electronic Toll Collection Systems
- ◊ Highway-Rail Crossings

Advanced Technology Options:

- ✓ Freeway Traffic Operations (NHI)
- ✓ Traffic Control Software and Signalization (NHI)
- ✓ Computerized Traffic Signal Systems (NHI)
- ✓ Advanced Traffic Signal Controllers (NHI)
- ✓ HOV Facilities (NHI)
- ✓ Use of the CORSIM Computer Traffic Simulation Model (U.S. DOT)
- ◇ Other models as they become available
- * Advanced course in writing business plans/ project plans, writing specifications (U.S. DOT, universities, professional associations)
- * Advanced course in negotiations (U.S. DOT, universities, professional associations)
- * Advanced course in procurement and legal issues (U. S. DOT)
- ◇ Seminar in ITS Legal Issues
- * Course in project management and change management (business schools, universities, professional associations)
- ✓ Recommended reading: Reports from ITS Federal Operational Tests and their evaluation strategies (EDL)

Recommended Core Training and Education for Public Sector Transit ITS Project Managers

Awareness Training

- ✓ ITS FTA in Transit (FTA)
- ✓ The National ITS Architecture: An Introduction for Senior FTA Staff (FTA)
- ✓ Deploying Integrated ITS — Metropolitan (NHI or internet: http://www.its.dot.gov/pcb/deploygd.htm)
- ✓ Deploying Integrated ITS — Rural (NHI)
- ✓ NTCIP and ITS Standards – What Do They Mean for You? (ITE)
- ✓ ITS and the Transportation Planning Process (NHI)
- ✓ ITS Public/Private Partnerships (NHI)
- ✓ ITS Telecommunications Overview (NHI)
- ✓ Lessons Learned in ITS Procurement (NHI)
- * Introductory courses on the software development process (U.S. DOT, vendors and universities)
- * Introductory courses on software integration (vendors and universities)
- * Introductory courses on systems engineering, installing and integrating hardware and software (vendors, universities, technical/vocational schools)
- * Introductory courses on data analysis, management and databases (U.S. DOT, universities)
- * Introductory courses on operating and maintaining networks and software, and inspection and testing of systems (vendors, technical/vocational schools)
- * Courses in public sector financial management: contracts, cost/benefit analysis, investment analysis, risk analysis, budgeting and accounting (U.S. DOT, universities, junior colleges)
- * Course in marketing/public relations basics (universities, junior colleges)
- ✓ Recommended reading in ITS and Institutional and Legal Issues (EDL)
- ✓ Recommended reading in ITS and Human Factors (JPO)
- ◇ Workshop on ITS project evaluation, setting performance measures, acceptance testing of devices and systems, and cost/benefit analysis after deployment.
- ◇ Workshop n using and writing ITS contracts and ITS specifications.
- ◇ Case studies on how local areas worked with legislators and appointed officials to change policies to incorporate ITS.

Specialized Training

- ✓ Transit Management Course (FTA)
- ✓ Using the National ITS Architecture for Deployment for the Public Sector (U.S. DOT)
- ✓ Standards Training Modules (U.S. DOT)
- ✓ Procuring New Technologies for Transit NTI)
- ✓ Managing Systems Integrators (ITSA)
- ✓ ITS Software Acquisition (NHI)
- ✓ ITS Telecommunications Analysis (NHI)
- ✓ Shared Resources for Telecommunications (NHI)
- ✓ Planning the Integration of Transit and Traffic ITS
- ✓ Intelligent Transportation Systems for Transit: Solving Real Problems (NTI)
- ✓ Transit Performance Evaluation: Using Information-Based Strategies (NTI)
- ✓ Reinventing Transit: Planning Information-Based Transit Services (NTI)

ITS Topic Specific:

- ✓ Advanced Public Transportation Systems (FTA, NTI)
- ◇ Electronic Fare Payment Systems
- ◇ Advanced Traveler Information Systems

- ◇ Use of planning models as they become available

Advanced Technology Options:

- ✓ NTI Workshops on Advanced Technologies and Innovative Practices for Transit (NTI)
- ✓ Geographic Information Systems: Transit Applications (NTI)Geographic Information Systems: Transit Applications (NTI)
- * Advanced course in writing business plans/ project plans, writing specifications (U.S. DOT, universities, professional associations)
- * Advanced course in negotiations (U.S. DOT, universities, professional associations)
- * Advanced course in procurement and legal issues (U.S. DOT)
- ◇ Seminar in ITS Legal Issues
- * Course in project management and change management (business schools, universities, professional associations)
- ✓ Recommended reading: Reports from ITS Federal Operational Tests and their evaluation strategies (EDL)

Recommended Core Training and Education for Private Sector ITS Project Managers

Awareness Training	
	✓ ITS Awareness Seminar (NHI or internet: http://www.nawgits.com/nawg/itsaware/) or ✓ ITS in Transit (FTA)
	✓ An Introduction: National ITS Architecture and Interim Guidance on Conformity (U.S. DOT) or ✓ The National ITS Architecture: An Introduction for Senior FTA Staff (FTA)
	✓ Deploying Integrated ITS — Metropolitan (NHI or internet: http://www.its.dot.gov/pcb/deploygd.htm) ✓ Deploying Integrated ITS — Rural (NHI)
	✓ NTCIP and ITS Standards – What Do They Mean for You? (ITE)
	✓ ITS and the Transportation Planning Process (NHI)
	✓ ITS Public/Private Partnerships (NHI)
	✓ ITS Telecommunications Overview (NHI)
	* Courses on project management (U.S. DOT, universities and junior colleges)
	* Course in marketing/public relations basics (universities, junior colleges)
	✓ Recommended reading in ITS Institutional and Legal Issues (EDL)
	✓ Recommended reading in ITS and Human Factors
	◇ Workshop on ITS project evaluation, setting performance measures, acceptance testing of devices and systems, and cost/benefit analysis after deployment

Specialized Training	
	✓ Using the National ITS Architecture for Deployment for the Private Sector (U.S. DOT)
	✓ Standards Training Modules (U.S. DOT)
	✓ ITS Software Acquisition (NHI)
	✓ ITS Telecommunications Analysis (NHI)
	✓ Shared Resources for Telecommunications (NHI)
	ITS Topic Specific: Depends on project type
	Advanced Technology Options: Depends on project type
	* Advanced course in negotiations (U.S. DOT, universities, professional associations)
	* Advanced course in procurement and legal issues (U.S. DOT)
	* Course in transportation engineering to learn vocabulary and fundamentals of traffic and/or transit (universities, transportation professional associations)
	✓ Use of the CORSIM Computer Traffic Simulation Model (U.S. DOT) ◇ Other planning models as they become available
	* Courses on the software development process (U.S. DOT, vendors and universities)
	* Advanced courses on software integration (vendors and universities)
	* Advanced courses on systems engineering, installing and integrating hardware and software (vendors, universities, technical/
	* Advanced courses on project management (U. S. DOT, universities and junior colleges)
	* Advanced courses on data management and databases (universities)
	* Advanced courses on operating and maintaining networks and software, and inspection and testing of systems (vendors, technical/
	* Courses in financial management: contracts, cost/benefit analysis, investment analysis, risk analysis, budgeting and accounting (U.S. DOT, universities, junior colleges)

ITS Curriculum — Software Developers

Role Description: The role of Software Developer within ITS deployment is emerging as one of the more critical ones since most ITS is dependent upon software for a wide variety of functions.

Some agencies will employ software developers to develop proprietary programs. Frequently, however, software development is not perceived to be a core competency in a public sector agency. On bigger and more complex projects, the agencies contract with a consultant or vendor who offers a mix of services, including software development.

Typical backgrounds of software developers are in computers and software engineering. It is critical for the software developer to have a good understanding of transportation fundamentals and mode-specific applications in order to develop software that is relevant to the agency. For instance, signal timing requires more than just LAN/WAN connections; it requires understanding how to time an intersection and the compounded effects of timed intersections on each other in terms of traffic flow. Again, the ability to work closely with the client aids in this understanding. They must also have in-depth knowledge of system analysis and design, the various technologies that will comprise the system, software and hardware operations, systems integration process and schedule, and data flow, analysis, and management issues.

Functions and Responsibilities:

- 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 the 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.

The following is a list of the recommended competencies to build the depth required for Software Developers:

Competency Recommendations at the Awareness Level	Competency Recommendations at the Specialized Level
ITS Awareness **Technology Options (3)** **Writing/Communications (7)** Project Management ITS Legal Issues Project Evaluation Operations Transportation Fundamentals	**Systems Integration (1)** **System Analysis and Design (4)** **Database Management and Analysis (10)** National ITS Architecture ITS Standards ITS Human Factors Software Development Software and Hardware Operations Problem Solving Systems Support and Maintenance

Recommended Core Training and Education for Software Developers

Awareness Training	
	✓ ITS Awareness Seminar (NHI or internet: http://www.nawgits.com/nawg/itsaware/) or ✓ ITS in Transit (FTA)
	✓ An Introduction: National ITS Architecture and Interim Guidance on Conformity (U.S. DOT) ✓ The National ITS Architecture: An Introduction for Senior FTA Staff (FTA)
	✓ Deploying Integrated ITS — Metropolitan (NHI or internet: http://www.its.dot.gov/pcb/deploygd.htm) ✓ Deploying Integrated ITS — Rural (NHI)
	✓ ITS Telecommunications Overview (NHI)
	✓ NTCIP and ITS Standards – What Do They Mean for You? (ITE)
	* Course in procurement and legal issues (U.S. DOT)
	* Course in writing business plans/project plans, writing specifications (U.S. DOT, universities, professional associations)
	* Courses on project management (U.S. DOT, universities and junior colleges)
	✓ Recommended reading in ITS Institutional and Legal Issues
	✓ Recommended reading in ITS and Human Factors (JPO)
	◇ Workshop on ITS project evaluation, setting performance measures, acceptance testing of devices and systems, and cost/benefits analysis after deployment. ✓ Transit Performance Evaluation: Using Information-Based Strategies (NTI)

Specialized Training	
	✓ Using the National ITS Architecture for Deployment for the Public Sector (U.S. DOT) or ✓ Using the National ITS Architecture for Deployment for the Private Sector (U.S. DOT)
	✓ Standards Training Modules (U.S. DOT)
	✓ Planning the Integration of Transit and Traffic ITS Applications (NTI)
	✓ ITS Telecommunications Analysis (NHI)
	Technology Options: ✓ Advanced Transportation Management Technology Workshop (FHWA) or ✓ Procuring New Technologies for Transit (NTI) and Geographic Information Systems: Transit Applications (NTI)
	* Advanced courses on software integration and performance testing (vendors and universities)
	* Courses on systems engineering, electrical engineering, telecommunications engineering, installing and integrating hardware and software, and testing methodologies (vendors, universities, technical schools)
	* Advanced courses on data analysis, management and databases (universities)
	* Courses on operating and maintaining networks and software, and inspection and testing of systems (vendors, technical/vocational schools)

ITS Curriculum — System Designers and Integrators

Role Description: Systems Designers and Integrators perform critical roles in ITS deployment. These roles require a broad technical understanding of ITS to be able to envision and connect hardware and technologies together and apply software applications to form working systems. It also means being able to integrate older "legacy" systems into operations. These roles also require a specific knowledge of how to design, install, integrate, operate, and test the technologies and systems being deployed. Knowledge of the fundamental principles of different types of engineering sciences is essential to these roles including:

- Electrical engineering;
- Telecommunications engineering;
- Systems engineering including systems architecture and standards;
- Software development including how software integrates with various ITS technologies;
- Hardware and wiring requirements;
- Relational databases and data sharing/data flow requirements.

Systems designers and integrators play complementary but different roles in ITS. Whereas one envisions and puts on paper the system to come, the other does hands-on application to make it happen. However, the competency set required is similar.

Functions and Responsibilities:

- Analyze existing infrastructure.
- Conduct user needs assessment; map out data flows to users.
- 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; provide designs for and connect devices through telecommunication wiring or wireless media.
- Install ITS technologies, ensuring functionality and quality control; bring together components to function as one system.
- Integrate technologies into 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.

Systems designers and integrators are predominantly employed in the private sector, although some professionals are employed by public sector transportation agencies. The competencies are similar, with the caveat that private sector designers and integrators must have a background in basic transportation fundamentals in order to understand why the transportation agency wants the system to function as it does, and to ensure that the system delivers the functions needed. The following is a list of the recommended competencies to build the breadth and depth required for Systems Designers and Integrators:

Competency Recommendations at the Awareness Level	Competency Recommendations at the Specialized Level
ITS Awareness **Writing/Communications (7)** ITS Legal Issues Project Management Procurement Operations, especially agency procedures Transportation Fundamentals	**Systems Integration (1)** **Organizational/Institutional Change (2)** **Technology Options (3)** **System Analysis and Design (4)** **Data Analysis and Management (10)** National ITS Architecture ITS Standards Software Development ITS Human Factors Software and Hardware Operations Problem Solving Project Evaluation

Recommended Core Training and Education for Systems Designers and Integrators

Awareness Training
✓ ITS Awareness Seminar (NHI or internet: http://www.nawgits.com/nawg/itsaware/) or ✓ ITS in Transit (FTA)
✓ An Introduction: National ITS Architecture and Interim Guidance on Conformity (U.S. DOT)
✓ Deploying Integrated ITS — Metropolitan (NHI or internet: http://www.its.dot.gov/pcb/deploygd.htm) ✓ Deploying Integrated ITS — Rural (NHI)
✓ ITS Telecommunications Overview (NHI)
✓ NTCIP and ITS Standards – What Do They Mean for You? (U.S. DOT)
Technology Options: ✓ Advanced Transportation Management Technology Workshop (FHWA) or ✓ Procuring New Technologies for Transit (NTI)
* Course in writing business plans/project plans, writing specifications (U.S. DOT, universities, professional associations
* Courses on project management (U.S. DOT, universities and junior colleges)
* Course in procurement and legal issues (U. S. DOT)
* Introductory course in transportation engineering to learn vocabulary and fundamentals of traffic and/or transit (universities, transportation professional associations)
✓ Recommended reading in ITS Institutional and Legal Issues (EDL)
✓ Recommended reading in ITS and Human Factors (EDL)
◇ Workshop on ITS project evaluation, setting performance measures, acceptance testing of devices and systems, and cost/benefit analysis after deployment
◇ Workshop on using and writing ITS specifications

Specialized Training
✓ Using the National ITS Architecture for Deployment for the Public Sector (U.S. DOT) or ✓ Using the National ITS Architecture for Deployment for the Private Sector (U.S. DOT)
✓ Standards Training Modules (U.S. DOT)
Advanced Technology Options: Depends on the type of ITS project
✓ ITS Telecommunications Analysis (NHI)
✓ Planning the Integration of Transit and Traffic ITS Applications (NTI)
✓ Lessons Learned in ITS Procurement (NHI)
ITS Topic Specific: Depends on project type
* Advanced courses on the software development process (U.S. DOT, vendors and universities)
* Advanced courses on software integration and performance testing (vendors and universities)
* Advanced courses on systems engineering, electrical engineering, telecommunications engineering, installing and integrating hardware and software, and testing methodologies (vendors, universities, technical/vocational schools)
* Advanced courses on data analysis, management and databases (universities)
* Advanced courses on operating and maintaining networks and software, and inspections and testing of systems (vendors, technical/vocational schools)
* Advanced courses on software and human factors (universities)
✓ Recommended reading: Reports from ITS Federal Operational Tests and their evaluation strategies (EDL)
* Course in project management and change management (business schools, universities)

ITS Curriculum — Operators

Role Description: Successful implementation of an ITS project results in more efficient operations of the existing transportation system. Operators are at the heart of the system, working at Transportation Management Centers at State and City/County DOTs or at Transit Operations Centers or Traveler Information Centers. They used to be predominantly public sector employees, but the recent wave of privatization has brought private sector firms in to manage these centers.

The role of the **operator within a management/operations center** is to ensure the smooth operation of the system, identify problems, and initiate and follow-through with responses. Operators use computers and video to monitor capacity and flow, collect data and make decisions in real-time for better management of the transportation system.

Traveler information center operators play a more limited role in delivering system information to the public. They respond to traveler's phone inquiries and maintain internet site and kiosk information. They manage the advanced traveler information systems which may include applications for cell phones, kiosks, variable message signs, the internet, etc.

Recent deployment experiences have revealed that operators should be included in the systems analysis and design process. Designers must consider what information they need, how the information is used, and how the operator is physically set-up to function in his/her space.

Operators require knowledge of basic transportation fundamentals and terminology, with extensive knowledge of the local transportation network and incident and emergency management procedures especially hazardous material diagnostics. These individuals must have good communication and problem-solving skills, and must be able to react quickly and rationally to an incident. Multi-tasking capabilities are also important for anyone performing one of these roles. Presentation skills are particularly important when interacting with the media.

Functions and Responsibilities:

- 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 call needs; offer suggestions for travel options.

The following is a list of the recommended competencies to build the breadth and depth required for Operators:

ITS Curriculum — Operators (cont'd)

Competency Recommendations at the Awareness Level	Competency Recommendations at the Specialized Level
ITS Awareness **Organizational/Institutional Change (2)** **Technology Options (3)** **Data Analysis and Management (10)** Marketing/Public Relations Systems Support and Maintenance Operations, especially agency procedures	**Writing/Communications (7)** Software and Hardware Operations Transportation Fundamentals ITS Topics: • Incident and Emergency Management Systems • Hazardous Materials • Freeway Management Systems • Advanced Public Transportation Systems Problem Solving

Recommended Core Training and Education for Operators

Awareness Training	
	✓ ITS Awareness Seminar (NHI or internet: http://www.nawgits.com/nawg/itsaware/) or ✓ ITS in Transit (FTA)
	Technology Options: Depends on the type of ITS project
	* Introductory courses on data analysis, management and databases (U.S. DOT, universities)

Specialized Training	
	* Course in the basics of public relations and public speaking (universities, junior colleges)
	* Courses on operating and minor troubleshooting of networks, hardware, and software (vendors, technical/vocational schools)
	* Courses on software applications such as word processing, spreadsheets, databases, or internet applications (junior colleges, universities, agency training programs, professional associations, software vendors)
	* Course in transportation engineering to learn vocabulary and fundamentals of traffic and/or transit (universities, transportation professional associations)
	* Advanced courses/certification in transportation operations (universities – e.g., CalPoly course, technical/vocational schools)
	ITS Topic Specific: Depends on type of management/operations/information center

ITS Curriculum — Dispatchers

Role Description: Dispatchers work closely with operators to manage fleets of vehicles that are critical in responding to: incidents, demand, or other problems. Dispatchers are predominantly public sector employees and are a mix of traditional and non-traditional transportation agency staff who work on-site at management/ operations centers as:

- Transit agency employees to dispatch buses.
- State and City/County DOT agency employees to dispatch tow trucks, snow plows, and other vehicles.
- Public safety employees to dispatch police, fire and emergency vehicles.
- Contractors hired as part of the operations staff at highway, traffic or transit agencies.

Dispatchers know where their vehicles are through vehicle location devices that are part of the system. Dispatchers help operators make decisions about the use of a vehicle and driver in mitigating a transportation system problem, such as an incident or increase in demand. They then make decisions as to how to get the vehicle in use or to a particular destination as quickly and safely as possible. Typically, dispatchers have risen through the ranks of highway and city patrol officers and others who have "road experience" and are familiar with the transportation network.

Moreso than operators, dispatchers are frequently engaged in cross-agency cooperation and team work. They must have an overall sense of the goal of operations, and be clear on the various agency operations procedures, and the potential jurisdictional issues and legal issues that might arise.

Functions and Responsibilities:

- 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.

The following is a list of the recommended competencies to build the breadth and depth required for Dispatchers:

Competency Recommendations at the Awareness Level	Competency Recommendations at the Specialized Level
ITS Awareness **Organizational/Institutional Change (2) and/or agency procedures** **Technology Options (3)** **Data Analysis and Management (10)** ITS Legal Issues Operations	Transportation Fundamentals Software and Hardware Operations Problem Solving ITS Specific Topics: • Incident Management • Hazardous Materials • Diagnostics and Procedures • Vehicle Diagnostics

Recommended Core Training and Education for Dispatchers

Awareness Training	
	✓ ITS Awareness Seminar (NHI or internet: http://www.nawgits.com/nawg/itsaware/) or ✓ ITS in Transit (FTA)
	Technology Options: Depends on the type of ITS project
	* Courses on data analysis, management and databases (U.S. DOT, universities)
	◇ Seminar on ITS Legal Issues

Specialized Training	
	* Courses on operating and minor trouble-shooting of networks, hardware, and soft-ware (vendors, technical/vocational schools)
	* Courses on software applications such as word processing, spreadsheets, databases, or internet applications (junior colleges, universities, agency training programs, pro-fessional associations, software vendors)
	* Course in transportation engineering to learn vocabulary and fundamentals of traffic and/or transit (universities, transportation professional associations)
	* Advanced courses/certification in transpor-tation operations (universities – e.g., the TMC Operators course at the California Polytechnic Institute, technical/vocational schools)
	ITS Topic Specific: Depends on type of man-agement/operations/information center but should include: ✓ Incident Management (NHI) ◇ Hazardous Materials ◇ Vehicle Diagnostics and Procedures

ITS Curriculum — Drivers

Role Description: "Drivers" include tow truck operators, law enforcement, emergency personnel, and transit drivers, among others. Drivers work closely with operators and dispatchers to respond to requests for assistance in emergencies or for increased demand. They are human probes on the roadway and report information and observations back to the management/operations center to supplement the data from the devices. They are also recipients of fully synthesized information from the center. Thus they must have good verbal communication skills. They also must be trained on the devices located on their vehicles for proper operations, downloading data, understanding how their data affects the system's management, and how the devices support them doing their job.

Functions and Responsibilities:

- 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.

The following is a list of the recommended competencies to build the breadth and depth required for Drivers:

Competency Recommendations at the Awareness Level	Competency Recommendations at the Specialized Level
ITS Awareness Transportation Fundamentals **Data Analysis and Management (10)** Operations	**Technology Options (3),** especially training on ITS devices ITS Topics: • Incident and Emergency Management • Hazardous Materials Management

Recommended Core Training and Education for Drivers

Awareness Training	✓ ITS Awareness Seminar (NHI or internet: http://www.nawgits.com/nawg/itsaware/) or ✓ ITS in Transit (FTA)
	* Courses on data analysis, management and databases (U.S. DOT, universities)
	* Introductory course in transportation engineering to learn vocabulary and fundamentals of traffic and/or transit (universities, transportation professional associations)

Specialized Training	* Training on ITS devices on vehicles (vendors)
	ITS Topic Specific: Depends on type of management/operations/information center but should include: ✓ Incident and Emergency Management (NHI) ◇ Hazardous Materials Management ◇ Vehicle Diagnostics

ITS Curriculum — Electronics Inspection and Maintenance Technicians

Role Description: Electronics inspection and maintenance technicians have traditionally maintained the electronics installed by contractors at the agency and in the field. Typically, contractors have trained public sector electronics technicians on the operation and the maintenance of the devices. Technicians are responsible for replacing and repairing devices that do not work and performing preventive maintenance on the technologies. With the advent of ITS, these individuals must be a greater part of the system design effort to ensure smooth integration of the ITS project into existing maintenance activities. This includes an involvement in the upfront stages of ITS planning, design and procurement where these technicians can provide important insight into:

- The technology selection process to ensure compatibility with existing devices and to plan for the inventory impact.
- Physical placement of the devices on the infrastructure to ensure ease of access, cost effective procedures of installation, and safety when making future repairs or expansions.
- The human factors of placing the equipment within the cabinets to ensure safety.

Functions and Responsibilities:

- Test and inspect construction and integration work, especially fiber optic splices and connections.
- Work with systems 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 on the infrastructure, as the human factors and safety considerations are particularly important for future repair and expansion.

The following competencies are recommended to build the ITS understanding required for electronics inspection and maintenance technicians:

Competency Recommendations at the Awareness Level	Competency Recommendations at the Specialized Level
ITS Awareness **Systems Integration (1)** **Organizational/Institutional Change (2)** **Systems Analysis and Design (4)** **Managing Contractors (5)** **Writing/Communications (7)** National ITS Architecture ITS Standards ITS Human Factors Project Evaluation Transportation Fundamentals	**Technology Options (3)** Software and Hardware Options Problem Solving Systems Support and Maintenance

Recommended Core Training and Education for Electronics Inspection and Maintenance Technicians

Awareness Training	
	✓ ITS Awareness Seminar (NHI or internet: http://www.nawgits.com/nawg/itsaware/) or ✓ ITS in Transit (FTA)
	✓ Deploying Integrated ITS — Metropolitan (NHI or internet: http://www.its.dot.gov/pcb/deploygd.htm) ✓ Deploying Integrated ITS — Rural (NHI)
	✓ An Introduction: National ITS Architecture and Interim Guidance on Conformity (U.S. DOT) or ✓ The National ITS Architecture: An Introduction for Senior FTA Staff (FTA)
	✓ NTCIP and ITS Standards – What Do They Mean for You? (U.S. DOT)
	✓ Lessons Learned in ITS Procurement (NHI)
	* Courses on software integration (vendors and universities)
	* Introductory courses on systems engineering, installing and integrating hardware and software, telecommunications engineering, electrical engineering (vendors, universities, technical/vocational schools)
	* Introductory course in verbal and written communications, presentations (universities, junior colleges)
	✓ Recommended reading in ITS and Human Factors (EDL)
	◇ Seminar on ITS Legal Issues
	◇ Workshop on ITS project evaluation, setting performance measures, acceptance testing of devices and systems, and cost/benefit analysis after deployment
	◇ Workshop on using and writing ITS specifications
	* Introductory course in transportation engineering to learn vocabulary and fundamentals of traffic and/or transit (universities, transportation professional associations)

Specialized Training	
	✓ Managing Systems Integrators (ITSA)
	✓ Standards Training Modules (U.S. DOT)
	Advanced Technology Options: Depends on the type of ITS project
	Advanced Technology Options: Depends on project type
	* Advanced courses on networks (vendors, universities, technical/vocational schools)
	* Advanced courses on repairing and maintaining electronics (vendors, universities, technical/vocational schools)

ITS Curriculum — Operations Managers/Supervisors

Role Description: The Operations Manager/Supervisor is responsible for running an operations center, referred to as Transportation Management Centers (TMCs) or Operations Centers (TOCs) depending on agency terminology. He/she determines operating procedures regarding signal controls and VMS message broadcasting based on congestion and incident data. This requires establishing decision-making procedures in cooperation with police, emergency staff, and other agency dispatchers. In the transit industry, this person actually manages the operation. For instance, the day-to-day transportation functions of a bus system are their responsibility.

These individuals must be adept at managing a rotating staff. They must have a strong understanding of the mission and the operational protocols of the TMC. In addition, they must be knowledgeable about the software, hardware, and operating systems, and experienced at troubleshooting technical problems and with incident management protocols. Most people at this level have come up through the ranks. They possess an in-depth knowledge of the existing system and its complexities and a strong transportation engineering background. Some of the interviewees had a traffic broadcasting background. Computer skills varied by agency.

Operations Managers/Supervisors step in as deployment activities turn to actual operations activities. They work closely with Project Managers to ensure that the system they inherit performs as needed, and continue to work with systems integrators and maintenance technicians to resolve operational needs.

Functions and Responsibilities:

- Managers:
  - Responsible for TMC Operations
  - Determine operating procedures including signals and VMS messages 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 TMC 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.

The following is a list of the recommended competencies to build the depth and breadth required for Operations Managers and Supervisors:

Competency Recommendations at the Awareness Level	Competency Recommendations at the Specialized Level
ITS Awareness **Writing/Communications (7)** **ITS Planning (8)** **Identifying Stakeholders/Building Coalitions (9)** **Data Analysis and Management (10)** ITS Standards Partnerships Marketing/Public Relations Project Management Project Evaluation ITS Human Factors	**Organizational/Institutional Change (2)** **Technology Options (3),** especially training on ITS devices **Managing Contractors (5)** **Financing (6)**, especially budgeting and accounting procedures Software and Hardware Operations Systems Support and Maintenance Problem Solving Operations

Recommended Core Training and Education for Operations Managers and Supervisors

Awareness Training	
	✓ ITS Awareness Seminar (NHI or internet: http://www.nawgits.com/nawg/itsaware/) or ✓ ITS in Transit (FTA)
	✓ Deploying Integrated ITS — Metropolitan (NHI or internet: http://www.its.dot.gov/pcb/deploygd.htm) ✓ Deploying Integrated ITS — Rural (NHI)
	✓ An Introduction: National ITS Architecture and Interim Guidance on Conformity (U.S. DOT) or ✓ The National ITS Architecture: An Introduction for Senior FTA Staff (FTA)
	✓ NTCIP and ITS Standards – What Do They Mean for You? (ITE)
	✓ ITS and the Transportation Planning Process (NHI)
	✓ ITS Public/Private Partnerships (NHI)
	If Transit Operations Manager: ✓ Intelligent Transportation Systems for Transit: Solving Real Problems (NTI) ✓ Reinventing Transit: Planning Information-Based Transit Services (NTI)
	* Courses on project management (U.S. DOT, universities and junior colleges)
	* Course in public relations and public speaking (universities, junior colleges)
	* Courses on data analysis, management and databases (U.S. DOT, universities)
	◇ Workshop on ITS project evaluation, setting performance measures, acceptance testing of devices and systems, and cost/benefit analysis after deployment
	* Recommended reading on ITS and Human Factors (JPO)

Specialized Training	
	Technology Options: ✓ Advanced Transportation Management Technology Workshop (FHWA) or ✓ Procuring New Technologies for Transit (NTI)
	Advanced Technology Options: Depends on project type
	If Transit Operations Manager: ✓ NTI Workshops on Advanced Technologies and Innovative Practices for Transit (NTI) and ✓ Geographic Information Systems: Transit Applications (NTI)
	✓ Managing Systems Integrators (ITSA)
	* Courses in public sector financial management: cost/benefit analysis, investment analysis, risk analysis, budgeting and accounting (U.S. DOT, universities, junior colleges)
	* Course in writing business plans/ project plans, writing specifications (U.S. DOT, universities, professional associations)
	* Courses on operating and maintaining networks and software, and inspection and testing of systems (vendors, technical/vocational schools)
	* Courses on software applications such as word processing, spreadsheets, databases, or internet applications (junior colleges, universities, agency training programs, professional associations, software vendors)
	* Course in transportation engineering to learn vocabulary and fundamentals of traffic and/ or transit (universities, transportation professional associations)
	* Course in change management (business schools, universities, professional associations)

ITS Curriculum — Business Analyst

Role Description: The position of Business Analyst is becoming increasingly important in ITS for numerous reasons. First, given the high costs of technology deployments, solid investment analysis must be done to "market" ITS projects to high-level decision-makers. In addition, innovative financing methods are increasingly being used. Partnership agreements require analysis of financial and investment risk. Decisions on technologies require cost/benefit analysis. Interviewees stressed the growing need to have this role filled within agencies and on projects.

Functions and Responsibilities:

- 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.

The following is a list of the recommended competencies to build the depth and breadth required for Business Analysts:

Awareness Level Competency Recommendations	Specialized Level Competency Recommendations
ITS Awareness **Technology Options (3)** **Writing/Communications (7)** **Data Analysis and Management (10)** ITS Legal Issues Legislative and Policy Change Procurement Software and Hardware Operations Transportation Fundamentals	**Organizational/Institutional Change (2)** **Financing (6)** Partnerships Project Evaluation

Recommended Core Training and Education for Business Analysts

Awareness Training	✓ ITS Awareness Seminar (NHI or internet: http://www.nawgits.com/nawg/itsaware/) or ✓ ITS in Transit (FTA)
	✓ Deploying Integrated ITS — Metropolitan (NHI or internet: http://www.its.dot.gov/pcb/deploygd.htm) ✓ Deploying Integrated ITS — Rural (NHI)
	✓ An Introduction: National ITS Architecture and Interim Guidance on Conformity (U.S. DOT) or ✓ The National ITS Architecture: An Introduction for Senior FTA Staff (FTA)
	Technology Options: Depends on the type of ITS project
	* Course in writing business plans/project plans, writing specifications (U.S. DOT, universities, professional associations)
	◇ Workshop on using and writing ITS contracts and ITS specifications
	* Courses on data analysis, management and databases (U.S. DOT, universities)
	◇ Seminar on ITS Legal Issues
	✓ Lessons Learned in ITS Procurement (NHI)
	* Course in procurement and legal issues (U.S. DOT) ✓ Procuring New Technologies for Transit (NTI)
	* Courses on software applications such as word processing, spreadsheets, databases or internet applications (junior colleges, universities, agency training programs, professional associations, software vendors)
	* Introductory course in transportation engineering to learn vocabulary and fundamentals of traffic and/or transit (universities, transportation professional associations)
	◇ Case studies from agencies who worked with their state, regional and local legislators and appointed officials to change policies to incorporate ITS
	* Course in change management (business schools, universities, professional associations)

Specialized Training	✓ Recommended reading in ITS Institutional and Legal Issues (EDL)
	* Advanced courses in public sector financial management: cost/benefit analysis, investment analysis, risk analysis, budgeting and accounting (U.S. DOT, universities, junior colleges)
	✓ Shared Resources for Telecommunications (NHI)
	✓ ITS Software Acquisition (NHI)
	✓ ITS Public/Private Partnerships (NHI)
	◇ Workshop on ITS project evaluation, setting performance measures, and cost/benefit analysis after deployment
	✓ Recommended reading: Reports from ITS Federal Operational Tests and their evaluation strategies (EDL)

ITS Curriculum — Data(base) Manager/Analyst

Role Description: Data(base) Managers/Analysts play a critical role in ITS operations and management given the breadth of data generated from advanced technologies. The proliferation of data collection devices, the need for public agencies to continually deliver "more for less", and the advances in database technology create a situation where so much information is available that it can tend to be overwhelming. The essence of any ITS device is the data that it produces, and the value of the system is closely related to how the data is used. Agencies need to apply the information they have gathered in ways that will improve their transportation systems, and better inform their decision-making processes. This is where the role of Data Managers and Analysts becomes critical.

Functions and Responsibilities:

- 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 decisionmaking.
- Report and disseminate data throughout organization; disseminate data results to other agencies.
- Resposible for overall quality and integrity of data generated and used by the system.
- Keep rpoject management well-informed of potential uses of data for planning, project evaluationa nd 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 and ITS standards.

The following is a list of the recommended competencies to build the depth and breadth required for Data(base) Managers and Analysts:

Competency Recommendations at the Awareness Level	Competency Recommendations at the Specialized Level
ITS Awareness **Organizational/Institutional Change (2)** **Technology Options (3)** **ITS Planning (8)** **Identifying Stakeholders/Building Coalitions (9)** National ITS Architecture ITS Standards ITS Human Factors, especially human interface design Transportation Fundamentals Operations	**Systems Integration (1)** **Systems Analysis and Design (4)** **Data Analysis and Management (10)** Software Development Software and Hardware Operations Problem Solving Systems Support and Maintenance

Recommended Core Training and Education for Data(base) Managers and Analysts

Awareness Training
✓ ITS Awareness Seminar (NHI or internet: http://www.nawgits.com/nawg/itsaware/) or ✓ ITS in Transit (FTA)
✓ Deploying Integrated ITS — Metropolitan (NHI or internet: http://www.its.dot.gov/pcb/deploygd.htm) ✓ Deploying Integrated ITS — Rural (NHI)
✓ An Introduction: National ITS Architecture and Interim Guidance on Conformity (U.S. DOT) or ✓ The National ITS Architecture: An Introduction for FTA Senior Staff (FTA)
✓ ITS Telecommunications Overview (NHI)
✓ NTCIP and ITS Standards – What Do They Mean for You? (ITE)
Technology Options: Depends on the type of ITS project
✓ ITS and the Transportation Planning Process (NHI)
If a Transit Manager: ✓ Intelligent Transportation Systems for Transit: Solving Real Problems (NTI) and ✓ Reinventing Transit: Planning Information-Based Transit Services (NTI) and ✓ Transit Performance Evaluation: Using Information-Based Strategies (NTI)
✓ Use of the CORSIM Computer Traffic Simulation Model (NHI) ◇ Other models as they become available
* Course in transportation engineering to learn vocabulary and fundamentals of traffic and/or transit (universities, transportation professional associations)
✓ Recommended reading in ITS Institutional and Legal Issues (EDL)
✓ Recommended reading on ITS and Human Factors (JPO)
* Introductory course on software and human factors

Specialized Training
✓ Using the National ITS Architecture for Deployment—Public Sector (U.S. DOT)
✓ Standards Training Modules (U.S. DOT)
✓ Planning the Integration of Transit and Traffic ITS Applications (NTI)
✓ ITS Telecommunications Analysis (NHI)
* Introductory course on the software development process (U.S. DOT, vendors and universities)
* Course on systems engineering, electrical engineering, telecommunications engineering, installing and integrating hardware and software, and testing methodologies (vendors, universities, technical/vocational schools)
* Advanced courses on data analysis management and databases (universities)
* Advanced courses on software applications such as basic language, databases, relational databases, queries and reports, or internet applications (junior colleges, universities, agency training programs, professional associations, software vendors)
* Courses on operating and maintaining networks and software, and inspection and testing of systems (vendors, technical/vocational schools)

ITS Curriculum — Contract Specialists

Role Description: Like traditional transportation capital improvement projects, ITS requires the use of contracts to procure necessary equipment and services. However, ITS equipment and services have proven to be unique to many procurement divisions in transportation agencies. Therefore, ITS contracts require different clauses and procurement methods. It also requires the ability and flexibility to contract for expertise that tends not to have a discrete time period or deliverable date.

Contract Specialists in ITS are those professionals who recognize all of these nuances, and know the agency's and state's legislative limitations well enough to figure out how to procure what they need for their ITS deployment. The contract specialist role is typically performed as part of the project manager's role, working in conjunction with their agency legal staff or, in some cases, even their state's attorney generals. However, there are agencies who employ acquisitions staff who will need to develop these competencies in order to provide effective contracts for ITS project contractors and technology purchases.

Functions and Responsibilities:

- Help prepare contracts.
- Incorporate clauses in contracts to address ITS issues including software ownership and Intellectual Property Rights.
- Select the most appropriate contract type for deployment.
- 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.

The following is a list of the recommended competencies to build the depth and breadth required for Contract Specialists:

Competency Recommendations at the Awareness Level	Competency Recommendations at the Specialized Level
ITS Awareness **Technology Options (3)** **Financing (6)** Partnerships Legislative and Policy Change Software Development Software and Hardware Operations	**Writing/Communications (7)** Procurement ITS Legal Issues

Recommended Core Training and Education for Contract Specialists

Awareness Training	
	✓ ITS Awareness Seminar (NHI or internet: http://www.nawgits.com/nawg/itsaware/) or ✓ ITS in Transit (FTA)
	✓ Deploying Integrated ITS — Metropolitan (NHI or internet: http://www.its.dot.gov/pcb/deploygd.htm) ✓ Deploying Integrated ITS — Rural (NHI)
	✓ An Introduction: National ITS Architecture and Interim Guidance on Conformity (U.S. DOT) or ✓ The National ITS Architecture: An Introduction for FTA Senior Staff (FTA)
	✓ NTCIP and ITS Standards – What Do They Mean for You? (ITE)
	Technology Options: Depends on the type of ITS project
	✓ ITS Public/Private Partnerships (NHI)
	✓ ITS Telecommunications Overview (NHI)
	* Courses in public sector financial management: Cost/benefit analysis, Risk analysis, Investment analysis, Budgeting and accounting (U.S. DOT, universities, junior colleges)
	* Introductory course on the software development process, software integration into a system, and performance measures for testing (U.S. DOT, vendors, universities)
	* Introductory course on operating and maintaining networks and software (vendors, technical/vocational schools)
	◇ Case studies from agencies who worked with their state, regional, and local legislators and appointed officials to change policies to incorporate ITS
	* ITS America's Legislative Affairs web site: http://www.itsa.org/legislative.html

Specialized Training	
	✓ Lessons Learned in ITS Procurement (NHI)
	✓ ITS Software Acquisition (NHI)
	✓ Shared Resources for Telecommunications (NHI) (as needed — depending on the type of project)
	* Advanced course in writing business plans/ project plans, writing specifications (U.S. DOT, universities, professional associations)
	* Course in procurement and legal issues (U. S. DOT)
	◇ Advanced workshop course in writing contracts for ITS procurements
	✓ Recommended reading in ITS Institutional and Legal Issues (EDL)

ITS Curriculum — Legal Staff

Role Description: Agency legal staffs are primarily involved in the preparation, review and execution of contracts, as well as an assessment of the project's risks and liabilities. Their up-front, as well as on-going involvement in understanding the project manager's role, and in the process of writing the RFPs and contracts for ITS can prove very valuable. Legal staff are responsible for helping project managers and agency executives understand the limits of the state's laws for using contracts as well as in approaching the state legislature for changes in law and policy. When legal staff were not aware of ITS issues, their review of the related contracts delayed the deployment process and they became obstacles to deployment.

Another role for legal staff in ITS is for negotiating such new situations as telecommunications leases or shared resource agreements. Their analysis of the potential liability that could arise from ITS deployments, and their assessment of the risk that it poses to the transportation agency can be invaluable, for instance, law suits that arise from providing route guidance in the instance of an accident or, privacy issues that arise from video enforcement.

Their expertise in the legal issues can come from involvement in an ITS deployment, learning from ITS America's legal issues committee, or even taking a class in specific areas that ITS introduces, such as software development law or intellectual property rights law Their law degree gives them the foundation to understand state laws and agency authority limitations, as well as for understanding contracting and the various types available.

Functions and Responsibilities:

- Review project specifications for liability issues in design.
- Review contracts for clauses and language supportive of ITS.

The following is a list of the recommended competencies to build the depth and breadth required for Legal Staff:

Competency Recommendations at the Awareness Level	Competency Recommendations at the Specialized Level
ITS Awareness **Technology Options (3)** **Financing (6)** Software Development Transportation Fundamentals	**Writing/Communications (7)** ITS Legal Issues Legislative and Policy Change Partnerships Procurement

Recommended Core Training and Education for Legal Staff

Awareness Training	
	✓ ITS Awareness Seminar (NHI or internet: http://www.nawgits.com/nawg/itsaware/) or ✓ ITS in Transit (FTA)
	✓ Deploying Integrated ITS — Metropolitan (NHI or internet: http://www.its.dot.gov/pcb/deploygd.htm) ✓ Deploying Integrated ITS — Rural (NHI)
	✓ An Introduction: National ITS Architecture and Interim Guidance on Conformity (U.S. DOT) ✓ The National ITS Architecture: An Introduction for FTA Senior Staff (FTA)
	✓ ITS Telecommunications Overview (NHI)
	✓ NTCIP and ITS Standards – What Do They Mean for You? (ITE)
	Technology Options: Depends on the type of ITS project
	* Courses in public sector financial management: cost/benefit analysis, investment analysis, risk analysis, budgeting and accounting (U.S. DOT, universities, junior colleges)
	* Courses on the software development process (U.S. DOT, vendors, universities)
	* Introductory course in transportation engineering to learn vocabulary and fundamentals of traffic and/or transit (universities, transportation professional associations)

Specialized Training	
	✓ Lessons Learned in ITS Procurement (NHI)
	✓ ITS Software Acquisition (NHI)
	✓ ITS Public/Private Partnerships (NHI)
	✓ Shared Resources for Telecommunications (NHI)
	* Course in procurement and legal issues (U. S. DOT)
	* Advanced course in writing business plans/ project plans, writing specifications, contracts (U.S. DOT, universities, professional associations)
	◇ Advanced workshop course in using and writing ITS contracts for ITS procurements
	◇ Case studies from agencies who worked with their state, regional, and local legislators and appointed officials to change policies to incorporate ITS
	* Course in change management (business schools, universities)

ITS Curriculum — Marketing/Public Relations Staff

Role Description: This role has become important given the need to publicize ITS to politicians, transportation officials and the general public. Marketing/Public Relations staff at public transportation agencies summarize ITS benefits and "lessons learned" in presentations targeted at high-level decision-makers, elected and appointed officials and the general public.

These individuals must have excellent communication skills. They must know how to communicate the benefits of ITS projects to high level decision-makers, elected and appointed officials, the general public and the press. This involves segmenting audiences and tailoring presentations to create "buy in". They can also be instrumental in promoting ITS internally, changing organizational behavior to a positive acceptance of ITS projects.

Functions and Responsibilities:

- 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.

The following is a list of the recommended competencies to build the depth and breadth required for Marketing / Public Relations Staff:

Competency Recommendations at the Awareness Level	Competency Recommendations at the Specialized Level
ITS Awareness **Organizational/Institutional Change (2)** **Technology Options (3)** **Identifying Stakeholders/Building Coalitions (9)** Legislative and Policy Change Transportation Fundamentals National ITS Architecture	**Writing/Communications (7)** Marketing/Public Relations

Recommended Core Training and Education for Marketing / Public Relations Staff

Awareness Training	✓ ITS Awareness Seminar (NHI or internet: http://www.nawgits.com/nawg/itsaware/) or ✓ ITS in Transit (FTA)
	✓ Deploying Integrated ITS — Metropolitan (NHI or internet: http://www.its.dot.gov/pcb/deploygd.htm) ✓ Deploying Integrated ITS — Rural (NHI)
	✓ An Introduction: National ITS Architecture and Interim Guidance on Conformity (U.S. DOT) or ✓ The National ITS Architecture: An Introduction for FTA Senior Staff (FTA)
	✓ NTCIP and ITS Standards – What Do They Mean for You? (ITE)
	Technology Options: Depends on the type of ITS project
	* Introductory course in transportation engineering to learn vocabulary and fundamentals of traffic and/or transit (universities, transportation professional associations)
	✓ Recommended reading in ITS Institutional and Legal Issues (EDL)
	◇ Case studies from agencies who worked with their state, regional, and local legislators and appointed officials to change policies to incorporate ITS

Specialized Training	* Advanced course in writing business plans/ project plans, writing specifications (U.S. DOT, universities, professional associations)
	* Advanced course in presentations and negotiations (U.S. DOT, universities, professional associations)
	* Advanced courses in marketing and public relations (universities, junior colleges)
	✓ Recommended reading: Marketing ITS Infrastructure in the Public Interest (EDL)

ITS Curriculum — Human Resources Staff

Role Description: Human Resources staff works closely with project managers to staff ITS teams. These individuals must know how to write job descriptions or adapt existing ones to include technical skills and responsibilities. They must also have a good understanding of salary scales to hire and retain staff needed for an ITS project.

Human Resource staff will see job classifications, descriptions and staff hiring trends change with ITS deployments. They must therefore be included in ITS PCB efforts.

A typical background includes knowledge of agency rules and regulations related to job classifications, descriptions and salary requirements. Backgrounds can also include either formal education in human resource management or many years of experience. If training is involved, a background in teaching is required.

Functions and Responsibilities:

- 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

The following is a list of the recommended competencies to build the depth and breadth required for Human Resources Staff:

Competency Recommendations at the Awareness Level	Competency Recommendations at the Specialized Level
ITS Awareness Transportation Fundamentals Software and Hardware Operations Operations, especially agency procedures	**Organizational/Institutional Change (2)** **Identifying Stakeholders/Building Coalitions (9)** Legislative and Policy Change Marketing/Public Relations

Recommended Core Training and Education for Human Resources Staff

Awareness Training	✓ ITS Awareness Seminar (NHI or internet: http://www.nawgits.com/nawg/itsaware/) or ✓ ITS in Transit (FTA)
	✓ ITS Public/Private Partnerships (NHI)
	* Introductory course in transportation engineering to learn vocabulary and fundamentals of traffic and/or transit (universities, transportation professional associations)
	* Courses on software applications such as word processing, spreadsheets, databases, or internet applications (junior colleges, universities, agency training programs, professional associations, software vendors)
	* Course in change management (business schools, universities)
	✓ Recommended reading in ITS Institutional Issues (EDL)

Specialized Training	✓ Deploying Integrated ITS — Metropolitan (NHI or internet: http://www.its.dot.gov/pcb/deploygd.htm) ✓ Deploying Integrated ITS — Rural (NHI)
	* Course in marketing/public relations basics (universities, junior colleges)
	◇ Case studies from agencies who worked with their state, regional, and local legislators and appointed officials to change policies to incorporate ITS

ITS Curriculum — Systems Administrators/Support Technicians

Role Description: Systems Administrators and Support Technicians maintain computer systems including servers, workstation clients, software, related hardware and un-interruptible power supply systems. They manage the networks — both technical (Computer Aided Dispatching, remote device control, and infrastructure monitoring) and administrative (user accounts, e-mail and system security). They plan, install, and maintain software, and provide upgrades. Typically this individual is a "jack of all trades" who ends up doing some programming, database or spreadsheet design, or scripting.

Given that ITS deployments can have extensive computer systems that collect, organize and disseminate information to different agency departments as well as other agencies, Systems Administrators and Support Technicians have added responsibilities in helping to manage the flow of data and help plan for its archiving, for which further professional capacity building may be needed.

Functions and Responsibilities:

- Work with systems designers to ensure technical and technological feasibility of design.
- Assist systems integrators and software developers with installation and testing, including the integration of software with the hardware systems.
- Assist with the evaluation of ITS deployments.
- Maintain data network and server, including data archiving and backups.
- Maintain and update hardware and software; troubleshoot systems hardware and software problems.
- Manage network; manage user accounts.
- In cooperation with electronic maintenance technicians, repair and replace ITS technologies.
- Follow maintenance procedures for prevention.

The following is a list of the recommended competencies to build the breadth and depth required for Systems Administrators and Support Technicians:

Competency Recommendations at the Awareness Level	Competency Recommendations at the Specialized Level
ITS Awareness **Systems Integration (1)** **Technology Options (3)** **Systems Analysis and Design (4)** **Writing/Communications (7)** **Data Analysis and Management (10)** Software Development ITS Legal Issues Project Evaluation Operations Transportation Fundamentals	Software and Hardware Operations Problem Solving Systems Support and Maintenance

Recommended Core Training and Education for Systems Adminstrators and Support Technicians

Awareness Training	
	✓ ITS Awareness Seminar (NHI or internet: http://www.nawgits.com/nawg/itsaware/) or ✓ ITS in Transit (FTA)
	✓ Deploying Integrated ITS — Metropolitan (NHI or internet: http://www.its.dot.gov/pcb/deploygd.htm) ✓ Deploying Integrated ITS — Rural (NHI)
	✓ An Introduction: National ITS Architecture and Interim Guidance on Conformity (U.S. DOT) ✓ The National ITS Architecture: An Introduction for Senior FTA Staff (FTA)
	✓ NTCIP and ITS Standards – What Do They Mean for You? (ITE)
	Technology Options: Depends on the type of ITS project
	✓ ITS Telecommunications Overview (NHI)
	✓ Planning the Integration of Transit and Traffic ITS Applications (NTI)
	* Introductory courses on systems engineering, electrical engineering, telecommunications engineering, installing and integrating hardware and software, and testing methodologies (vendors, universities, technical/vocational schools)
	* Introductory courses on software integration and performance testing (vendors and universities)
	* Course on data analysis, management and databases (universities)
	* Introductory course in transportation engineering to learn vocabulary and fundamentals of traffic and/or transit (universities, transportation professional associations)
	◇ Seminar on ITS Legal Issues

Specialized Training	
	If Transit Agency: ✓ Transit Performance Evaluation: Using Information-Based Strategies (NTI)
	* Courses on software applications such as word processing, spreadsheets, databases, or internet applications (junior colleges, universities, agency training programs, professional associations, software vendors)
	* Advanced courses (and/or certifications)on operating and maintaining networks and software, and inspection and testing of systems (vendors, technical/vocational schools)
	* Advanced courses (and/or certifications) on repairing and maintaining electronics (vendors, technical/vocational schools, universities)

ITS Curriculum — Program/Agency Managers

Role Description: Program/Agency Managers are higher level agency decision makers. Whereas Project Managers are concerned with daily project activities throughout all the stages of deployment, Program/Agency Managers are concerned with how the ITS projects fit in with or impact other agency work, agency staffing and functioning, organizational and institutional changes, funding, and policy reform and legislative changes that facilitate smoother deployments.

This role is important especially in the mainstreaming of ITS into the transportation planning process. The Program/Agency Manager can ensure that an agency considers ITS as possible solutions to transportation problems and that projects are compliant with federal regulations. They can help to identify federal, state, local, and private sector funding sources and apply for them. They can ensure that all legal conformity requirements are met, for example, that the technologies are using accepted standards and are consistent with the National ITS Architecture. They may have to explore the possibility of promoting legislative, organizational, or policy change to facilitate ITS deployments.

Functions and Responsibilities:

- Provide outreach and education to senior decision makers and appointed and/or elected officials.
- Work to diminish agency and institutional barriers.
- Build coalitions among agencies and with the private sector.
- Form working groups and task forces.

The following is a list of the recommended competencies to build the ITS breadth and depth required for Program/Agency Managers:

Competency Recommendations at the Awareness Level	Competency Recommendations at the Specialized Level
ITS Awareness **Technology Options (3)** **Systems Analysis and Design (4)** **ITS Planning (8)** **Data Analysis and Management (10)** National ITS Architecture ITS Standards Procurement ITS Legal Issues Project Management Software and Hardware Operations Operations	**Organizational/Institutional Change (2)** **Managing Contractors (5)** **Financing (6)** **Writing/Communications (7)** **Identifying Stakeholders/Building Coalitions (9)** Legislative and Policy Change Partnerships Marketing/Public Relations Problem Solving Transportation Fundamentals

Recommended Core Training and Education for Program / Agency Managers

Awareness Training	
	✓ ITS Awareness Seminar (NHI or internet: http://www.nawgits.com/nawg/itsaware/) or ✓ ITS in Transit (FTA)
	✓ Deploying Integrated ITS — Metropolitan (NHI or internet: http://www.its.dot.gov/pcb/deploygd.htm) ✓ Deploying Integrated ITS — Rural (NHI)
	✓ An Introduction: National ITS Architecture and Interim Guidance on Conformity (U.S. DOT) or ✓ The National ITS Architecture : An Introduction for Senior FTA Staff (FTA)
	T NTCIP and ITS Standards – What Do They Mean for You? (ITE)
	Technology Options: Depends on the type of ITS project
	✓ ITS and the Transportation Planning Process (NHI)
	For Transit Managers: ✓ Intelligent Transportation Systems for Transit: Solving Real Problems (NTI)
	✓ Planning the Integration of Transit and Traffic ITS Applications (NTI)
	✓ Lessons Learned in ITS Procurement (NHI)
	✓ ITS Telecommunications Overview (NHI)
	* Course in procurement and legal issues (U.S. DOT)
	* Introductory courses on the software development process, software integration, and performance measures and testing (U.S. DOT, vendors, and universities)
	* Introductory course on software applications such as databases, data analysis and management, and internet applications (junior colleges, universities, agency training programs, professional associations, software vendors)
	* Courses on project management (U.S. DOT, universities and junior colleges)
	* Introductory courses on operating and maintaining networks and software, and inspection and testing of systems (vendors, technical/vocational schools)

Specialized Training	
	✓ Managing Systems Integrators (ITSA)
	✓ ITS Public/Private Partnerships (NHI)
	✓ ITS Software Acquisition (NHI)
	✓ Lessons in ITS Procurement (NHI)
	* Courses in public sector financial management: cost/benefit analysis, investment analysis, risk analysis, budgeting and accounting (U.S. DOT, universities, junior colleges)
	* Advanced course in writing business plans/ project plans (U.S. DOT, universities, professional associations)
	* Course in marketing/public relations basics (universities, junior colleges)
	* Advanced course in negotiations (U.S. DOT, universities, professional associations)
	* Advanced course in transportation engineering to learn vocabulary and fundamentals of traffic and/or transit (universities, transportation professional associations)
	✓ Recommended reading in ITS Institutional and Legal Issues (EDL)
	◇ Seminar on ITS Legal Issues
	◇ Case studies from agencies who worked with their state, regional, and local legislators and appointed officials to change policies to incorporate ITS
	* ITS America's Legislative Affairs web site: http://www.itsa.org/legislative.html

ITS Curriculum — Inter-jurisdictional Coordinators

Role Description: Inter-jurisdictional Coordinators facilitate cooperative structured working arrangements with all participating stakeholders. This involves identifying and bringing on all necessary agencies which can include police, fire, emergency as well as State and local transportation organizations, and private sector firms. Given that metropolitan areas often cross many jurisdictions, this role is particularly important for traffic signal coordination and Transportation Management Center projects. A solid understanding of the ITS planning process as well as the legal issues involved in policy changes is important for this role. Given the nature of ITS projects, it requires working with many jurisdictions, establishing agreements, and defining roles and levels of coordination.

Metropolitan ITS projects often cross jurisdictions given their integrative features. Thus, an Inter-jurisdictional Coordinator, who often is also the project manager or regional champion, can coordinate with various parties to overcome organizational and institutional barriers.

Functions and Responsibilities:

- Facilitate integration across jurisdictions and agencies.
- Track regional ITS deployments to identify opportunities for integration, leveraging of resources, and elimination of redundancies.
- Bring stakeholders from various agencies on board.
- Assist with policy, rules, and regulations changes when needed.

The following is a list of the recommended competencies to build the breadth and depth required for Inter-jurisdictional Coordinators:

Competency Recommendations at the Awareness Level	Competency Recommendations at the Specialized Level
ITS Awareness National ITS Architecture ITS Standards Partnerships Procurement Operations Transportation Fundamentals	**Organizational/Institutional Change (2)** **Writing/Communications (7)** **ITS Planning (8)** **Identifying Stakeholders/Building Coalitions (9)** Legislative and Policy Change ITS Legal Issues

Recommended Core Training and Education for Inter-jurisdictional Coordinators

Awareness Training	
	✓ ITS Awareness Seminar (NHI or internet: http://www.nawgits.com/nawg/itsaware/) or ✓ ITS in Transit (FTA)
	✓ Deploying Integrated ITS — Metropolitan (NHI or internet: http://www.its.dot.gov/pcb/deploygd.htm) ✓ Deploying Integrated ITS — Rural (NHI)
	✓ An Introduction: National ITS Architecture and Interim Guidance on Conformity (U.S. DOT) or ✓ The National ITS Architecture: An Introduction for Senior FTA Staff (FTA)
	✓ NTCIP and ITS Standards – What Do They Mean for You? (ITE)
	✓ ITS Public/Private Partnerships (NHI)
	✓ ITS Telecommunications Overview (NHI)
	✓ Lessons Learned in ITS Procurement (NHI)
	* Introductory course in transportation engineering to learn vocabulary and fundamentals of traffic and/or transit (universities, transportation professional associations)

Specialized Training	
	✓ ITS and the Transportation Planning Process (NHI)
	✓ Planning the Integration of Transit and Traffic ITS Applications (NTI)
	✓ Shared Resources for Telecommunications (NHI)
	* Advanced course in writing business plans/ project plans, writing specifications (U.S. DOT, universities, professional associations)
	* Advanced course in negotiations (U.S. DOT, universities, professional associations)
	* Course in procurement and legal issues (U. S. DOT)
	✓ Recommended reading in ITS Institutional and Legal Issues (EDL)
	◇ Seminar on ITS Legal Issues
	◇ Case studies from agencies who worked with their state, regional, and local legislators and appointed officials to change policies to incorporate ITS
	* ITS America's Legislative Affairs web site: http://www.itsa.org/legislative.html

Definitions of ITS Competencies, Critical Knowledge & Skills, and Sources of PCB Training and Education

The following pages present a guide that identifies the available ITS training and education by competency. The guide also includes a more detailed definition of each competency, including a breakdown of the "bundled" critical knowledge and skills that comprise the competency. The top ten competencies are presented first, as it is assumed that these are the subjects most people will be interested in.

The training and education courses are listed using the same symbols as the curricula: a checkmark denotes courses that are identified and available with the presenting organization listed in parentheses; a star denotes courses, reading materials, and web sites that should be easily accessible from the organizations listed in parentheses; and a diamond denotes courses and reading materials that have not been identified. These courses and materials may exist or may need to be developed. Also included, is a notation where materials are available on the ITS Electronic Document Library (EDL).

Competency #1 - Systems Integration: A comprehensive transportation system comprises a number of smaller individual transportation organizations and their facilities. The "system" encompasses all of them, even though each is complete and functional in its own right. Systems integration refers to bringing together specific components or devices with the appropriate connections. These devices include mechanical, electrical, software, hardware, telecommunications, fiber optics, microwave components or radio. Each device's internal performance, its communication links to other devices and the system, the data input/output or manipulation, and the control mechanisms are part of a complex chain with many, potential "weak" links. The devices and the system as a whole must work properly and communicate accurately to the system with timely information to be of any use.

CRITICAL KNOWLEDGE AND SKILLS		**AVAILABLE TRAINING/EDUCATION**		
		From U.S DOT PCB Catalog		**Other Sources**
		What	**Access**	
Transportation and ITS deployment operations	Awareness	✓ Deploying Integrated ITS- Metropolitan	NHI	* Recommended reading: *Successful Approaches to Deploying a Metropolitan Intelligent Transportation System*, FHWA-JPO-99-032 (EDL)
		✓ Deploying Integrated ITS- Rural	NHI	
	Specialized	✓ Planning the Integration of Transit and Traffic ITS Applications	NTI	
National ITS Architecture and Interim Guidance on Conformity	Awareness	✓ An Introduction: National ITS Architecture and Interim Guidance on Conformity with Architecture and Standards	U.S. DOT	* Courses on National ITS Architecture, NTCIP, and ITS concepts offered by professional associations and vendors
		✓ The National ITS Architecture: An Introduction for FTA Senior Staff	FTA	
	Specialized	✓ Using the National ITS Architecture for Deployment -- Public	U.S. DOT	
		✓ Using the National ITS Architecture for Deployment -- Private	U.S. DOT	
		◇ Turbo Architecture	U.S. DOT	

(Systems Integration, cont' d)

Systems engineering and device configuration	Awareness			* Courses on systems engineering and electrical engineering offered by universities and vendors
	Specialized			
Telecommunications engineering	Awareness	✓ ITS Telecommunications Overview	NHI	* Recommended reading: JPO's *Telecommunications Resource Guide* * Courses on telecommunications engineering, networking and fiber optics offered by universities and vendors
	Specialized	✓ ITS Telecommunications Analysis	NHI	

Install and integrate hardware and software in networks and integration with existing systems	Awareness			* Courses on installing and integrating hardware and software, and testing methodologies offered by universities and vendors
				* Courses on inspecting, operating and maintaining networks and software offered by universities and vendors
				* Courses on the software development process offered by universities and vendors
				* Recommended reading:
				  * *Tracking the Deployment of the Integrated Metropolitan ITS Infrastructure in the USA: FY 1997 Results*, FHWA-JPO-99-001 (EDL)
				  * *Review of and Preliminary Guidelines for Integrating Transit into Transportation Management Centers*, DOT-T-94-25 (EDL)

	Specialized			
Data and database management	Awareness			* Courses on data analysis, management and databases offered by universities and professional associations
	Specialized	✓ Transit Performance Evaluation: Using Information-Based Strategies	NTI	
		✓ Geographic Information Systems: Transit Applications	NTI	
ITS Standards, protocols, and interfaces	Awareness	✓ NTCIP and ITS Standards – What Do They Mean for You?	ITE	
	Specialized	◇ National ITS Standards Training Modules	U.S. DOT	
Risk Analysis	Awareness			* Courses in public sector financial management: cost/benefit analysis, investment analysis, and risk analysis offered by U.S. DOT, universities or junior colleges
	Specialized		U.S. DOT	

(Systems Integration, cont' d)

Inspection and acceptance testing procedures, setting performance measures, quality assurance/quality control	Awareness			
	Specialized	◇ Workshop on setting ITS systems performance measures, and inspection and testing		
Electronics	Awareness	✓ Advanced Transportation Management Technology Workshop ✓ Procuring New Technologies for Transit ✓	FHWA NTI	
	Specialized	✓ Freeway Traffic Operations ✓ Traffic Control Software and Signalization ✓ Computerized Traffic Signal Systems ✓ Advanced Traffic Signal Controllers ✓ HOV Facilities ✓ Sensors, Data Exchange, and Interoperatility ✓ NTI Workshop on Advanced Technologies and Innovative Practices for Transit ✓ Geographic Information Systems: Transit Applications	NHI NHI NHI NHI NHI ITS America NTI NTI	
ITS project management	Awareness	◇ Workshop on bridging public-private sector differences		* Course in writing business plans and/ or project plans offered by U.S. DOT, universities or professional associations * Course in project management offered by U.S. DOT, universities or junior colleges * Course in negotiations offered by universities or professional associations
	Specialized	✓ Procuring and Managing Systems Integrators	ITSA	

Competency #2 – Organizational/institutional change: ITS will challenge agencies to change their mission and approach to operations as advanced technology deployments become more interagency and systems-oriented. Given that agencies are accustomed to operating based on modal thinking, institutional issues become the greatest non-technical barrier to ITS deployments. These issues will address how agencies can leverage funding, facilities and staff to avoid redundancies. It will also concern how agencies can plan, design, install, operate, and maintain ITS more effectively through the cooperation of multiple stakeholders.

CRITICAL KNOWLEDGE AND SKILLS		**Available Training/Education**		
		From DOT PCB Catalog		**Other Sources**
		What	**Access**	
Identifying Stakeholders/ Coalition Building (also, see competency definition on page 70)	Awareness	✓ ITS Awareness Seminar ✓ An Introduction: National ITS Architecture and Interim Guidance on Conformity with Architecture and Standards ✓ The National ITS Architecture: An Introduction for FTA Senior Staff ✓ Deploying Integrated ITS — Metropolitan ✓ Deploying Integrated ITS — Rural	NHI NHI	* Recommended reading: * *Successful Approaches to Deploying a Metropolitan Intelligent Transportation System*, FHWA-JPO-99-032 (EDL) * *The New York-New Jersey-Connecticut Metropolitan Model Deployment Initiative: A Review of the Initial Negotiations Process*, FHWA-JPO-98-033 (EDL)
	Specialized			
Understanding the Political Environment	Awareness			* Recommended reading: * *Traveling with Success: How Local Government Use Intelligent Transportation Systems*, FHWA-JPO-96-009 (EDL) * *ITS Market Resource Guide: Federal, State, and Local Contacts in ITS*, ITS America.
	Specialized			
Policy Skills	Awareness			
	Specialized			

(Organizational/Institutional Change, cont' d)

Financing	Awareness			* Courses in public sector financial management: cost/benefit analysis, investment analysis, risk analysis, budgeting and accounting offered by U.S. DOT, universities or junior colleges
	Specialized	✓ Shared Resources for Telecommunications ✓ ITS Software Acquisition	NHI NHI	
Project Evaluation	Awareness	✓ Transit Performance Evaluation: Using Information-Based Strategies	NTI	* Recommended reading: Reports from ITS Federal Operational Tests and their evaluation strategies (search on the EDL)
	Specialized	◇ Workshop on ITS project evaluation, setting performance measures, acceptance testing of devices and systems, cost/benefit analysis after deployment		
Partnerships	Awareness	✓ ITS Public/Private Partnerships	NHI	
	Specialized	✓ Shared Resources for Telecommunications	NHI	
Procurement	Awareness	◇ Lessons in ITS Procurement	U.S. DOT	* Courses in procurement and legal issues offered by U.S. DOT * Recommended reading in ITS Institutional and Legal Issues (search on the EDL)
	Specialized	✓ Procuring New Technologies for Transit ◇ Seminar on ITS Legal Issues ◇ Seminar on using and writing ITS contracts and ITS specifications	NTI	
Organizational change/ Change Management	Awareness			* Courses in change management offered by business schools, universities, or professional associations * Courses in marketing and public relations offered by universities or professional associations * Courses in negotiations offered by U.S. DOT, universities or professional associations
	Specialized			

Competency #3 - Technology Options: ITS introduces the application and use of advanced technologies into surface transportation. With most capital projects, transportation professionals have not required a background in high tech. However, in ITS, in order to understand the range of options available, new or enhanced skills to choose the most appropriate technology are needed. These technologies generally include communications and networks, computers and computing technologies that constitute information systems, diagnostics, electronics, and detection and surveillance technologies. Skills needed include understanding the nomenclature, specifications, functional use and limitations of the various technologies, and the difference between competing products or solutions.

CRITICAL KNOWLEDGE AND SKILLS		**Available Training/Education**		
		From DOT PCB Catalog		**Other Sources**
		What	**Access**	
Range of ITS technologies and Electronics	Awareness	✓ Intelligent Transportation Systems Awareness Seminar	NHI	
		✓ ITS in Transit	FTA	
	Specialized	✓ Advanced Transportation Management Technology Workshop	FHWA	
		✓ Incident Management	NHI	
		✓ Freeway Traffic Operations	NHI	
		✓ Traffic Control Software and Signalizations	NHI	
		✓ Computerized Traffic Signal Systems	NHI	
		✓ Advanced Traffic Signal Controller	NHI	
		✓ NTI Fellows Workshops on Advanced Technologies and Innovative Practices for Transit	NTI	
		✓ Procuring New Technologies for Transit	NTI	
		✓ High Occupancy Vehicle Facilities	NHI (TBD)	
		✓ Video Communications Systems	Vendors	
		✓ Traffic Management Systems	Vendors	
		✓ Traffic Surveillance Systems	Vendor	

(Technology Options, cont' d)

Technology benefits and performance assessment	Awareness			
	Specialized	◇ Use of the CORSIM Computer Traffic Simulation Model ◇ Other planning models ✓ Intelligent Transportation Systems for Transit: Solving Real Problems ✓ Reinventing Transit: Planning Information-Based Transit Services ✓ Transit Performance Evaluation: Using Information-Based Strategies	U.S. DOT NTI NTI NTI	
Writing specifications and procurement	Awareness			* Recommended reading: *The Road to Successful ITS Software Acquisition, Executive Summary* FHWA-JPO-98-037, *Volume 1: Overview and Themes,* FHWA-JPO-98-025, and *Volume 2: Software Acquisition Process Reference Guide,* FHWA-JPO-98-036 (EDL)
	Specialized	✓ ITS Software Acquisition ◇ Lessons Learned in ITS Procurement ◇ Seminar on using and writing ITS contracts and ITS specifications	NHI	
Repair and Maintenance	Awareness			* Courses on repairing and maintaining electronics offered by vendors, technical/vocational schools, universities * Repair and maintenance procedures manuals received from vendors
	Specialized			
Training on ITS devices and equipment	Awareness			* Courses offered by vendors after installation * Operations procedures manuals received from vendors
	Specialized			
Inspection and acceptance testing procedures, setting performance measures, quality assurance/quality control	Awareness			
	Specialized	◇ Workshop on setting ITS systems performance measures, and inspection and testing		

Competency #4 - Systems Analysis and Design: ITS requires designing systems using a comprehensive integrative approach. Include identifying user needs, analyzing the network infrastructure, and developing or adapting software. In doing this, it is important to clearly define what the system is expected to do now and in the future. Identification of technology risks and costs. The architecture can be used as a tool in the planning stages. One must fully analyze potential capabilities and limitations using a life cycle approach. Looking at investment costs, operations and maintenance costs, staffing and training are all important.

CRITICAL KNOWLEDGE AND SKILLS		AVAILABLE TRAINING/EDUCATION		
		From U.S DOT PCB Catalog		Other Sources
		What	Access	
Transportation and ITS deployment operations	Awareness	✓ Deploying Integrated ITS- Metropolitan	NHI	* Recommended reading: *Successful Approaches to Deploying a Metropolitan Intelligent Transportation System*, FHWA-JPO-99-032 (EDL)
		✓ Deploying Integrated ITS- Rural	NHI	
	Specialized	✓ Planning the Integration of Transit and Traffic ITS Applications	NTI	
User Needs Assessments	Awareness			* Workshops on conducting user needs assessments offered by universities, continuing education programs, or professional associations
	Specialized			
National ITS Architecture and Interim Guidance on Conformity	Awareness	✓ An Introduction: National ITS Architecture and Interim Guidance on Conformity with Architecture and Standards	U.S. DOT	* Courses on National ITS Architecture, NTCIP, and ITS concepts offered by professional associations and vendors
		✓ The National ITS Architecture: An Introduction for FTA Senior Staff	FTA	
	Specialized	✓ Using the National ITS Architecture for Deployment -- Public	U.S. DOT	
		✓ Using the National ITS Architecture for Deployment -- Private	U.S. DOT	
		◇ Turbo Architecture	U.S. DOT	

(Systems Analysis and Design, cont' d)

Systems engineering and device configuration	Awareness			* Courses on systems engineering and electrical engineering offered by universities and vendors
	Specialized			
Telecommunications engineering	Awareness	✓ ITS Telecommunications Overview	NHI	✓ Recommended reading: JPO's *Telecommunications Resource Guide* * Courses on telecommunications engineering, networking and fiber optics offered by universities and vendors
	Specialized	✓ ITS Telecommunications Analysis	NHI	

Install and integrate hardware and software in networks and integration with existing systems	Awareness			* Courses on installing and integrating hardware and software, and testing methodologies offered by universities and vendors
				* Courses on inspecting, operating and maintaining networks and software offered by universities and vendors
				* Courses on the software development process offered by universities and vendors
				* Recommended reading:
				  * *Tracking the Deployment of the Integrated Metropolitan ITS Infrastructure in the USA: FY 1997 Results*, FHWA-JPO-99-001 (EDL)
				  * *Review of and Preliminary Guidelines for Integrating Transit into Transportation Management Centers*, DOT-T-94-25 (EDL)

	Specialized			
Data and database management	Awareness			* Courses on data analysis, management and databases offered by universities and professional associations
	Specialized	✓ Transit Performance Evaluation: Using Information-Based Strategies ✓ Geographic Information Systems: Transit Applications	NTI NTI	
ITS Standards, protocols, and interfaces	Awareness	✓ NTCIP and ITS Standards – What Do They Mean for You?	ITE	
	Specialized	◇ National ITS Standards Training Modules	U.S. DOT	
Analysis	Awareness			Courses in analysis: cost/benefit analysis, investment analysis, and risk analysis offered by U.S. DOT, universities or junior colleges
	Specialized		U.S. DOT	

(Systems Analysis and Design, cont' d)

Inspection and acceptance testing procedures, setting performance measures, quality assurance/quality control	Awareness			
	Specialized	◇ Workshop on setting ITS systems performance measures, and inspection and testing		
Electronics	Awareness	✓ Advanced Transportation Management Technology Workshop ✓ Procuring New Technologies for Transit ✓	FHWA NTI	
	Specialized	✓ Freeway Traffic Operations ✓ Traffic Control Software and Signalization ✓ Computerized Traffic Signal Systems ✓ Advanced Traffic Signal Controllers ✓ HOV Facilities ✓ Sensors, Data Exchange, and Interoperatility ✓ NTI Workshop on Advanced Technologies and Innovative Practices for Transit ✓ Geographic Information Systems: Transit Applications	NHI NHI NHI NHI NHI ITS America NTI NTI
ITS project management	Awareness	◇ Workshop on bridging public-private sector differences		* Course in writing business plans and/ or project plans offered by U.S. DOT, universities or professional associations * Course in project management offered by U.S. DOT, universities or junior colleges * Course in negotiations offered by universities or professional associations
	Specialized	✓ Procuring and Managing Systems Integrators	ITSA	

Competency #5 - Managing Contractors: Many state and local transportation agencies must train in-house staff to manage contractors on ITS projects. First, many agencies have hiring freezes and/or are downsizing leaving many advanced technology projects designed and installed by contractors. Second, university and college graduate transportation programs are not preparing students in the advanced technology skills needed to deploy ITS. Third, given that the hi-tech industry is intensely competitive, it is hard to attract electrical engineers and software developers to the public service given government salary caps. This leaves agencies with many mid-level staff that need to be trained to manage contractors on unfamiliar technology projects.

CRITICAL KNOWLEDGE AND SKILLS		**Available Training/Education**		
		From DOT PCB Catalog		**Other Sources**
		What	**Access**	
ITS project management	Awareness	◇ Workshop on bridging public-private sector differences		* Recommended reading: *Successful Approaches to Deploying a Metropolitan Intelligent Transportation System*, FHWA-JPO-99-032 (EDL)
	Specialized	✓ Procuring and Managing Systems Integrators	ITSA	
Procurement	Awareness	◇ Lessons in ITS Procurement	U.S. DOT	* Courses in procurement offered by U.S. DOT
	Specialized	✓ Procuring New Technologies for Transit ◇ Workshop on using and writing ITS contracts and ITS specifications	NTI	
Organizational/ Institutional Issues	Awareness	◇ Workshop on bridging public-private sector differences		* Recommended reading in ITS institutional and legal issues (search on the EDL) * Courses in change management offered by business schools, universities or professional associations * Courses in negotiations offered by U.S. DOT, universities, or professional associations
	Specialized			

Competency #6 - Financing: Currently funding is designated to specific transportation agencies. This "stove-piped" approach inhibits interagency cooperation on ITS projects. Funding mechanisms need to change to alleviate this barrier. Innovative financing such as new tolls, video enforcement ticketing, user fees, and public-private partnerships can also assist in financing ITS projects. Agencies could also initiate new procurement strategies that would leverage their positions to purchase technologies at low cost. Need for funding systems operations and maintenance. Many times funds have been provided to design and install a system but the high costs for operations and maintenance makes running the system prohibitive.

CRITICAL KNOWLEDGE AND SKILLS		**Available Training/Education**		
		From DOT PCB Catalog		**Other Sources**
		What	**Access**	
TEA-21 planning and financing provisions	Awareness	✓ ITS and the Transportation Planning Process	NHI	
	Specialized			
Investment analysis and benefit-cost analysis	Awareness	✓ Intelligent Transportation Systems Awareness Seminar	NHI	* Courses in public sector financial management: cost/benefit analysis, investment analysis, and risk analysis offered by U.S. DOT, universities or junior colleges
	Specialized	✓ Transit Performance Evaluation: Using Information-Based Strategies ✓ Reinventing Transit: Planning Information-Based Transit Services ✓ Intelligent Transportation Systems for Transit: Solving Real Problems	NTI NTI NTI	
Risk analysis	Awareness			* Courses in public sector financial management: cost/benefit analysis, investment analysis, and risk analysis offered by U.S. DOT, universities or junior colleges
	Specialized			

(Financing, cont' d)

Procurement	Awareness	◇ Lessons in ITS Procurement	U.S. DOT	
	Specialized	✓ Procuring New Technologies for Transit ✓ Procuring and Managing Systems Integrators ◇ Workshop on using and writing ITS contracts and ITS specifications	NTI ITS America	* Recommended reading: * *Innovative Contracting Practices for ITS, Executive Summary*, L.S. Gallegos & Associates, Inc (EDL) * *The Road to Successful ITS Software Acquisition, Executive Summary*, FHWA-JPO-98-037, *Volume 1: Overview and Themes*, FHWA-JPO-98-025, and *Volume 2: Software Acquisition Process Reference Guide*, FHWA-JPO-98-036 (EDL)
Identifying Sources of Funding	Awareness			* Technical assistance from U.S. DOT headquarters, FTA Regional Office ITS Specialists, and FHWA Resource Center and Division Office ITS Specialists
	Specialized			

Competency #7 – Writing/Communications: ITS requires precision and effective interactions between individuals in internal and external organizations. It includes verbal and written communications, including oral presentations and report writing. Negotiations are about persuading individuals to consider an issue or line of reasoning. The types of documents that are important include RFPS, contracts, MOUs, specifications writing, and requirements writing.

CRITICAL KNOWLEDGE AND SKILLS		**Available Training/Education**		
		From DOT PCB Catalog		**Other Sources**
		What	**Access**	
Writing specifications and RFPs for ITS projects	Awareness			* Course in writing business plans or project plans offered by U.S. DOT, universities or professional associations
	Specialized	◇ Workshop on using and writing ITS contracts and ITS specifications		
Negotiations	Awareness			* Courses in negotiations offered by U.S. DOT, universities, professional associations
	Specialized			
Managing contractors	Awareness	◇ Workshop on bridging public-private sector differences		
	Specialized	✓ Procuring and Managing Systems Integrators	ITS America	
Technical and Legal issues associated with writing RFPs for ITS deployment	Awareness			* Course on Intellectual Property Rights, Copyrights and Patents from law schools * Recommended reading in ITS institutional and legal issues (search on the EDL)
	Specialized	✓ ITS Software Acquisition ◇ Seminar on ITS Legal Issues	NHI	

Competency #8 - ITS Planning: As ITS capabilities become ready for deployment through the use of regular funding sources, they will encounter the established transportation planning and programming process, requiring choices among competing projects within financial and other constraints. ITS introduces the need for transportation agencies to work more closely to achieve a common regional vision in planning and operations for the transportation system. ISTEA and TEA-21 strongly encourage alternatives to traditional transportation construction. ITS does not change the well-developed planning process. Rather, it necessitates new considerations of ITS projects as alternatives and complements to more traditional capital projects. ITS introduces new federal requirements through the long-range plans (LRPs) and transportation improvement programs (TIPs). It also requires a change in focus from less capital construction to more effective management of the existing transportation network. The role of planning in ITS deployments has increased with ISTEA and TEA-21 to focus on more regional operations and management.

CRITICAL KNOWLEDGE AND SKILLS		**Available Training/Education**		
		From DOT PCB Catalog		**Other Sources**
		What	**Access**	
Developing a Regional Concept of Operations for ITS and Mainstreaming ITS	Awareness	✓ ITS and the Transportation Planning Process ✓ An Introduction: The National ITS Architecture and Interim Guidance on Conformity with Architecture and Standards ✓ The National ITS Architecture: An Introduction for FTA Senior Staff	NHI NHI FTA	* Recommended reading: * *Integrating Intelligent Transportation Systems within the Transportation Planning Process: An Interim Handbook*, FHWA-SA-98-048 (EDL) * *Streamlining ITS Planning, Identifying Common Needs: National ITS Architecture*, FHWA-JPO-99-013 (EDL# 6865) * *Tracking the Deployment of the Integrated Metropolitan ITS Infrastructure in the USA: FY 1997 Results*, FHWA-JPO-99-001 (EDL)
	Specialized	✓ Planning the Integration of Transit and Traffic ITS Applications	NTI	
Transportation Planning fundamentals	Awareness			* Courses on planning, land use, and transportation offered by universities and professional associations
	Specialized			

(ITS Planning, cont' d)

Project Evaluation and Analysis	Awareness	✓ Intelligent Transportation Systems Awareness Seminar	NHI	* Courses in analysis: cost/benefit analysis, investment analysis, risk analysis offered by universities, professional associations or junior colleges * Recommended reading: Reports from ITS Federal Operational Tests and their evaluation strategies (search on the EDL)
	Specialized	✓ Reinventing Transit: Planning Information-Based Transit Services ✓ Transit Performance Evaluation: Using Information-Based Strategies ✓ Use of the CORSIM Computer Traffic Simulation Model ◇ Workshop on ITS project evaluation, setting performance measures, acceptance testing of devices and systems, and cost/benefit analysis after deployment	NTI NTI U.S. DOT	
GIS and mapping	Awareness			
	Specialized	✓ Geographic Information Systems: Transit Applications	NTI	
Negotiations	Awareness			* Course in negotiations offered by U.S. DOT, universities or professional associations
	Specialized			
Environmental and Societal Impacts	Awareness			
	Specialized	◇ Workshop in analyzing the environmental impacts of ITS including air quality, noise, energy and environmental justice		

Competency #9 - Identifying Stakeholders/Building Coalitions: ITS requires that transportation agencies, firms, and professionals who are involved in the shift to systems operations and management work in cooperation with one another. This requires setting goals and developing a regional concept of operations together. Frequently, ITS includes stakeholders from non-transportation agencies, such as law enforcement and emergency personnel.

CRITICAL KNOWLEDGE AND SKILLS		**Available Training/Education**		
		From DOT PCB Catalog		**Other Sources**
		What	**Access**	
Developing a Regional Concept of Operations for ITS	Awareness	✓ Deploying Integrated ITS- Metropolitan ✓ Intelligent Transportation Systems Awareness Seminar ✓ Deploying Integrated ITS- Rural	NHI NHI NHI	* Systems engineering courses offered by vendors and universities * Recommended reading: *Successful Approaches to Deploying a Metropolitan Intelligent Transportation System*, FHWA-JPO-99-032 (EDL)
	Specialized	✓ Shared Resources for Telecommunications ✓ Planning the Integration of Transit and Traffic ITS Applications	NHI NTI	
Planning fundamentals	Awareness	✓ ITS and the Transportation Planning Process	NHI	* Recommended reading: Reports from ITS Federal Operational Tests and their evaluation strategies (search on the EDL)
	Specialized	✓ Reinventing Transit: Planning Information-based Transit Services ✓ Planning the Integration of Transit and Traffic ITS Applications	NTI NTI	
User Needs Assessments	Awareness			* Workshops on conducting user needs assessments offered by universities, continuing education programs, or professional associations
	Specialized			
Partnerships and Coalition building	Awareness	✓ ITS Public/Private Partnerships	NHI	
	Specialized	✓ Shared Resources for Telecommunications	NHI	

(**Identifying Stakeholders/Building Coalitions, cont' d)**

Negotiations	Awareness			* Courses in negotiations offered by U.S. DOT, universities or professional associations
	Specialized			
ITS project management	Awareness	◇ Workshop on bridging public-private sector differences		
	Specialized	✓ Procuring and Managing Systems Integrators	ITSA	

Competency #10 - Data Analysis and Management: Many transportation professionals desire to understand what data might be produced and how it might be utilized in decision-making. Data can be used to determine traffic trends, patterns and growth for planning, operations and maintenance staff. Data analysts and managers must first look at how data is distributed within and amongst agencies to see if systems are compatible. Linkages might have to be made amongst agencies to see if systems are compatible. Linkages might have to be made amongst systems thus adding a step in conversion and translation of data from one system to the next. The proliferation of data collection devices and advances in database technologies creates a situation in which so much information is available that it can be overwhelming. The value of the system is closely related to how the data is managed. Effective use involves issues such as one-way data sharing versus multiple and real-time sharing as well as data consistency and accuracy, archiving and storage, analysis and interpretation, and privacy.

CRITICAL KNOWLEDGE AND SKILLS		**Available Training/Education**		
		From DOT PCB Catalog		**Other Sources**
		What	**Access**	
National ITS Architecture and Data sharing between agencies	Awareness	✓ An Introduction: National ITS Architecture and Interim Guidance on Conformity with Architecture and Standards ✓ The National ITS Architecture: An Introduction for FTA Senior Staff	U.S. DOT FTA	* Courses on National ITS Architecture, NTCIP, and ITS concepts offered by vendors
	Specialized	◇ Turbo Architecture	U.S. DOT	
Transportation and ITS deployment operations	Awareness	✓ Deploying Integrated ITS- Metropolitan ✓ Deploying Integrated ITS- Rural	NHI NHI	* Systems engineering courses offered by vendors and universities
	Specialized	✓ Planning the Integration of Transit and Traffic ITS Applications	NTI	
Protocols, standards, and interfaces	Awareness	✓ NTCIP and ITS Standards -- What Do They Mean for You?	ITE	
	Specialized	◇ National ITS Standards Training Modules		
Testing procedures, setting performance measures, quality assurance/quality control on databases and software once integrated	Awareness			
	Specialized	◇ Workshop on setting ITS systems performance measures, and inspection and testing		

(Data Analysis and Management, cont' d)

Data and database management, maintenance and archiving	Awareness			* Courses on building databases and relational databases offered by universities
				* Recommended reading:
				  * *ITS As A Data Resource: Preliminary Requirements for a User Service* (EDL)
				  * *Archived Data User Services (ADUS): An Addendum to the ITS Program Plan, Final Version,* (EDL)

	Specialized	✓ Transit Performance Evaluation: Using Information-Based Strategies ✓ Geographic Information Systems: Transit Applications	NTI NTI	

Install and integrate hardware and software in networks and ensure systems security	Awareness	✓ ITS Software Acquisition	NHI	* Courses on installing and integrating hardware and software, and testing methodologies offered by universities and vendors
				* Courses on inspecting, operating and maintaining networks and software offered by universities and vendors
				* Courses on the software development process offered by universities and vendors
				* Recommended reading:
				  * *Protecting Our Transportation Systems: An Information Security Awareness Overview*, FHWA-JPO-98-005 (EDL)
				  * *The Road to Successful ITS Software Acquisition, Executive Summary* FHWA-JPO-98-037, *Volume 1: Overview and Themes*, FHWA-JPO-98-025, and *Volume 2: Software Acquisition Process Reference Guide*, FHWA-JPO-98-036 (EDL)
				  * *Protecting Our Transportation Systems: An Information Security Awareness Overview,* FHWA-JPO-98-005 (EDL)

	Specialized			
Training on the use of databases	Awareness			* Courses offered by database developers after installation and integration * Operations procedures manuals received from vendors
	Specialized			

ITS Awareness: The introduction of ITS has required that new disciplines bring unfamiliar knowledge and skills to the transportation industry. An understanding of what ITS is comprised of and the scope of the program and its goals, is a critical and basic element in achieving effective and successful ITS deployments and operations. ITS Awareness is the one competency area that is not a mix of knowledge and skills. Instead, it is being cognizant of ITS and having:

- an understanding of what ITS is, why it came about, and what it achieves;
- vocabulary and terminology that is common to ITS;
- a working definition of ITS — the components, how they fit together, and methods of deploying and operating;
- a sense of the role transportation professionals and their agencies perform in deploying and operating the transportation system with ITS, and;
- an understanding of the benefits that result from systems operations and management of the transportation system and from interagency cooperation to achieve intermodalism;
- an understanding of the ITS program areas applicable to the type of planned deployment (each program area has its own page at the end of this resource guide).

CRITICAL KNOWLEDGE AND SKILLS		**Available Training/Education**		
		From DOT PCB Catalog		**Other Sources**
		What	**Access**	
Awareness	Awareness	✓ Intelligent Transportation Systems Awareness Seminar	NHI or internet	* Recommended reading: * *1996 ITS Report to Congress*, FHWA-JPO-97-026 (EDL) * *1997 ITS Report to Congress*, FHWA-JPO-98-034 (EDL) * *ITS Benefits: Continuing Successes and Operational Test Results*, FHWA-JPO-98-002 (EDL) * *Successful Approaches to Deploying a Metropolitan Intelligent Transportation System*, FHWA-JPO-99-032 (EDL)
	Specialized	✓ Deploying Integrated ITS—Metropolitan	NHI	
		✓ Deploying Integrated ITS—Rural	NHI	

National ITS Architecture: To realize the full potential of ITS, a unified framework for integration, called "the National ITS Architecture" was developed to guide the coordinated deployment of ITS by public agencies and private organizations alike. The National ITS Architecture defines the functions performed by ITS components and the various ways in which they can be interconnected. The Architecture is a tool that allows agencies to envision systems, and design projects and deployment approaches for meeting near-term needs while keeping options open for eventual system expansion and integration. The National ITS Architecture does not represent a specific design. Rather, it provides decision points from which stakeholders can work together to make the vision of a unified ITS for their region a reality. The Architecture provides choices that allow deployments to be tailored to localized needs and preferences. The Architecture provides advice on where standards are useful for ensuring interoperability.

CRITICAL KNOWLEDGE AND SKILLS		**Available Training/Education**		
		From DOT PCB Catalog		**Other Sources**
		What	**Access**	
National ITS Architecture and Interim Guidance on Conformity with Architecture and Standards	Awareness	✓ An Introduction: National ITS Architecture and Interim Guidance on Conformity with Architecture and Standards ✓ The National ITS Architecture: An Introduction for FTA Senior Staff	U.S. DOT FTA	* Courses on National ITS Architecture, NTCIP, and ITS concepts offered by vendors * Recommended reading: *Streamlining ITS Planning, Identifying Common Needs: National ITS Architecture*, FHWA-JPO-99-013 (EDL# 6865)
Use of the Architecture in planning and design	Specialized	✓ Using the National ITS Architecture for Deployment — Public Sector ✓ Using the National ITS Architecture for Deployment — Private Sector ◇ Turbo Architecture	U.S. DOT U.S. DOT U.S. DOT	* Recommended reading: * *Developing ITS Using the National Architecture: An Executive Edition for Senior Transportation Managers*, FHWA-JPO-98-025 (EDL) * *National ITS Architecture Transit Guidelines*, FHWA-JPO-97-0016 (EDL) * *Developing Freeway and Incident Management Systems Using the National ITS Architecture*, FHWA-JPO-98-032 (EDL) * *Developing Traveler Information Systems Using the National ITS Architecture*, FHWA-JPO-98-031 (EDL) * *Developing Traffic Signal Control Systems Using the National ITS Architecture*, FHWA-JPO-98-026 (EDL)

(National ITS Architecture, cont' d)

Integration with existing infrastructure	Awareness	◇ Modules on tracking existing infrastructure		* Course on systems engineering and integration offered by universities
				* Recommended reading:
				  * *Tracking the Deployment of the Integrated Metropolitan Intelligent Transportation Systems Infrastructure in the USA: FY 1997 Results*, FHWA-JPO-99-001 (EDL)
				  * *Review of and Preliminary Guidelines for Integrating Transit into Transportation Management Centers*, DOT-T-94-25 (EDL)

	Specialized			

Partnerships: ITS introduces the opportunity for, and in some cases has required, that agencies and firms work closely together to share resources, costs, risks and rewards of reaching project goals. Partnering takes many forms in ITS depending on the project and partners. It includes public-public partnerships among agencies and public-private partnerships between agencies and firms.
Frequently, forums that are used to build coalitions also provide opportunities for recognizing mutually beneficial partnerships. Partnerships have basic legislative and financial parameters and barriers. They require clear documentation — either Memorandums of Understanding (MOUs) or contracts — describing many important issues. It is important to include staff at all levels in structuring partnership agreements to ensure buy-in and the feasibility of the goals. The following should be considered when structuring partnerships:

- partner's expectations, goals and steps for achieving them;
- the agency's or firm's authority, responsibilities, technical capabilities, statutory limitations, time and funding constraints;
- the agency's or firm's priorities regarding the partnership (for example, after systems installation and testing, which partner will maintain the system?);
- market requirements and financial stability;
- responsibilities regarding decision-making during incidents, control of ITS devices, and data sharing;
- provisions for sharing software and hardware, staff, and operations and maintenance costs;
- contract clauses that clearly spell out how monies will be distributed and contract clauses that that describe that agency personnel staffed on the project have the technical expertise needed to do the job.

CRITICAL KNOWLEDGE AND SKILLS		**Available Training/Education**		
		From DOT PCB Catalog		**Other Sources**
		What	**Access**	
Benefits of Partnering	Awareness	✓ Public/Private Partnerships	NHI	* Recommended reading: *PCB Shared Resources: Sharing Right-Of-Way for Telecommunications: Guidance on Legal and Institutional Issues*, FHWA-JPO-96-0015 (EDL)
	Specialized	✓ Shared Resources for Telecommunications	NHI	
Structuring Agreements	Awareness			* Course on Intellectual Property Rights, Copyrights and Patents from law schools * Courses in writing contracts and Memorandums of Understanding (MOUs) from U.S. DOT * Recommended reading in ITS Institutional and Legal Issues (EDL) * Recommended reading: *The New York-New Jersey-Connecticut Metropolitan Model Deployment Initiative: A Review of the Initial Negotiations Process*, FHWA-JPO-98-033 (EDL)
	Specialized	◇ Workshop on using and writing ITS contracts		

ITS Standards: The foundation of intermodal, interoperable ITS is based on a need for, and compliance with, technical standards. ITS requires that new standards be developed that address, for example, communication protocols. Having these standards brings about many benefits. First, decision-makers can be assured that standardized technologies are being used and no future retrofitting will have to occur. Second, it assures interconnectivity and compatibility of systems. Third, standards allow for the manufacture of "open" or non-proprietary systems, that also allows customers a wider choice of technologies which enables growth of economies of scale and consequently reduced prices. The definition and publication of the complete set of ITS standards should help promote vendor growth and stability, and in turn provide the necessary economies of scale to lower prices.

CRITICAL KNOWLEDGE AND SKILLS		**Available Training/Education**		
		From DOT PCB Catalog		**Other Sources**
		What	**Access**	
Applying ITS Standards, protocols, and interfaces	Awareness	✓ NTCIP and ITS Standards — What Do They Mean for You?	ITE	* Recommended web site: http://www.its.dot.gov/standard/standard.htm
	Specialized	◇ National ITS Standards Training Modules		
Relationship to the National ITS Architecture	Awareness	✓ An Introduction: The National ITS Architecture and Interim Guidance on Conformity with Architecture and Standards	U.S. DOT	
	Specialized	◇ National ITS Standards Training Modules		

Software & Hardware Operations: ITS requires an understanding of how to operate computers including various operating systems and software packages. It is similar to Technology Options, but focuses on the *application* of these technologies. This competency is as simple as turning on a computer, to identifying and troubleshooting simple problems, to communicating with systems support for more sophisticated problems. Typical tasks include installing and operating a software package, maintaining files and extracting data, and knowing proper shut down and re-boot procedures. It includes some organizational change in that it changes the way transportation business is done. As one senior executive related, the introduction of computer system networks meant that staff no longer worked in isolation--if one person was not doing their job, it had an effect on others in the system.

CRITICAL KNOWLEDGE AND SKILLS		**Available Training/Education**		
		From DOT PCB Catalog		**Other Sources**
		What	**Access**	
Procure hardware and software	Awareness Specialized	✓ ITS Software Acquisition ◇ Lessons Learned in ITS Procurement	NHI NHI	* Recommended reading: *The Road to Successful ITS Software Acquisition, Executive Summary* FHWA-JPO-98-037, *Volume 1: Overview and Themes,* FHWA-JPO-98-025, and *Volume 2: Software Acquisition Process Reference Guide,* FHWA-JPO-98-036 (EDL)
Install and integrate hardware and software in networks	Awareness Specialized			* Courses on installing and integrating hardware and software, and testing methodologies offered by universities and vendors * Courses on inspecting, operating and maintaining networks and software offered by universities and vendors * Courses on the software development process offered by universities and vendors
Operate and maintain networks, servers and software	Awareness Specialized			* Courses on the software development process, programming and languages offered by universities, technical/vocational schools, or junior colleges * Courses on operating and maintaining networks and software, and inspection and testing of systems offered by vendors, technical/vocational schools, or universities

(Software and Hardware Operations, cont' d)

Data and database management and maintenance	Awareness			* Courses on data analysis, management and databases offered by universities and professional associations
	Specialized	✓ Transit Performance Evaluation: Using Information-Based Strategies ✓ Geographic Information Systems: Transit Applications	NTI NTI	
Software Applications	Awareness			* Courses on software applications such as word processing, spreadsheets, databases, or internet applications offered by junior colleges, universities, agency training programs, professional associations or software vendors
	Specialized			
Inspection and acceptance testing procedures, setting performance measures, quality assurance/quality control	Awareness			
	Specialized	◇ Workshop on setting ITS systems performance measures, and inspection and testing		
Integration with existing systems, expandability and extendability	Awareness			* Course on systems engineering and integration offered by universities
	Specialized			

Software Development: Software is the heart and blood of computer systems. Many issues must be considered in software development since the process is often fraught with cost overruns and lack of usability. Decisions on when to develop software from scratch and when to modify must be made. Life cycle and cost analyses are done to support these decisions and monitor software development costs in the near and long term. Device control, transmission protocols, data capture and storage are elements of software development. Data sharing is also a crucial element. Decisions on what data gets shared with whom must also be done. Agencies can collaborate on projects to maximize return on costly development cycles. Extendibility and expandability of the software must also be considered. Maintenance issues such as upgrades, the software's reliability, backups and redundancies all have to be addressed. Related issues of hardware procurement must be evaluated so the system has the right platform to operate the software. Developers must have a thorough understanding of the transportation problem the software is aimed to address. This requires a good understanding of transportation fundamentals and terminology.

CRITICAL KNOWLEDGE AND SKILLS		**Available Training/Education**		
		From DOT PCB Catalog		**Other Sources**
		What	**Access**	
Software Development	Awareness			* Courses on the software development process, programming and languages offered by universities, technical/vocational schools, or junior colleges * Courses on operating and maintaining networks and software, and inspection and testing of systems offered by vendors, technical/vocational schools, or universities
	Specialized			
Software Acquisition	Awareness			* Course on Intellectual Property Rights, Copyrights and Patents from law schools * Courses in writing contracts and Memorandums of Understanding (MOUs) from U.S. DOT * Recommended reading in ITS Institutional and Legal Issues (EDL) * Recommended reading: *The Road to Successful ITS Software Acquisition, Executive Summary*, FHWA-JPO-98-037, *Volume 1: Overview and Themes*, FHWA-JPO-98-025, and *Volume 2: Software Acquisition Process Reference Guide*, FHWA-JPO-98-036 (EDL)
	Specialized	✓ ITS Software Acquisition ◇ Lessons Learned in ITS Procurement		

(Software Development, cont' d)

Electrical Engineering	Awareness			* Courses in electrical engineering and wiring networks offered by universities
	Specialized			
Human Factors	Awareness			* Courses in software engineering and human factors, especially human interface design, offered by universities * Recommended Reading: *Design of an ITS Level Advanced Traffic Management System: A Human Factors Perspective*, FHWA-JPO-
	Specialized			
Analysis	Awareness			* Courses in analysis: cost/benefit analysis, investment analysis, risk analysis offered by universities, professional associations or junior colleges
	Specialized			
User Needs Assessment	Awareness			* Workshops on conducting user needs assessments offered by universities, continuing education programs, or professional associations
	Specialized			
Integration with existing systems, expandability and extendability	Awareness			* Course on systems engineering and integration offered by universities
	Specialized			
Training on the use of databases and software applications	Awareness			* Courses offered by software and database developers after installation and integration * Operations procedures manuals received from vendors
	Specialized			

ITS Human Factors: ITS introduces and requires making advanced technologies user-friendly. This particularly relates to the ergonomics of technology and system design for Variable Message Signs (VMS) and Traffic Management Centers (TMC). VMS messages, for example, need to be concise and easily readable by transportation users. Great care must go into how much information should be included in a message so that users can read it moving at the speed limit. Therefore, research on driving reaction to VMS should be done. VMS must also be placed in locations where users have enough time to make alternative route decisions. TMC consoles must be designed to be user-friendly for operators. For example, operators need easy access to different control mechanisms in split second time. Consoles should thus be designed to allow for quick usage of key elements in a sequential execution that reflects agency procedures. This will help operators to be more comfortable in executing their tasks. Human factors research also can allow for a more comfortable transition from manual to automated functions in that users will slowly trust computer capabilities.

CRITICAL KNOWLEDGE AND SKILLS		**Available Training/Education**		
		From DOT PCB Catalog		**Other Sources**
		What	**Access**	
Human Factors in ITS	Awareness			* Recommended reading: * *Summary reports on Human Factors Research Needs* No. FHWA-RD-98-147 and FHWA-RD-98-184 through –188 (EDL) * *Design of an ITS-Level Advanced Traffic Management System: A Human Factors Perspective*, FHWA-RD-95-181 (EDL)
	Specialized			
Human Factors Engineering	Awareness			* Courses on human factors offered by universities
	Specialized			
Human factors and software engineering	Awareness			* Course on software engineering and human factors, especially human interface design offered from universities
	Specialized			

Procurement: ITS requires changes in contracts and procurement processes. Whereas capital projects are most often based on low-bid, ITS projects may require design-build or fixed price plus fee contracts. Procurement processes can have unique elements because of an agency's culture. For example, agencies may have certain specification requirements and rules of procurement that may be an obstacle to advanced technology purchases. Long approval processes could also burden the project and result in technologies being outdated once deployed. Life cycle analysis and costs should be performed on alternative procurement options. Specification writing is of paramount importance in ITS projects given the newness of technologies. Furthermore, ITS systems are not easily "spec'ed out" due to unique technological, geographical and agency requirements. Thus, standard "off the shelf" contracts are difficult to use. Contracts should be based on the Scope of Work from the RFP instead of the contractor's bid. This will better ensure that project objectives are met since the bid is based on the contractor's capabilities. Contract clauses should clarify source code ownership, testing criteria, use of proprietary platforms and software, and performance standards for contractors. They should also spell out liability and risk sharing, reward sharing, dedication of resources, the extendibility and expandability of the system, use of prototypes, staff training on the system, and warranties. Legislation changes may have to occur in order to allow the usage of new contracts.

CRITICAL KNOWLEDGE AND SKILLS		**Available Training/Education**		
		From DOT PCB Catalog		**Other Sources**
		What	**Access**	
Procurement options, contracts and legal issues	Awareness	◇ Lessons in ITS Procurement	U.S. DOT	
	Specialized	✓ Procuring New Technologies for Transit ✓ Procuring and Managing Systems Integrators ✓ ITS Software Acquisition ◇ Workshop on using and writing ITS contracts and ITS specifications ◇ Seminar in ITS Legal Issues	NTI ITS America NHI	* Course in procurement and legal issues offered by U.S. DOT * Recommended reading: ITS institutional and legal issues (search on the EDL)
Identifying Sources of Funding	Awareness			* Technical assistance from U.S. DOT headquarters, FTA Regional Office ITS Specialists, and FHWA Resource Center and Division Office ITS Specialists
	Specialized			

Project Evaluation: Project evaluation is about measuring if the desired objectives were achieved. Project managers must think of project evaluation from the beginning by identifying what are the critical factors for success and what are the project milestones to get there. This must be written into the Scopes of Work, Requests for Proposals and contracts. Periodic analysis of whether the project is effectively meeting these critical factors and milestones is then done. A final evaluation of the project will analyze if the investment was worth the benefits it generated. It will also hold good lessons for future projects. Interviewees noted that it is difficult to do final project evaluations since no funds are allocated for it. Other interviewees noted that federal agencies could fund or perform the evaluations to ensure impartiality.

CRITICAL KNOWLEDGE AND SKILLS		**Available Training/Education**		
		From DOT PCB Catalog		**Other Sources**
		What	**Access**	
Analysis	Awareness			* Courses in analysis: cost/benefit analysis, investment analysis, risk analysis offered by universities, professional associations or junior colleges
	Specialized			
Inspection and acceptance testing procedures, setting performance measures, quality assurance/quality control	Awareness			
	Specialized	◇ Workshop on setting ITS systems performance measures, and inspection and testing		
Project Evaluation	Awareness	✓ Transit Performance Evaluation: Using Information-Based Strategies	NTI	* Recommended reading: Reports from ITS Federal Operational Tests and their evaluation strategies (search on the EDL)
	Specialized	◇ Workshop on ITS project evaluation, setting performance measures, acceptance testing of devices and systems, cost/benefit analysis after deployment		
Technology benefits and performance assessment	Awareness			
	Specialized	◇ Use of the CORSIM Computer Traffic Simulation Model ◇ Other planning models ✓ Intelligent Transportation Systems for Transit: Solving Real Problems ✓ Reinventing Transit: Planning Information-Based Transit Services ✓ Transit Performance Evaluation: Using Information-Based Strategies	U.S. DOT NTI NTI NTI	

Project Management: ITS requires more project/business management skills than in the past. In ITS, project management takes on the features of being multi-agency, multi-discipline, and multi-jurisdictional with a high technology orientation. This includes ensuring that the deployment project is coordinated with other ITS deployments occurring within the region and that consideration is given to the operations, maintenance, and evaluation of the systems in the planning and design stages. ITS project management highlights overcoming the institutional obstacles that exist, especially as networks connect agencies and data, and employees find their work environment evolving toward technological interdependency. As a result, ITS project management requires a mix of skills that broadly fall into the categories of managerial, technical, financial, strategic planning and evaluation.

CRITICAL KNOWLEDGE AND SKILLS		**Available Training/Education**		
		From DOT PCB Catalog		**Other Sources**
		What	**Access**	
Technical Management: managing the technical feasibilty, and related issues such as extendability, expansion, or systems security; applying the principles of systems, electrical, and telecommunications engineering.	Awareness	◇ Workshop on writing ITS specifications		* Course on the software development process and software engineering offered by universities * Course on the principles of systems engineering offered by universities * Recommended reading: *Protecting Our Transportation Systems: An Information Security Awareness Overview*, FHWA-JPO-98-005 (EDL)
	Specialized			
Financial Management: managing the budgeting, accounting, tracking, and procurement efforts	Awareness	◇ Workshop on writing and using ITS contracts		* Course in public sector financial management: cost/benefit analysis, investment analysis, risk analysis, budgeting and accounting procedures, and use of Gantt charts offered by universities, junior colleges, and U.S. DOT
	Specialized			
Analysis	Awareness			* Courses in analysis: cost/benefit analysis, investment analysis, risk analysis offered by universities, professional associations or junior colleges
	Specialized			

(Project Management, cont' d)

Strategic Planning: coordination with other deployments and construction activities; coordinating cross-agency work; applying the principles of the National ITS Architecture.	Awareness	✓ An Introduction: National ITS Architecture and Interim Guidance on Conformity with Architecture and Standards ✓ The National ITS Architecture: An Introduction for FTA Senior Staff ◇ Workshop on ITS Project Management	FHWA FTA	* Course on project management from U.S. DOT, universities or junior colleges * Course on writing business plan/project plans from U.S. DOT, universities, or professional associations
	Specialized	✓ Planning the Integration of Transit and Traffic ITS Applications ✓ Using the National ITS Architecture for Deployment — Public Sector ✓ Using the National ITS Architecture for Deployment — Private Sector ◇ Turbo Architecture	NTI FHWA FHWA	
Management: managing contractors; building and managing intra-agency and inter-agency teams; obtaining appropriately qualified staff, possibly designing new positions; managing organizational change	Awareness	✓ Public/Private Partnerships ✓ Procuring and Managing Systems Integrators ◇ Workshop on bridging public-private sector differences	NHI ITS America	* Course in change management offered by business schools or universities * Recommended reading: *Successful Approaches to Deploying a Metropolitan Intelligent Transportation System*, FHWA-JPO-99-032 (EDL)
	Specialized			
Project Evaluation: setting performance measures; designing test and evaluation methodologies	Awareness	✓ Transit Performance Evaluation: Using Information-Based Strategies	NTI	* Recommended reading: Reports from ITS Federal Operational Tests and their evaluation strategies (search on the EDL)
	Specialized	◇ Workshop on ITS project evaluation, setting performance measures, acceptance testing of devices and systems, cost/benefit analysis after deployment		
Operations: planning for operations in the design stage; managing the transition from deployment to operations	Awareness	✓ Operating and Maintaining ITS	ITE	
	Specialized			

Operations: Deploying ITS technologies results in the ability to better operate and manage transportation systems to achieve safety, efficiency, better response time, and better mobility. The knowledge and skills involved in operations form a foundation for professionals to understand how the technologies, the network linkages and the personnel combine to form an ability to manage the transportation systems in real-time. This competency requires a certain level of success in deployment whereby institutional barriers are reduced and a new way of doing business is established. Based on this success, actual operations and management activities can proceed to achieve systems performance goals.
The tasks involved in operations must be considered and planned for in the planning and design stages of deployment.

CRITICAL KNOWLEDGE AND SKILLS		**Available Training/Education**		
		From DOT PCB Catalog		**Other Sources**
		What	**Access**	
Managing an operations center and/or a traveler information center	Awareness	✓ Operating and Maintaining ITS	ITE	* Courses in management including budgeting and scheduling from universities, junior colleges, and business schools
	Specialized			
Transportation and ITS operations	Awareness	✓ Deploying Integrated ITS- Metropolitan ✓ Deploying Integrated ITS- Rural	NHI NHI	* Systems engineering courses offered by vendors and universities * Recommended reading: *Successful Approaches to Deploying a Metropolitan Intelligent Transportation System*, FHWA-JPO-99-032 (EDL)
	Specialized	✓ Planning the Integration of Transit and Traffic ITS Applications	NTI	
National ITS Architecture and Data sharing between agencies	Awareness	✓ An Introduction: National ITS Architecture and Interim Guidance on Conformity with Architecture and Standards ✓ The National ITS Architecture: An Introduction for FTA Senior Staff	U.S. DOT FTA	* Courses on National ITS Architecture, NTCIP, and ITS concepts offered by vendors
	Specialized	◇ Turbo Architecture	U.S. DOT	
Partnerships and cross-agency teamwork	Awareness	✓ Public/Private Partnerships ◇ Workshop on bridging public-private sector differences	NHI	
	Specialized	✓ Procuring and Managing Systems Integrators	ITS America	

(Operations, cont' d)

Staffing, scheduling, and training	Awareness			* Course in human resource management including writing job classifications and staffing, offered by business schools and universities * Courses in training and presentations offered by universities, professional associations, and junior colleges * Courses in teaching with advanced technologies * Courses in Instructional Systems Design (ISD)
	Specialized			
Software Applications	Awareness			* Courses on software applications such as word processing, spreadsheets, databases, or internet applications offered by junior colleges, universities, agency training programs, professional associations or software vendors
	Specialized			
Data and database management and maintenance	Awareness			* Courses on building databases and relational databases offered by universities
	Specialized	✓ Transit Performance Evaluation: Using Information-Based Strategies ✓ Geographic Information Systems: Transit Applications	NTI NTI	

ITS Legal Issues: ITS requires addressing legal issues such as intellectual property rights, data and broadcast content, and software & hardware sharing arrangements. These issues should all be addressed in the contract and MOU. Intellectual property rights considerations include making clear who owns the source code and modifications to it when a contractor develops software. *See Competency Category on Software Development.* It also includes licensing agreements for copyrights, trademarks and patents for products and services used and perhaps modified by an agency. Privacy issues are raised with data sharing amongst agencies and with the private sector. Detailed broadcast video of freeway incidents or a failure in traffic signal coordination that results in an accident can leave agencies open to liability. These issues must be addressed in contracts and MOUs to safeguard agency operations. Contracts should also include clauses for testing and prototyping of systems as well as warranties and guarantees for work completed. Changes in legislation may have to occur to allow for public-private partnerships and inclusion of these issues into contracts.

CRITICAL KNOWLEDGE AND SKILLS		**Available Training/Education**		
		From DOT PCB Catalog		**Other Sources**
		What	**Access**	
Contracts and procurement	Awareness	◇ Workshop on writing and using ITS contracts and specifications ◇ Lessons Learned in ITS Procurement	 NHI	
	Specialized	✓ Procuring New Technologies for Transit	NTI	
ITS legal issues including liability and institutional risk	Awareness			* Recommended reading in ITS institutional and legal issues (search on the EDL) * Course in legal issues offered by the U.S. DOT * ITS America's Legislative Affairs web site: http://www.itsa.org/legislative.html
	Specialized	◇ Seminar on ITS Legal Issues		
Intellectual Property Rights/Copyrights/Patents	Awareness			* Course on Intellectual Property Rights, Copyrights and Patents from law schools *
	Specialized			
Cooperative Agreements/ MOUs, compensation agreements	Awareness	✓ Public/Private Partnerships ✓ Shared Resources for Telecommunications	NHI NHI	* Recommended reading: *PCB Shared Resources: Sharing Right-Of-Way for Telecommunications: Guidance on Legal and Institutional Issues,* FHWA-JPO-96-0015 (EDL)
	Specialized			

Marketing/Public Relations: Marketing and public relations has become a critical part in the management of ITS projects. The public needs to be aware of the changes resulting from projects and be encouraged to use ITS products and services. Politicians and decision-makers need to see the benefits of ITS projects to continue funding and consideration of additional ITS. Marketing ITS products and services begins with the selection of the most effective message, easily comprehended, that will motivate the public to use ITS and demonstrates its benefits. This message will be well packaged and distributed. Decisions on the best way to reach customers—through radio, television, bus advertisements, pamphlets, etc. are made. Agency approvals and clearances for marketing campaigns may be necessary. Suitable administrative and control procedures for effective operation of advertising, sales promotion, publicity, merchandising, and other communication activities, whether they be in-house or contracted out, may also have to occur. In addition, transportation officials must have good public relations skills in order to communicate with the public and politicians using "laymen's terms" and not transportation jargon.

CRITICAL KNOWLEDGE AND SKILLS		**Available Training/Education**		
		From DOT PCB Catalog		**Other Sources**
		What	**Access**	
Marketing and public relations skills	Awareness			* Courses in marketing and public relations offered by universities and junior colleges.
	Specialized			
Marketing ITS to Agency Senior Decision Makers, and Appointed and Elected Officials	Awareness			* Recommended reading: * *Marketing ITS Infrastructure in the Public Interest*, FHWA-JPO-98-029 (EDL) * *Traveling with Success: How Local Government Use Intelligent Transportation Systems*, FHWA-JPO-96-009 (EDL) * *ITS Market Resource Guide: Federal, State, and Local Contacts in ITS*, ITS America.
	Specialized			
Marketing ITS to the Traveling Public and engaging the media	Awareness			◇ Case studies on the best practices and lessons learned from ITS deployment projects and engaging the media and traveling public
	Specialized			

Problem Solving: ITS requires recognizing and defining problems that arise during the stages of an ITS project. Issues arise due to the multitude of agencies and people involved in projects. Problem solving requires analyzing relevant information and looking at alternative solutions. Conflict management involves anticipating potential conflicts and resolving confrontations, disagreements, and complaints in a constructive manner when they do occur. This competency is about identifying and dealing with problems diplomatically and effectively.

Unlike the other competencies, it is not a bundle of knowledge and skills, but rather an ability to apply the skill of problem solving when applying the other competencies. To facilitate building problem solving capacity, the PCB program will focus future efforts on creating a series of hands-on initiatives. Workshops, labs and case studies are proposed to address needs related problem solving for the following topics:

- ⇨ Managerial/Administrative Skills: Managing contractors, negotiations, writing specifications, institutional issues.
- ⇨ Technical Skills: Equipment installation, maintenance, troubleshooting.

Systems Support & Maintenance: The Systems Support and Maintenance competency consists of a thorough knowledge of the computer hardware, operating systems, and application software. It is most often site-specific, so that the support person is able to install, maintain and troubleshoot both the in-house hardware and software. Given that ITS deployments have extensive computer systems that collect, organize and disseminate information to different agency departments as well as other agencies, Systems Support and Maintenance Technicians have added responsibilities for which further professional capacity building may be needed.

CRITICAL KNOWLEDGE AND SKILLS		**Available Training/Education**		
		From DOT PCB Catalog		**Other Sources**
		What	**Access**	
Network Administration	Awareness			* Course in systems administration including maintenance of servers, backing up servers, client account maintenance, repair and troubleshooting
	Specialized			
Software installation and updating	Awareness			* Course in systems administration that includes software installation, maintenance, upgrades, and troubleshooting
	Specialized			

Transportation Fundamentals: It was discovered in interviews that a basic grasp of transportation principles, both highways and transit, was critical for system integrators and software engineers to do transportation applications. This requires a basic understanding of the vocabulary and concepts common to transportation agencies, for example, "dwell time" (which refers to the length of time a bus spends on a given stop). Along with terminology and traffic concepts, one needs an understanding of the modal functions that drive the mission, design and operation of an agency's system. This need was mostly expressed in context of consultant deficiencies. While many consultants are well versed in the design and installation of technologies, they lack knowledge on how their work solves transportation problems. This can prevent them from designing systems that most fully satisfy the needs of their clients. See Competency Category on Systems Analysis & Design. This competency is about ensuring that non-civil engineers are knowledgeable on how their work is being applied to transportation problems.

CRITICAL KNOWLEDGE AND SKILLS		**Available Training/Education**		
		From DOT PCB Catalog		**Other Sources**
		What	**Access**	
Traffic/Transit operations vocabulary	Awareness			* Course on the basics of transportation engineering to learn the vocabulary and fundamentals of traffic and/or transit offered by universities, transportation professional associations, or vendors
	Specialized			
Transportation planning basics	Awareness			* Course on the basics of transportation planning offered by universities
	Specialized			
Operations	Awareness	✓ Operating and Maintaining ITS	ITE	
	Specialized			
Intermodalism	Awareness			
	Specialized			

Legislative & Policy Change: ITS requires a good understanding of agencies' legislative authority in providing new transportation solutions. ITS projects such as HOV lanes and new revenue sources like video enforcement ticketing may require legislative changes to deploy. This involves identifying obstacles in state constitutions and laws as well as federal regulations that restrict the types of contracts and partnerships allowed. Jurisdictional boundary issues such as different procurement processes and contracting methods must also be addressed.

CRITICAL KNOWLEDGE AND SKILLS		**Available Training/Education**		
		From DOT PCB Catalog		**Other Sources**
		What	**Access**	
Promoting and marketing ITS to Senior Agency Decision Makers, and Appointed and Elected Officials	Awareness			
	Specialized			◇ Case studies from agencies who worked with their state, regional, and local legislators and appointed officials to change policies to accommodate ITS * Course in negotiations offered by universities or junior colleges
Understanding the Political Environment and Policy Skills	Awareness			* Recommended reading: * *Traveling with Success: How Local Government Use Intelligent Transportation Systems*, FHWA-JPO-96-009 (EDL) * *ITS Market Resource Guide: Federal, State, and Local Contacts in ITS*, ITS America.
	Specialized			

Freeway Management Systems: Systems that provide information to motorists and detect problems to increase capacity, and minimize congestion caused by crashes.

CRITICAL KNOWLEDGE AND SKILLS	Available Training/Education		
	From DOT PCB Catalog		Other Sources
	What	Access	
Concept	✓ High Occupancy Vehicle Facilities ✓ Freeway Traffic Operations	NHI NHI	* Recommended reading: * *Emissions Management Using ITS Technology*, FHWA-JPO-99-039 (EDL# 6325) * *Developing Freeway and Incident Management Systems Using the National ITS Architecture*, FHWA-JPO-98-032 (EDL)
Technologies	✓ Traffic Control Software and Signalization	NHI	

Incident and Emergency Management Systems: Systems that enable communities to identify and respond to crashes or breakdowns with the best and quickest emergency services, thereby minimizing clean-up time. Coordinated emergency response ensures that the closest available and most appropriate emergency response unit can respond to a crash.

CRITICAL KNOWLEDGE AND SKILLS	**Available Training/Education**		
	From DOT PCB Catalog		**Other Sources**
	What	**Access**	
Concept and Technologies	✓ Incident Management	NHI	* Recommended reading*:* * *Enhancing Public Safety, Saving Lives: Emergency Vehicle Preemption*, FHWA-JPO-99-002 (EDL #6871) * *Speeding Response, Saving Lives: Automatic Vehicle Location Capabilities for Emergency Services*, FHWA-JPO-99-003 (EDL# 6866) * *Faster Response Time, Effective use of Resources: Integrating Transportation Systems and Emergency Management Systems*, FHWA-JPO-99-004 (EDL# 6874) * *Improving Mobility, Saving Lives: Safety Service Patrols*, FHWA-JPO-99-005 (EDL #6872) * *Safer Travel, Improved Economic Productivity: Incident Management Systems*, FHWA-JPO-99-006 (EDL# 6868) * *Sharing Resources, Coordinating Response: Deploying and Operating Incident Management Systems*, FHWA-JPO-99-007 (EDL #6869) * *ITS Field Operational Test Cross-Cutting Study: Emergency Notification and Response*, FHWA-JPO-99-033 (EDL# 6326) * *ITS Field Operational Test Cross-Cutting Study: Incident Management: Detection, Verification, and Traffic Management*, FHWA-JPO-99-034 (EDL# 6328) * *ITS Field Operational Test Cross-Cutting Study: Hazardous Material Incident Response*, FHWA-JPO-99-035 (EDL# 6327)

Advanced Traveler Information Systems: Also known as regional multimodal traveler information systems. They are systems that provide road and transit information to travelers, businesses and truckers, so that they can more effectively plan their travel.

CRITICAL KNOWLEDGE AND SKILLS	Available Training/Education		
	From DOT PCB Catalog		Other Sources
	What	Access	

Concept			* Recommended reading:
			  * *ITS Field Operational Test Cross-Cutting Study: Advanced Traveler Information Systems*, FHWA-JPO-99-038 (EDL# 6323)
			  * *Developing Traveler Information Systems Using the National ITS Architecture*, FHWA-JPO-98-031 (EDL)

Technologies			

Advanced Public Transportation Systems: Updated transit management systems that allow new ways of monitoring and maintaining our Nation's sizable transit fleets through advanced vehicle locating devices, equipment monitoring systems, vehicle diagnostics, and fleet management systems.

CRITICAL KNOWLEDGE AND SKILLS	Available Training/Education		
	From DOT PCB Catalog		Other Sources
	What	Access	
Concept	✓ ITS in Transit ✓ ITS Transit Management ✓ Intelligent Transportation Systems for Transit: Solving Real Problems ✓ Transit Performance Evaluation: Using Information-Based Strategies ✓ Reinventing Transit: Planning Information-Based Transit Strategies ✓ Planning the Integration of Transit and Traffic ITS Applications	FTA FTA NTI NTI NTI NTI	* Recommended reading: * *Better Service, Safer Service: Transit Management for Fixed-Route Systems*, FTA.TRI.10.98.1 (EDL# 6875) * *Better Service, Greater Efficiency: Transit Management for Demand Response Systems*, FTA.TRI.10.98.2 (EDL# 6876) * *National ITS Architecture Transit Guidelines*, FHWA-JPO-97-0016 (EDL) * *Review of and Preliminary Guidelines for Integrating Transit into Transportation Management Centers*, DOT-T-94-25 (EDL) * *Advanced Public Transportation Systems: The State of the Art Update of '98*, FTA-MA-26-7007-98-1 (EDL) * *Advanced Paratransit Systems: An Application of Digital Map, Automated Vehicle Scheduling, and Vehicle Location Systems*, UCB-ITS-RR-97-1 (EDL)

CRITICAL KNOWLEDGE AND SKILLS	Available Training/Education		
	From DOT PCB Catalog		Other Sources
	What	Access	
Technologies	✓ Procuring New Technologies for Transit ✓ Geographic Information Systems: Transit Applications ✓ Analytic Troubleshooting for the Advanced Technology Bus: Train-the-Trainer ✓ NTI Fellows Workshops on Advanced Technologies and Innovative Practices for Transit	NTI NTI NTI NTI	* Recommended reading: *FTA National Transit Geographical Information Systems Guidelines, Standards, and Recommended Practices,* DTRS57-95-P-80861 (EDL)

Advanced Traffic Signal Control Systems: Modernized traffic signal control systems that automatically adjust themselves to optimize traffic flow.

CRITICAL KNOWLEDGE AND SKILLS	**Available Training/Education**		
	From DOT PCB Catalog		**Other Sources**
	What	**Access**	
Concept	✓ Computerized Traffic Signal Systems ✓ Traffic Control Software and Signalization	NHI NHI	* Recommended reading: *Developing Traffic Signal Control Systems Using the National ITS Architecture*, FHWA-JPO-98-026 (EDL)
Technologies	✓ Advanced Traffic Signal Controller	NHI	

Electronic Fare Payment Systems: New systems that enable a person to pay for parking, bus and train fares, and tolls by using a single smart card.

CRITICAL KNOWLEDGE AND SKILLS	Available Training/Education		
	From DOT PCB Catalog		Other Sources
	What	Access	
Concept			* Visit ITS America's web site: http://www.itsa.org/payment.html
Technologies			

Electronic Toll Collection Systems: Systems that provide drivers and transportation agencies with convenient and reliable automated transactions. This will dramatically improve traffic flow at toll plazas and increase the operational efficiency of toll collecting.

CRITICAL KNOWLEDGE AND SKILLS	Available Training/Education		
	From DOT PCB Catalog		Other Sources
	What	Access	
Concept			* Visit ITS America's web site: http://www.itsa.org/payment.html * Visit a private sector web site for information: http://www.ettm.com
Technologies			

Highway-Rail Intersection Systems: Advances in railroad crossings that are coordinated with traffic signals and train movements, and that notify drivers of approaching trains through in-vehicle warning systems.

CRITICAL KNOWLEDGE AND SKILLS	Available Training/Education		
	From DOT PCB Catalog		Other Sources
	What	Access	
Concept			
Technologies			

Commercial Vehicle Operations/CVISN: Electronic systems and networks that allow for simple, cost-effective, and seamless exchange of safety and administrative data, electronic business transactions, and information on commercial vehicle operations and processes. There are four areas of applications to CVISN:

- **Safety assurance programs and services** designed to assure the safety of commercial drivers, vehicles and cargo. These include automated roadside safety inspections and carrier reviews, safety information systems, and onboard safety monitoring.
- **Credential administration programs and services** designed to improve the deskside procedures and systems for managing motor carrier regulation. These include electronic application, purchase and issuance of credentials, as well as automated tax reporting and filing.
- **Electronic screening systems and services** designed to facilitate the verification of size, weight and credential information. These include the automated screening of commercial vehicles at fixed weigh stations and international border crossings.
- **Carrier operations activities and services** designed to reduce congestion and manage the flow of commercial vehicle traffic, such as travel advisory and hazardous materials incident response services. The private sector is taking the lead in implementing fleet and vehicle management technologies and systems that improve motor carrier productivity.

(Commercial Vehicle Operations/CVISN, cont' d)

CRITICAL KNOWLEDGE AND SKILLS	Available Training/Education		
	From DOT PCB Catalog		Other Sources
	What	Access	
Concept	✓ ITS/CVO Program Management ✓ ITS/CVO Basic Awareness Course ✓ ITS/CVO Executive Briefing Session ✓ Introduction to ITS/CVO ✓ ITS/CVO Technical Project Management for Non-Technical Managers	NTC NTC NTC NTC NTC	* Recommended reading: * *Improved Enforcement, Safer Roads for State Agencies: Commercial Vehicle Electronic Screening*, FHWA-JPO-99-008 (EDL# 6873) * *Achieving Shared Efficiencies Through Cooperative Implementation: Commercial Vehicle Electronic Screening*, FHWA-JPO-99-009 (EDL# 6867) * *Safer Trucks, Higher Profits for Motor Carriers: Commercial Vehicle Electronic Screening*, FHWA-JPO-99-010 (EDL#6870) * *ITS Field Operational Test Cross-Cutting Study: Commercial Vehicle Operations — Roadside*, FHWA-JPO-99-036 (EDL# 7863) * *ITS Field Operational Test Cross-Cutting Study: Commercial Vehicle Administrative Processes*, FHWA-JPO-99-037 (EDL# 6324)
Technologies	✓ Understanding ITS/CVO Technology Applications		

Rural ITS systems: ITS services and applications that are applied to meet the transportation needs of rural areas and small towns, travelers on rural roads, and in the National Highway System. Some rural systems will be extension of metropolitan and CVISN systems, applied to specific rural needs. Other applications are uniquely developed for rural needs. Services that characterize rural ITS are:

- **Traveler safety and security technologies** that alert drivers to hazardous conditions and dangers, and include wide-area information dissemination of site-specific safety advisories and warnings.
- **Emergency services technologies** that automatically mobilize the closest policy, ambulances, or fire fighters in cases of collisions or other emergencies — even in the most remote locations.
- **Tourism and travel information services** that provide information to travelers who are unfamiliar with the local rural areas. These services can be provided at specific locations, en route, or well in advance of the traveler's destination.
- **Public traveler and mobility services** that improve the efficiency of transit services and their accessibility to rural residents. Advanced vehicle locating devices and communications systems can help achieve better scheduling, improved dispatching, smart card payment transactions, and advanced ridesharing and ride-matching sytems.
- **Roadway operations and maintenance technologies** that improve the ability of our highway workers to maintain and operate rural roads. These include severe weather information systems, early detection of pavement and bridge failures, and immediate detection of dangers to work zone crews.
- **Fleet operations and maintenance systems** that improve the efficiency of rural transit and other rural fleets, such as snowplows and even law enforcement vehicles, through advanced vehicle tracking and on-board equipment monitoring systems.
- **Commercial vehicle systems** that manage the movement and logistics of commercial vehicles in rural settings, and locate them during emergencies and breakdowns. These include applications to improve safety, such as warnings associated with slow-moving vehicles, and scheduling applications for harvest season when vast numbers of trucks are needed during a very small time window.

(Rural ITS systems, cont' d)

CRITICAL KNOWLEDGE AND SKILLS	**Available Training/Education**		
	From DOT PCB Catalog		**Other Sources**
	What	**Access**	
Concept	◇ Workshop that bridges the gap between weather information and transportation needs — what is currently available from the Weather Services ✓ Incident Management	NHI	* Course on fleet management systems available from vendors * Recommended reading: * *Saving Lives, Improving Transportation Efficiency: Weather Information for Surface Transportation*, FHWA-JPO-99-015 (EDL# 6863) * *Rural Intelligent Transportation Systems Program Plan* (EDL) * *Rural Intelligent Transportation Systems Strategic Plan* (EDL)
Technologies			* Recommended reading: * *Technology in Rural Transportation: Simple Solutions*, FHWA-RD-97-108 (EDL) * *Rural Public Transportation Technologies: User Needs and Applications, Executive Summary*, FHWA-RD-98-126 *and Final Report*, FHWA-RD-98-125 (EDL)

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