Building Professional Capacity in ITS

An Assessment of ITS Training and Education Needs: The Transit Perspective

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The Transit Perspective

Federal Transit Administration
Professional Capacity Building Program

Prepared By

The Volpe National Transportation Systems Center
US Department of Transportation
Kendall Square
Cambridge, MA

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U.S. Department of Transportation
Washington, DC

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EXECUTIVE SUMMARY

The transit community, particularly transit operators, continuously strive to improve service delivery. Too frequently funding constraints preclude expansion of the system (to meet organizational goals of improving mobility) through major capital investments in equipment or infrastructure.

Consequently, strong interest exists in identifying and implementing innovative, cost-effective solutions. Recognition is growing among the transit community, particularly operators, of the availability of technological applications, which can be readily implemented. There is also recognition that many more technology options are in research and development and will soon be ready for testing and full deployment.

If there are to be successful deployments of new technologies by transit operators, the Federal Transit Administration (FTA) recognizes a great need exists for further professional development. This consists of enhancing the knowledge and skills base of individuals who are employed by transit agencies, contractors, consultants and vendors, and students and recent graduates of university and vocational school programs.

At the request of the FTA, the Volpe Center initiated a needs assessment. This research coincided with a much larger effort sponsored by the Intelligent Transportation System (ITS) Joint Planning Office (JPO) on professional capacity building needs. The focus of the needs assessment has been on developing a set of recommendations for guiding FTA initiatives for enhancing or expanding the Professional Capacity Building (PCB) program. In doing so, the research focused on identifying professional capacity building needs by position or role, project type, and stage of deployment.

Approximately 70 on-site interviews were conducted with employees of transit properties in five metropolitan areas, and with FTA Regional ITS specialists. Approximately 130 more interviews were conducted with individuals employed in the regional or district offices of the Federal Highway Administration, and by state departments of transportation, metropolitan planning organizations, and city and county public works and transportation departments.

Based on the research that was conducted, the following conclusions were reached:

- Members of the transit community are calling for targeted, tailored, and accessible resources. These must be available on-demand, just-in-time learning/problem-solving resources, which can overcome time and budget constraints.
- Transit agencies must make staff training and development of professional ITS expertise a priority in their agency budgets.
- There are at least three options for satisfying these requirements, including an expansion of the PCB program role, enhancement of the FTA regional specialist's role, and alternative delivery options for needed technical assistance and training.

- The challenge is to develop accessible information and delivery methods that provide the necessary competencies to support PCB requirements.

And, the PCB program is encouraged to:

- ***Expand and enhance current training*** by modifying existing courses and developing new ones. The course material and the delivery style must be designed to be consistent with the findings of this needs assessment - tailored, and targeted. They must also demonstrate real applications that have been successfully tested and deployed.

- ***Develop a program to create a Virtual Learning Environment.*** This would meet the audience's interest in receiving knowledge and specific information about technologies, application and deployments on a just-in-time or on an on-demand basis. It would satisfy the demand for immediate problem-solving that many individuals in the public sector face. Besides easy access, this provides individuals with a self-directed learning experience.

- ***Enhance & target activities with partners.*** Many of the transit properties recognize that their success with any deployment depends on their ability to tap into expertise that already exists in either the public or private sectors. FTA Headquarters must more clearly define the ITS responsibilities for Regional staff, and develop partnerships with other modal administrations on how to best leverage available training and informational resources. This includes working with associations, universities, and vendors to ensure that they provide very tailored training or information on what works, and what will produce the greatest benefits.

Chapter 1: Introduction

- The Intelligent Transportation Systems (ITS) Professional Capacity Building (PCB) program was launched in March of 1996, under joint sponsorship of the Federal Highway Administration (FHWA) and the Federal Transit Administration (FTA); initial ITS needs are identified and course work development inaugurated.
- An expanded research focus on Metropolitan Infrastructure, including transportation agencies (transit agencies, state and local departments of transportation, and metropolitan planning organizations (MPOs)) and the FTA and FHWA, began in Spring of 1998.
- Needs assessment done in the field over the summer of 1998, with nearly 200 interviews, including approximately 70 transit interviews. This information was supplemented with data from other current research and studies.
- Both available course work as well as most effective delivery methods are evaluated and recommendations are made on formal education, information dissemination, on-the-job training, technical assistance and training.
- A redirection for the resources of the PCB program is also recommended.

1.1 Background

An expanded research focus on Metropolitan Infrastructure training and educational needs was undertaken starting in the spring of 1998. It included transportation agencies, (transit agencies, state and local departments of transportation, and metropolitan planning organizations) the Federal Transit Administration (FTA) and Federal Highway Administration (FHWA). An assessment of field needs was conducted by on-site visits to five metropolitan areas, and convening focus groups. Nearly 200 interviews were conducted, including approximately 70 transit interviews. The information gained was supplemented with data from a number of related studies on ITS training needs.

A report, **"Building Professional Capacity in Intelligent Transportation Systems: Documentation and Analysis of Training and Education Needs in Support of ITS Deployment"**, documenting the overall results of this process, is in final stages of preparation. This report is meant to supplement **"Building Professional Capacity in Intelligent Transportation Systems: Documentation and Analysis of Training and Education Needs in Support of ITS Deployment"** by focusing on the transit elements of the needs analysis effort.

1.2 Current Training Resources

Currently (Feb.1999), there are a number of training courses and seminars on ITS which fall under the sponsorship of the U.S. DOT Professional Capacity Building (PCB) Program. Two of these courses are focused on transit: The ITS in Transit Seminar (there is also an Executive Summary of the ITS in Transit Seminar) and the Transit Management Course. Additional courses are currently under development.

The transit PCB training and the other general ITS courses, which have attempted to integrate topics relative to public transportation, have achieved varying degrees of interest to transit. In addition, the National Transit Institute (NTI) at Rutgers University currently is presenting seven ITS courses of specific interest to the transit industry. NTI is funded by the Federal Transit Administration (FTA).

There are other sources where some technical training for the transit industry is provided, including:

- Other Federal Departments (Health & Human Services, Department of Education)
- State Governments
- Universities
- Organizations such as American Public Transit Association (APTA) and ITS America
- State Transit Associations (Florida Transit Association, Colorado Transit Association)
- Private Companies (a number of vendors provide product training).

1.3 Purpose of This Report

This report seeks to develop a more complete understanding of the full range of ITS skill and training needs as they relate to transit. It summarizes the findings, conclusions and recommendations from a research project undertaken recently on ITS.

The report examines the delivery methods associated with that knowledge, skills and abilities (KSA) development, and concludes that more innovative delivery is required to meet the current demands of transit professionals. Additionally, the current role of the FTA is examined, with recommendations for a re-evaluation of the federal role in guiding ITS deployment. In conjunction with related work, gaps are identified between KSAs and current training, so appropriate new courses can be developed.

1.4 ITS Projects

The most common ITS technologies found in the transit field include:

- Automatic Vehicle Location (AVL)*(includes Global Positioning System (GPS)*)
- Geographic Information System (GIS)*
- Automatic Passenger Counter*
- Computer-Aided Dispatch (CAD)*
- Traveler Information System*
- Electronic Fare Payments*
- Automated Service Coordination
- Traffic Management (Operations) Center (TMC)*
- Traffic Signal Priority

(*Specific interviews were conducted on projects that included these technologies.)

1.5 Context

This report is designed to supplement the ITS JPO sponsored **"Building Professional Capacity in Intelligent Transportation Systems: Documentation and Analysis of Training and Education Needs in Support of ITS Deployment"** report, by providing a focus on transit and the role of the FTA. Additionally, it is a companion piece to the **"White Paper on Current and Future Training for Transit in Intelligent Transportation Systems - Professional Capacity Building Program"**. The white paper is a separate evaluation which was conducted of the PCB courses, as well as of other related training opportunities, to provide a picture of where gaps in training to the transit community currently exist, and how these gaps may be overcome.

1.6 Report Outline

- **Chapter 2** briefly outlines the methodology behind the research. It offers the interview approach and the development of the interview guide. It explains the selection of the field contacts and the professional range of people interviewed.

- **Chapter 3** presents the key findings from the field. It examines the concept of an "ideal team" and related roles. It highlights the top 10 transit knowledge and skill needs, based on a survey that was part of the interview guide. Alternative delivery methods are discussed and explored. Policy issues are also delineated.

- **Chapter 4** examines field expectations of the role of the FTA, including both the regional office and headquarters staff. It evaluates the current role of the FTA in ITS deployment, and offers suggestions gathered from the field for expanded and new directions for the administration to consider.

- **Chapter 5** presents the conclusions and recommendations, with some proposals for the next steps to be taken.

1.7 Preliminary Conclusions and Recommendations

The desire for non-traditional delivery methods was a consistent finding throughout the transit industry. Ideas include such things as Website clearing houses for information, and a peer-to-peer network that has been redesigned to include people below the senior level in the organization.

However, interviewees still expressed an interest in attending transit-specific courses and conferences. Strong interest was expressed in attending courses that addressed how ITS solutions have been implemented at various transit agencies. In order to appeal and attract a sizable audience, interviewees indicated that these courses or conferences must be offered locally (possibly at a regional level) so that they incur limited travel expenses and minimize their absences from work.

As regards to the FTA, the interviewees frequently observed that FTA regional staff, because of other duties, often had only limited time available to spend on specific ITS-oriented tasks. In addition, time and funding constraints have limited FTA regional staff from taking advantage of PCB and NTI transit ITS training opportunities. As a consequence, the transit industry does not typically turn to the regional office for technical ITS expertise.

But because both depth and breadth in project-specific experience is critical for technical assistance, regional staff need a greater level of ITS technical depth. Lastly, field interviews indicate a need for FTA staff to have a higher profile in the ITS arena; the most important first step is for the dissemination of pertinent technical policy information to the regional offices.

Chapter 2: Methodology

- The needs assessment commenced with a literature review of ITS research as well as currently available educational and training offerings from the PCB program, NTI, NHI, ITS America and other professional organizations.
- An interview guide was developed in preparation for on-site visits at federal and transportation agencies throughout the U.S. It focused on **staff roles** and **responsibilities**, **knowledge and skills (KSs)** and **needs.**
- The interviews were conducted at twenty-five agencies located in five major metropolitan areas, and included nearly 200 interviews. The transit industry and the FTA represented approximately a third of this group. The interviews were augmented with focus group and telephone interviews.
- The analysis focused on identifying common themes and included specific evaluations of roles, knowledge and skills, and delivery needs across agencies and deployment stages.

This needs assessment began in April 1998. Twenty-five agencies located in five major metropolitan areas were contacted and nearly 200 interviews were conducted. Approximately one third of the interviewees included individuals employed by transit agencies where ITS-related projects are being actively pursued. The remainder of the interviews was with individuals employed in the regional offices of the Federal Transit Administration, and the regional or divisional offices of the Federal Highway Administration. The interview sample also included employees of state departments of transportation, metropolitan planning organizations, and city and county public works and transportation departments.

Recognizing the complexity of each organization and the deployment requirements for ITS projects, the research was conducted to identify professional capacity building needs by position or role, project type, and stage of deployment.

The research included individuals in executive and management positions, and in planning, design, technical, operational, and maintenance roles. Many of these individuals assumed multiple roles, providing significant contributions from project conceptualization through operation and maintenance. The research also included individuals with highly honed expertise whose participation was more discreet, contributing at only one stage of the deployment process or on a particular task. These individuals included lawyers, and contracting agents, human resource, marketing and public relations specialists.

To a great extent, the transit agencies that were contacted represented a cross-section of transit operators. The sample, although limited, included agencies providing bus, subway and multi-modal, as well as paratransit services, and who had a wide range of experience with the deployment of advanced technologies. Several of the agencies had a history of using state-of-the art technology, whereas, others were just beginning to consider technology options, and assess

the potential impact of their deployments on service performance and internal operations. In certain instances, the transit properties had a history of working cooperatively with other transportation agencies, for example, state departments of transportation, in the planning, design and operation of fairly simple to very complex ITS projects.

This project was conducted in three distinct phases. Phase 1 consisted of a literature search, and a review of the most recent reports that have been prepared on ITS professional capacity building. The review included becoming familiar with the ITS educational and training offerings that are available via the Professional Capacity Building program, National Transit Institute, National Highway Institute, ITS America, ITE and other professional organizations.

A major portion of Phase 1 was also dedicated to determining what information was needed to reach a more in-depth understanding of transit professionals' knowledge and skills and their educational and training needs. To capture this information, a decision was made to conduct in-depth, in-person interviews with a range of employees from the different agencies. The majority of the interviews were conducted in-person at the transit properties. Additional interviews were conducted via the telephone and through a transit focus group in Washington, D.C.

An interview guide was developed in preparation for the on-site visits (Appendix A). It served as a reference for conducting the interviews with FTA staff and agency representatives. Many of the interview sessions included more than one agency staff member. Typically the group interviews included the most senior staff member and his/her staff, many of whom had day-to-day responsibilities for operations and project implementation.

The interviews were qualitative in nature, focusing on the following subject areas:

- **Staff Roles and Responsibilities**: Those that are readily available on staff; those that are missing; backgrounds and skills of agency staff; and contractor roles.

- **Knowledge and Skills**: A list of 39 knowledge areas was presented, and interviewees were asked to select the ones that were most important and rank them.

- **Needs**: This included determining whether training, education or technical assistance was more important to meeting interviewees' needs, and what delivery method was the most desirable.

Phase 2 consisted of conducting interviews, reviewing the contents of the interviews, and honing the approach. Prominent national ITS experts identified individuals in each of the metropolitan areas to contact for interviews. FTA Regional staff also recommended contacts among the different agencies. Additional individuals were identified while on site (typically during interviews) and interviews were then scheduled with them.

As part of Phase 2, a focus group was conducted in Washington, D.C. that included transit professionals primarily from the private sector. The focus group followed the structure of the interview guide; however, participants were also asked to identify:

- Types of projects that they have been involved in;
- The greatest professional capacity building needs of their staff and public agency staffs;
- Those areas of consulting on ITS projects which have been the most problematic;
- Those areas where value-added consulting services are most needed by agencies.

During Phase 3, analysis was conducted of the information that was gathered. Time was dedicated to identifying common themes, as well as differences among the agencies. In addition, detailed information specific to each of the interviews on roles and responsibilities, and training, education, technical assistance and delivery needs were entered into a relational database. This facilitated additional cross-cutting analyses to determine the ideal ITS team by project types and deployment stages, required competencies, gaps in knowledge and skill areas, and what training, education and technical assistance professionals are demanding.

Chapter 3: Key Findings

- The development of an "Ideal Team", with important roles to be played through the different stages of deployment, proved to be remarkably uniform across transit agencies.
- The roles of the "Team" can be played by a few people, wearing a number of hats.
- A survey conducted at the interviews produced a top ten list, where technology options and the need for organizational change topped the list.
- Transit professionals want quick delivery of information and training, accessible resources, and training at their convenience.
- The shift in transportation policy at the federal level has created statutory and organizational issues at the regional and local levels which agencies need to address before moving forward with deployments.

3.1 "Ideal Team"

A critical part of the needs assessment concerned staffing and the concept of an "ideal team". During the interviews, people were asked to describe the actual staffing on their ITS projects. The background of the staff person was described, as well as the role they played on the project. Gaps in experience necessary for an ITS deployment were identified, and new knowledge and skill areas were highlighted. Interviewees were also given a chance to describe an "ideal team", one created with hindsight, and with no restrictions on funding. While the answers often reflected the particular stage of deployment for the project, there was a remarkable uniformity across transit agencies in describing their ideal roles. As an introduction, the make-up of the "ideal team" is depicted Figure 1.

It is important here to distinguish between roles and staffing. Many of the "ideal team" members reflect necessary roles needed for the most successful deployments. These roles do not correspond directly to staff positions, and a few people could wear many hats. Many of the deployments studied during the needs assessment did not have the level of roles represented on the ideal team. A number of factors - the size of the transit agency, whether it had a dedicated funding source, and the complexity of the project - had a great impact on how many roles were required, and whether they were filled with in-house staff or were contracted out.

Figure 1. "Ideal" ITS Team Roles by Deployment

Developing a Regional ITS Concept of Operations

Champions
Planners

Roles for the Design, Procurement, Installation, Operations, Maintenance and Evaluation Stages

Project Managers
Software Developers
Systems Designers/Integrators
Operators
Dispatchers
Drivers
Electronics Inspection and Maintenance Technicians

Cross-Cutting Roles

Operations Managers/Supervisors
Business Analysts
Data Analysts and Managers
Contract Specialists
Legal Staff
Public Relations (PR)/Marketing Staff
Human Resources Staff
System Administrators/Support Technicians

Creating Change: Competencies for Mainstreaming ITS

Agency/Program Manager
Inter-Jurisdictional Coordinator

It was the similarities among the role descriptions, supplemented with later analyses conducted across all stages of deployment, which led to the "ideal team." It is listed in Figure 2 and will be defined more fully in the **"Building Professional Capacity in Intelligent Transportation Systems: Documentation and Analysis of Training and Education Needs in Support of ITS Deployment"** report.

Figure 2. Ideal Transit Team

Champions
Planners
Project Managers
Business Analyst
Database Analyst/ Manager
Operator/Dispatcher
PR/Marketing
Legal Staff
Contract Specialist
Electronics Inspection & Maintenance Technicians
Software Developer
System Designer/Integrator
System Administrators/ Support Technicians

The importance of data collection, analysis and dissemination cannot be underscored. During the transit interviews, it became increasingly clear that staff members are recognizing the importance of data management. They are struggling with identifying what data are most important, and how to apply the data to improving operations, and project and facility planning and scheduling.

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 are used. Transit agencies need to apply the information they have gathered in ways that will improve their transportation systems (e.g., scheduling, route planning, equipment programming and procurement), and better inform their decision-making processes. Therefore, the role(s) played by the database analyst/manager is uniformly crucial.

The desire for a role with competency in Public Relations (PR)/Marketing usually came from more experienced ITS practitioners. They had learned the critical importance of marketing a project, within their own agency, and to external groups, such as mayors, city commissioners, legislators, and the public. It was interesting that the more advanced the stage of deployment was for an interviewee, the more often the public relations/marketing role was identified. Having faced numerous internal and external obstacles, they recognized that an ability and readiness to sell the benefits of the project were paramount to moving forward. They also recognized that they needed to continue to be proactive, publicizing the benefits of the deployments, to maintain political and public interest, and financial support.

In addition to the make-up of the "ideal team", there were other common findings throughout the transit interviews. There was a noted shift toward generalists within agencies, especially for the role of project manager. The desired list of roles for the project manager crosses so many professional categories that a generalist "jack-of-all-trades" would be a better description. People were interviewed whose educational backgrounds were diverse, including liberal arts, planning, architecture, and engineering degrees. Nevertheless, individuals in these roles typically shared a number of traits: some technical expertise, business savvy, good communication and motivational skills, RFP experience, contract negotiating skills, and the ability to manage contractors.

Many transit agencies contract out for technical expertise that is specialized, to maximize their resources, to better concentrate on core competencies, and to capture the cutting edge of technical innovation. The role of system integrator, for instance, was infrequently found on staff. A person with these skills was regarded as a precious resource, to be used sparingly at the right times. Although given the stage of the deployment, the need for a system integrator becomes more critical, and their presence on-site for extended periods of time becomes a necessity.

Depending on the type of project, maintenance could be contracted out (off-the shelf devices, like an automated passenger counter, for instance), or in-house staff could receive extensive training from the manufacturer (automated fare collection systems are a good example).

When describing the necessary roles and staffing required for an ITS project, an equally important finding was the level of involvement, by deployment, of any given role. In interpreting the above referenced list of roles, the stage of deployment will determine whether a role is highly required or a lower level of involvement is sufficient. The level of knowledge and skill required is also varied. The Matrices in Appendix B outline in more detail the roles for transit projects. Many members of the "ideal team" are only needed at a specific, crucial stage in deployment, and there is a constant re-teaming occurring as the project progresses. This information enables project managers to marshal scarce resources, and bring in needed expertise in a coordinated fashion.

3.2 Important ITS Knowledge And Skill Areas

Part of the interview was a survey of 39 ITS Knowledge and Skill areas (Appendix A) that interviewees were asked to review. The review had two purposes: first and most importantly, a ranking of the top five were solicited, and the second purpose was to clarify that the list included the most important knowledge and skill areas. Below (Table 1) is the listing of the "top ten" for the transit part of the sample. It speaks to both the technical skills and the organizational savvy required to successfully implement ITS projects. These areas are also referred to as "Competencies" in **"Building Professional Capacity in Intelligent Transportation Systems: Documentation and Analysis of Training and Education Needs in Support of ITS Deployment"** report.

TABLE 1.

Top Ten Transit ITS Knowledge/ Skills Areas (based on 70 interviews)

- Technology Options
- Creating Organizational/Institutional Change
- Communications: Writing Specifications
- Technology Options: Cost/Benefit Analysis
- Systems Integration
- Managing Contractors
- Financing
- System Support & Maintenance: Training on ITS Devices/Equipment
- ITS Planning: Regional Concept of Operations
- ITS Planning: Developing a Business Plan

As a result of the interviews, it became clear that there are at least two levels of proficiency for each of the identified knowledge and skill areas. The first is aimed at the "awareness" level. Individuals' knowledge must be sufficient to understand ***what*** information in the different knowledge areas is important and ***why.*** The second is aimed at the actual implementation and deals with the ***"how***" aspects (i.e., moving forward with implementation and eventual operation). The levels are distinguished, in part, by the degree of technical expertise required. See Appendix B for detailed transit project matrices.

Clearly, the delivery of PCB must be targeted to the appropriate level of need and expertise that professionals require to successfully meet job performance expectations. Given the interest of the JPO-PCB program in providing relevant training, interviewees were asked what topics were needed (content), what was the best way to deliver the material (method), and who should deliver it (source). Naturally, the method of delivery and preferred deliverer vary based on the content or information to be transferred. For example, systems integration skills or systems analysis and design should be taught at the university level. An awareness of the available technical options for a given project, however, could be gathered from information provided by the equipment vendors or via vendor sponsored training sessions.

A brief discussion follows on each of the above ten, as it relates to the transit industry.

Technology Options:

The issue in this case deals with how to choose the most appropriate and cost-effective technology, one that will satisfy the greatest number of system users. There are a number of issues to consider. These include both the costs and the benefits of the system as well as its capabilities and limitations. The ready availability of the technology, its expandability and extendibility are all-important criteria to examine. The risk involved - meaning is it a proven technology? - is yet another consideration. Its life cycle and projected obsolescence, the nemesis of high technology, have to be considered. The criteria for its performance must be evaluated, and adequate acceptance testing procedures predetermined. Lastly, it must conform to standards still under evaluation by the federal government.

When transit people in the field were interviewed, the "Technology Options" knowledge area was the most frequently identified area. Certain critical components of a full analysis were important enough that "Technology Options" was actually selected more than once (See Cost/Benefit below - which is actually a part of a full Technology Options review).

The ability to clearly identify the most appropriate ITS technology is a critical need. The procurement process plays a significant role in the ability to make the most suitable choice. The best choices and the most comprehensive options were the ones selected with everyone from the managers to the maintainers involved in the process. There was no "one size fits all" model to be learned from the field.

Creating Organizational/Institutional Change:

Often the most difficult obstacles in ITS deployments are not technical but institutional. Given that agencies are accustomed to operating based on modal thinking, institutional issues become the greatest non-technical barrier to ITS deployments.

ITS requires agencies to change their mission and approach to operations as advanced technology deployments become more inter-agency and systems-oriented. ITS projects can require that transit agencies cooperate with one another, as well as other transportation organizations - in concept and project planning, as well as other stages of deployment - in ways that are often a precedent.

Such institutional problems include narrowly defined mission statements that translate into rigid agency rules, policies and procedures. Interviewees particularly noted that specification requirements, and procurement and contracting procedures that require lengthy internal approval review are a major hindrance. Others interviewees noted that narrowly defined job classifications, pay structures, and union contracts hinder the flexibility needed to staff ITS projects. The lack of budget priority for needed training and development of the required staff expertise is also an issue.

To combat these institutional issues, agencies deploying ITS must form interagency committees to coordinate efforts. In this way, agencies can leverage funding, facilities and staff to avoid redundancies. These committees can be for planning, design, installation, operations and maintenance purposes

Organizational barriers can be divided into internal and external barriers. Internal barriers include an agency's mission and objectives that narrowly defines its purpose, an agency's limited authority to make decisions, funding constraints, high turnover in project managers and inability to retain computer and systems engineers. External includes agency turf protection, limited past interagency cooperation, lack of a strong champion and funding processes that are stove-piped. At the same time, state and local legislation, sometimes preclude the degree of interagency cooperation that is necessary.

Communications: Writing Specifications:

Good communication skills are crucial in every aspect of project development and deployment. ITS communications includes the ability to concisely explain advanced technologies and systems to a "lay audience" that does not have a technical background. This lay audience includes politicians, executive branch managers, staff aides, public interest groups and citizens. An important aspect of this skill is "managing expectations"-making sure that realistic assumptions are made about the project's ultimate performance and communicating these to elected and appointed officials and agency staff.

Besides good oral communication skills, written skills are important since the genesis of any deployment depends on the preparation of project proposals, request for proposals (RFPs), specifications and contracts.

This category also includes the writing of specifications during the procurement process. In writing specifications, it is important to distinguish between functional and operational requirements versus simply specifying technological options. Too frequently, ITS deployments require iterative problem-solving that includes the consideration of alternative technologies and devices along with periods of testing. At the same time, specifications which detail descriptions of equipment or services have been found to be counter-productive, given that the life-cycle for new technology does not typically extend beyond 18 months.

Technology Options: Cost/Benefit Analysis:

In order to choose the most appropriate and cost-effective technology, one that will satisfy the greatest number of system users, there are a number of issues to consider. These include both the costs and the benefits of the system (See above- Technology Options). The ability to perform a detailed cost/benefit analysis is a skill in its own right. This is an area where previous experiences could be disseminated to help novice transit agencies with the most appropriate technology selection. It also lays the groundwork, as part of project evaluation, for the ultimate selection of the appropriate technology.

Systems Integration:

The term "systems integration" has a number of different meanings according to the context in which it is used. At the broadest level, systems integration refers to the recognition that a comprehensive regional transportation system is made up from a number of smaller individual transportation organizations or projects. The “system” encompasses all of them, although each is complete and functional in its own right. Transit is just beginning to participate in regional "systems", with innovations such as "Smart Cards" and TMCs.

On a more detailed level, systems integration refers to the specific components or devices of individual projects, and how they are related. Each device’s internal performance, its communication links to other devices, data input/output or manipulation, and control mechanisms are part of a complex chain. The devices must work properly and communicate accurate and timely information to be of any use. In transit, this is the context in which systems integration is most commonly used.

Managing Contractors:

ITS deployments require management skills not found in traditional government-contract relationships. Since managing outside contractors is such an important part of most ITS deployments, it is especially important to understand both the contractor and the public sector agency point of view. The ability to manage contractors requires continual support throughout the deployment process. It starts with the writing of good functional specifications for the

"request for proposals," and continues to the development of detailed contract documents that are clearly stated and understood.

Many agencies must build expertise internally to deploy ITS. This is due to several reasons. Many agencies have hiring freezes and/or are downsizing, leaving much of advanced technology projects to be designed and installed by contractors. Given that the hi-tech industry is currently so competitive, it is hard to attract the right talent with the salary caps in government. This leaves agencies with many mid-level staff that need training to manage contractors in unfamiliar technology projects. Again, budget prioritization for training is needed.

Financing:

The sources of funding for ITS projects range from direct federal funding from the FTA, to a myriad of public/private partnerships on a local level. Understandably, the transit field is interested in any available source of funding. It is important to note that FTA ITS-designated funding carries the caveat of conformance with the National Architecture.

Many ITS projects in the transit arena are grant driven. There are drawbacks to grants; the most common being that the grant drives the project, rather than the reverse. Additionally, operations and maintenance are not typically grant-funded functions. This demands attention from the policy makers at the federal level.

Partnerships present another level of complexity to funding questions. One such example concerns the ownership of software developed with public money.

An important component to the funding question concerns the ready access of information available on funding sources. It would be useful to have a centralized location to access such information, or to have clearly established FTA points-of contacts who are specialists in this area and can readily advise or respond to transit agency requests.

Currently ITS funds are stove-piped in that they are designated to individual transportation agencies. New funding must be given for interagency projects.

Transit interviewees particularly noted a need for funding that covers system operations and maintenance. There also needs to be more innovative financing such as ticketing, user fees, and public-private partnerships. Agencies could initiate new procurement strategies that would leverage their positions to purchase technologies at low cost. Interviewees also noted an important need for funding of project evaluation.

System Support & Maintenance: Training on ITS Devices/Equipment:

The introduction of ITS requires the use of electronic devices that operate systems and collect and disseminate data for transportation decision-making. Agencies repeatedly made a request for professionals who were “electronic electricians”. An electrician runs wires and installs devices; an electronics technician is able to work on devices at the component level. Due to the sophisticated electrical nature of electronic devices deployed in ITS, an "electronic electrician" is needed.

How to install and integrate devices through networks and computers, ensuring that all operate together as one, is a chief concern at all agencies. To have a fully functional system requires different types of inspection and testing as well as alterations to the construction of the physical infrastructure. Basic fundamentals are telecommunications engineering, software engineering, data and database management, inspection and testing procedures, understanding transmission media especially fiber optics, protocols and standards, interfaces and issues with connecting new and older devices.

ITS Planning: Regional Concept of Operations:

The regional concepts of operations that have been evolving recently have been focusing on more effective management of the existing transportation system. Metropolitan areas continue to be committed to increasing capacity and improving the overall performance of all the components of their transportation system. The emphasis, however, has shifted from construction to alternative solutions, some of which incorporate advanced technologies.

The requirement, resulting from the passage of Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA), for metropolitan areas to conduct major investment studies, has provided an opportunity for ITS-related solutions to be proposed and evaluated along with more traditional alternatives in the development of a regional concept. In addition, with the passage of Transportation Efficiency Act for the 21st Century (TEA-21), regions, which are committed to ITS projects, must demonstrate conformity with the National Architecture for their projects to qualify for federal funding.

ITS Planning: Developing a Business Plan:

The selection of "how to develop a business plan" reflected a concern expressed by experienced transit project managers. These individuals had learned the hard way that a piecemeal approach had serious consequences for the success of any ITS deployment. In addition to identifying goals, objectives, participants, tasks, schedules and funding sources, interviewees indicated that these plans must define what partnerships are needed, establish performance criteria, and present marketing strategies. There was recognition that business plans similar to those prepared in the private sector could be prove to be useful road maps for moving forward with deployments.

3.3 PCB Delivery Issues

Just-In-Time, On-Demand Delivery Needs

Interviewees were asked what topics were needed, what was the best way to deliver the material, and who should deliver it. This line of questioning produced useful information on what additional topics are of interest to transit professionals.

During the course of the interviews, it became increasingly clear that demand exists for more information, and ITS training and education. More importantly, however, interviewees stressed that traditional course offerings and training sessions, which are classroom based, will not meet all their needs. The PCB program (as well as, universities and associations), if it is to be effective in meeting transit professionals' needs, must begin to consider other delivery methods for disseminating information and providing training. In fact, research recently completed by the Volpe Center (documented in **"The White Paper on Current and Future Training for Transit in Intelligent Transportation Systems"**) indicates that transit agencies have been under-represented at PCB courses (in comparison to other public agencies).

The interest among transit professionals is in:

- Quick delivery
- Accessibility to resources
- Convenience - - an ability to take a course or training at any time - day, night, or the weekend.

There are several reasons why transit professionals have recommended that alternative delivery methods be considered and incorporated into the PCB program. Few transit agencies can afford to send staff members to lengthy training classes. Finding time to commit to a 2 or 5 day course or training session is difficult. Time availability is constrained by the day-by-day operations of the agencies, and the need for a hands-on approach by most employees. Many of the employees also indicated that if they could go to a course or training session, finding a back-up to cover for them was almost impossible, since staffing at most agencies is very lean.

In addition, a number of interviewees complained that courses that they attended were too general. They were looking for more targeted information on a far wider spectrum of topics. Individuals stated that courses were frequently designed to meet the needs of the "lowest common denominator" rather than providing more targeted, in-depth material. Clearly, the classroom setting and the pre-designed curriculum are not sufficiently flexible - they can not be easily adjusted to meet the needs or the backgrounds of the students who show up.

Besides a need for highly technical information on such topics as fiber optic use, system integration, and radio communication technology, some transit agencies said they needed assistance with meeting more basic training needs - teaching employees about personal computers (PCs) and software packages (such as word processing, spreadsheets and relational databases).

One interviewee stated "we need assistance teaching employees how to turn a computer on". Another interviewee stated “our student interns are often way ahead of us in basic computer skill”.

Clearly, if the needs of the transit professionals are to be met, the PCB program must continue to develop courses, but begin using delivery methods, which provide for just-in-time or on-demand learning.

Internet-Based Delivery

Given organizational and job constraints, and the need for immediate knowledge, more and more of the interviewees suggested that they would like to begin receiving training and specific knowledge on ITS-related subjects via compact discs or from the Internet. Essentially, they want to be able to get to a resource while sitting at their desks in the matter of seconds. Internet accessibility, interviewees recognize, provides the opportunity for:

- Receiving relevant and up-to-date information
- Connecting with a peer-to-peer network
- Receiving encapsulated training on discreet topics
- Participating in lengthy courses

Many of the interviewees were unaware of the range of published documents that are available, the Electronic Document Library, the range of ITS Web-sites, the ITS peer-to-peer network and the courses that are available via the PCB program and from many other organizations.

Consequently, interviewees expressed the need for the creation of an electronically accessible "one-stop" shopping location - a centralization of existing resources that can be modified, enhanced or updated over time.

For information dissemination purposes, an Internet-based one-stop shopping location could provide users with access to:

- The Electronic Document Library, which contains published ITS documents
- A searchable database to secure shorter articles and executive summaries of lengthy publications, and
- A monitored database, which would provide some level of personal response to questions or problems

For providing technical assistance, the introduction of an Internet based site could provide an opportunity for United Stated Department of Transportation (US DOT) to enhance its peer-to-peer network, and make case studies of different deployments available.

It became increasingly clear during the interviews that most interviewees did not know of the peer-to-peer network's existence. The creation of a readily accessible Rolodex of technical experts to be managed by FTA and FHWA field staff was frequently suggested. The Rolodex would

consist of experts who would be available to advise, guide or consult on a short-term basis. It was envisioned by interviewees to be a referral service, providing quick, as well as, free access to knowledgeable individuals at any time during a deployment.

Interviewees also called for readily accessible information on best practices or deployment case studies. Quick accessibility would leverage already acquired knowledge. Individuals moving forward with an ITS deployment would be able to learn from the mistakes of others or avoid unnecessarily re-inventing the wheel.

Many of the interviewees recognized that success in their jobs requires them to be proactive, continuously learning and acquiring new skills. At the same time, many of the positions that they are filling demand a fast track for the acquisition of the required knowledge and skills. Once again, Internet based courses or training sessions were perceived by interviewees to be quick fix vehicles. The availability via the Internet would enable them to learn at their own pace, and delve as deep they want into different subjects.

Additional Educational and Training Needs

Given the demographics, knowledge and skill base of their organization's employees, interviewees indicated that there is a strong need for courses on the following topics:

- Transportation fundamentals
- Data analysis and management
- Viability (including risk) of technology options
- Planning tools
- Principles of systems engineering
- Principles of telecommunications engineering
- Public-private sector differences

As discussed above, if the delivery approach is a traditional classroom, the courses will not be well attended by transit professionals.

Because of the advent of advance computing and communication technologies, some organizations have been actively hiring recent graduates with system or electrical engineering degrees. Given the scope of their academic programs, these "fresh-outs" have no or limited knowledge of transportation, public policy, project management, contracting options, systems integration or data management and analysis.

Consequently, to be able to effectively mainline these individuals, agencies need short, readily accessible and inexpensive courses on any of one of the above topics.

Even though demand exists for an offering of short, readily accessible courses on many of these different topics via the PCB program, interviewees said universities need to incorporate many of these topics into existing courses or identify relevant courses across professional programs.

Since the backbone of many of these agencies is individuals who are mid-career, demand exists for courses of a technical nature. The goal for these individuals is to become current as quickly as possible on such topics as computing and telecommunication technologies, system design and integration issues, and automated modeling tools. These individuals also need ready access to very specialized training, limited in duration, on such topics as managing contractors, negotiating contracts, writing specifications, and installing, maintaining and troubleshooting equipment.

3.4 Policy Discussion

Agencies that participated in the study have discovered that they have been unprepared to meet all of the demands that have emerged during the deployments. Participants have come to understand that ITS projects are complex problem-solving endeavors that require more than competent professionals contributing their knowledge and skills. They have learned that ITS requires a paradigm shift that involves changes in public policy, legislation, and organizational structure. Those changes that interviewees identified in each of these subject areas are discussed below.

Public Policy

Clearly, a shift in transportation policy at the national level occurred with the passage of ISTEA. The impact of this legislation has not yet been complete. Transit agencies are grappling with:

- Recognition that funding to finance major construction projects is not limitless
- Identification of alternative strategies for improving mobility
- Evaluation of strategies, particularly those that incorporate advanced technologies

Many of the interviewees who are actively involved in ITS deployments stated that their ability to move forward has been hampered by a lack of awareness or buy-in among decision-makers. There is also a need for new federal and local legislation as well as a public policy shift, which enables agencies to modify operating and business practices.

- Interviewees called for:

  - recognition among policy-makers at state and local levels that selecting a consultant, contractor or vendor based on price alone is not always in the public's best interest. Other criteria, such as value-added services (e.g., a providers' commitment to a continuing level of support, to troubleshooting problems following deployment, and delivering products or services that are consistent with the specified requirements) need to be as heavily weighted.
  - considering functionality (along with the acquisition and application of technology) when developing a deployment strategy will result in more effective, and long lasting solutions, particularly since technology is advancing at a rapid pace.
  - unlike transit construction projects, there is no recipe for each stage of deployment for ITS. There must be sufficient latitude in each of the stages (planning, design, and

implementation) for problem solving, troubleshooting and the testing of cutting-edge technology.
  - public agencies must begin to work cooperatively and continuously to implement technology, conduct evaluations, make performance-based decisions, and leverage procurement.
  - without a local funding source, such as a dedicated sales tax, many transit agencies are unable to move beyond the maintenance of day-to-day operations, and initiate more cutting-edge type projects. The financing of the day-to-day operations, equipment acquisition and maintenance, and operational tests and full deployments of new technology is heavily dependent upon the availability of federal grants.

- Legislation which:

  - enables agencies to acquire the intellectual property rights of software and technology that have been developed on their behalf.
  - allows agencies to form partnerships with other public organizations, as well as private enterprises, to plan and deploy ITS projects, jointly own and operate technology, establish protocols for sharing and transmitting data, and arrange for cooperative purchases.

Organizational Change

The interviewees emphasized that their organizations do not provide them with the latitude to readily take on many of the deployment problems that they are encountering. Their organizations have been shaped by public policy and enabling legislation that evolved at a time when improving transportation and regional mobility was equated with new construction.

Openness to Change

The interviewees indicated that ITS deployments require an organizational culture, or climate, where the following exists:

- Openness to change, which is implemented with the full support of decision-makers and management
- Institutionalization of values and shared attitudes among employees, which encourages
  - Teamwork and cohesiveness among employees from different departments and with external agencies
  - An interest in considering new technologies or strategies
  - An atmosphere where "risk-taking" is permissible (organizations can consider solutions or technologies that are not "tried and true")
  - Consideration of functionality rather than proposing quick-fixes
  - An interest in delivering improvements that continuously meet "customer" needs
  - Identification and commitment of personnel who are able to:
  - Implement the accepted vision
  - Provide day-to-day leadership
  - Take on unpopular "causes" and work as an advocate among employees and management

– Provide project management expertise, including consultant oversight

Internal Business Process Improvements

Besides the shift in organizational culture, interviewees identified a number of improvements to internal business processes and practices, which are needed to fully support ITS-related deployments. These different areas are discussed below.

Human Resources

Interviewees called for the adoption of human resource practices that are more in-tune with the technical developments that have taken place, the competitiveness of the job market, and the service demands of customers. Specifically, they called for:

- Creation of job classifications and descriptions, which enable them to hire individuals with current computer science, electrical engineering, system development and integration, and database management skills.
- Adoption of competitive pay scales and compensation packages which enable them to recruit individuals who are fresh-out of undergraduate and graduate programs, attract individuals who are mid-career and have developed the desired expertise, and retain valued employees.
- An educational and training strategy, which caters to mid-career employees who are searching for on-the-job challenges and want to continue working for the same employer.

Interviewees clearly stated that any change at the operating and maintenance level is dependent upon labor contracts, which have been negotiated with the agencies' labor unions. In some instances, interviewees have indicated that recent labor negotiations have resulted in provisions committing agencies to provide a set number of hours of training for its employees over the period of a year. This provides agencies with opportunities to train employees on both the awareness and use of new technologies. The focus of the training needs to be on how the technology will make their jobs easier. Otherwise, operators too often perceive the new technology to be a threat.

Procurement and Contracting

Interviewees consistently stated that deployment of ITS projects depended upon significant modifications to the standard procurement and contracting procedures that have been employed by their organizations. The procedures or practices need to be modified to accommodate:

- extensive on-site problem-solving, provided by a range of technical experts
- the use of functional specifications, which facilitate problem-solving and the use of the most current technology
- the creation of solid working relationships or partnership among public agencies and with private sector organizations that are based on contractual agreements regarding:
    - risk sharing
    - continued cooperation following prototyping and deployment

- ownership of intellectual property and data, and
- maintenance of hardware, software and systems

- the rapid changes that are occurring in the communication and information technology markets, where product life cycles are lasting no more than 12 to 18 months

Interviewees stated that their legal and procurement personnel must forge new working relationships with transportation and management information staffs, and with external contractors. They must work together to identify user needs, translate those needs into requirements and specifications, understand the life cycle of technology, identify best sources for technological options, and determine and negotiate development and intellectual property rights.

The complexity of ITS related transportation programs has made it necessary for agencies to begin employing different procurement strategies. That is, the procurement strategy that is used should be structured to meet program needs, secure necessary services and equipment, and to establish the working relationship or "partnership" that is needed to meet program objectives on an ongoing basis.

Greater knowledge of contracting options, how to protect intellectual property rights, and structure licensing agreements has become necessary prerequisites for legal staffs. Often the low cost bid or design/build procurements do not meet the needs of ITS technology purchases. For example, software procurements need to take into consideration compatibility and extendibility issues. In addition, the selection of the low cost provider sometimes excludes value-added services - access to troubleshooters, hardware and software updates, and maintenance support - that are needed to ensure continued well-being of the operational systems.

Chapter 4: The Role of the FTA in ITS

- FTA regional staff, because of other duties, often have only limited time available to spend on specific ITS-oriented tasks.
- "Customers" do not typically turn to the regional office for technical ITS expertise.
- Because breadth and depth in project-specific experience is critical for technical assistance, regional staff need a greater level of ITS technical depth.
- Field interviews indicate a need for FTA staff to have a higher profile in the ITS arena; the most important first step is for the dissemination of pertinent technical policy information to the regional offices.

4.1 Summary

As the Methodology chapter indicated, over a third of the interviews were with either transit staff or FTA regional offices. Questions were specifically asked about the skill areas, roles and desired assistance from the FTA on ITS projects. This chapter discusses the responses from those questions and evaluates the current and potential future roles for both FTA regional staff and FTA headquarters in ITS planning and deployment.

4.2 Current Roles of FTA Regional Office ITS Specialists

The interviews clarified the typical roles currently performed by the ITS specialist in the FTA region. They included acting as liaison with Headquarters and translating the federal policy for the field. Additionally, regional staff provides funding information and processes grant applications for transit agencies. The specialist also acts as a regional program development officer, who conducts planning certification reviews. Last, but by no means least, regional staff operates as the transportation interface for welfare-to-work issues.

While these are all important and meaningful roles for staff to play, they also constitute very full-time responsibilities. **FTA regional staff, because of other duties, often have only limited time available to spend on specific ITS-oriented tasks.** Consequently, only a portion of a FTA's staff person's time is spent performing the responsibilities that an ITS specialist would be charged with. More importantly, staffs in these positions do not have time to learn ITS specialties. **Because breadth and depth in project-specific experience is critical for technical assistance, regional staff needs a greater level of ITS technical depth.**

The policy (softer) side of ITS has been the primary focus of the regional ITS specialist — institutional, political, programming and funding issues, including transit planning — yet customers tend to be more technically oriented and focused. **In general, the interviews revealed**

that customers do not typically turn to the regional office for expertise in technical ITS areas.

4.3 Ideal Roles for FTA Regional Offices and Staff

During the interviews with FTA and transit agency staffs, many suggestions were offered for modifying the role of the FTA regional specialist so that it would be more responsive to the ITS audience. The research indicated that, ideally, FTA staff competencies in the following areas are critical:

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

Suggestions from both FTA and agency staff pointed to a basic requirement for ITS competency. FTA staff responsibilities must include overall regional oversight on ITS deployment and integration. This included tracking the status of projects as well as accessing resources or information on ITS for transit. This oversight function would provide the regional staff with additional knowledge about projects, their schedules and budgets, which could then be shared with other interested transit providers.

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

In the recent past, an additional source of knowledge has been provided, in some cases, by a working liaison with FHWA regional staff to further project integration. However, the FHWA reorganization and the creation of the new FHWA Resource Centers will make the coordination more difficult, in part, due to the decrease in the number of FHWA offices, and the reassignment of FHWA regional staff. But there is also an opportunity to spread resources across the DOT through the FHWA Centers. The plan to develop enhanced in-house ITS specialization at the Resource Centers may be a resource that can be utilized by the FTA as well.

Other ideas from the field included the ability, by acting regionally, to leverage transit procurement funding by enhancing group purchasing power. This would require different transit

agencies within a FTA region coordinating their equipment and service needs as they move forward with deployments. The FTA regional office would be the logical focal point for this coordination.

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

4.4 Role of FTA Headquarters and Staff

Feedback from the field was that FTA Headquarters also needs to play a higher profile role in the promotion of ITS in the transit field. To make this happen, a high level FTA focal point needs to be clearly identified. This focal point would have responsibility for providing direction to the Regional Administrators and the Regional ITS Specialists on the importance of ITS.

Obviously, to elevate the importance of ITS, the role of the ITS specialist in the regional office must be enhanced. **A good starting point for a higher profile would be to insure the dissemination to the field of all pertinent technical and policy ITS information currently available**. Often, both regional staff and transit agency staff were unfamiliar with available federal publications, information sources and Websites that have an ITS focus. It is also a desire of the field that some governmental body, state or federal, play a role in certifying ITS technicians to insure quality.

4.5 Recommended Next Steps

1. Validate, modify preliminary results based on feedback

2. Develop "model" curriculum for FTA Regional staff

   Assume basic education is in place and recommend courses to achieve technical and non-technical competencies

3. Investigate and offer the most appropriate delivery methods

4. Establish immediate training opportunities for existing and new hires

5. Recommend how to establish a "learning environment for continuous education and for establishing a continuous pool of talent

Chapter 5: Conclusions and Recommendations

- The clear call from the field is for targeted, tailored, and accessible resources. These must be available on-demand, just-in-time learning/problem-solving resources, which can overcome time and budget constraints.
- There are at least three options for satisfying these requirements, including an expansion of the PCB program role, enhancement of the FTA regional specialist's role, and alternative delivery options for needed technical assistance and training.
- The challenge is to develop accessible information and delivery methods that provide the necessary competencies to support PCB requirements.

5.1 Conclusions

Transit interviewees expressed interest in the training (courses) offered via the PCB program; however, strong demand exists for training that is readily accessible, meets immediate needs, and is presented at a level of detail that is required to move forward with the task at-hand.

Although strong interest in PCB courses exists, interviewees stated that their opportunities to attend training that required attendance off-site and was for a day or more were limited. As discussed earlier in this report, their organizations have limited training and travel budgets. Their organizations will not pay for courses that are several days long or require travel to another city. Also, given the operational demands of their jobs, many of these individuals have little time to spare. Even if time could set be aside for training, many of these interviewees said that they have no one to fill in for them while they are away, since staffing levels are almost always lean.

PCB courses do not meet immediate problem-solving needs that many of these individuals are facing. The nature of many of the technology deployments requires that they come up to speed as quickly as possible - sometimes in the matter of hours. They do not always have the luxury of waiting for a course to become available, then enrolling in it, and then wading through a tremendous amount of material to uncover the one nugget that they need.

As more interviews were conducted, it became increasingly clear that the traditional classroom setting could no longer be the only standard for delivering training. Besides the budgetary and time constraints cited above, many of the interviewees stated that these courses attempted to be too many things to too many people. Individuals stated that courses were frequently designed to meet the needs of the "lowest common denominator" rather than providing more targeted, in-depth material. Clearly, the classroom setting and the pre-designed curriculum are not sufficiently flexible - they can not be easily adjusted to meet the needs or the backgrounds of the students who show up.

In addition, many of the interviewees said that they would like access to experts who can advise them on technology options, and planing, implementation and operational issues. They would like these experts to be only a call away. There is interest in having the FTA ITS specialists be the initial point-of-contact for identifying the appropriate person and possibly making whatever introductory calls are necessary.

5.2 Recommendations

Given the results of the research that has been conducted, the PCB program is encouraged to:

- ***Expand and enhance current training*** by modifying existing courses and developing new ones. The course material and the delivery style must be designed to be consistent with the findings of this needs assessment - tailored, and targeted. They must also demonstrate real applications that have been successfully tested and deployed. The range of course offerings must satisfy the professional needs of individuals who are mid-career, relativelyfresh-out (from schools), and in the midst of their professional education. At the same time, the course offerings must also meet the needs of individuals with advanced professional degrees as well as those with technical backgrounds who have either learned on-the-job or have advanced through programs offered by vocational schools and community colleges.

  - It is recommended that the PCB program along with organizations like the NTI, APTA and ITS-America ***continue to examine course offerings, modify course content, and consider new delivery methods***. This process should be done in a coordinated manner. Any efforts need to be consistent with the findings that will be documented in detail in the **"Building Professional Capacity in Intelligent Transportation Systems: Documentation and Analysis of Training and Education Needs in Support of ITS Deployment"** report**.**

  - Interviewees expressed strong interest in ***partaking in hands-on, application oriented learning situations***. They called for interactive classroom situations for professionals, which focus on problem-solving, managing contractors, negotiating skills, writing specifications. For technicians, the focus of the "labs" would be on equipment installation, maintenance and troubleshooting.

  - As efforts move forward, the ***transit community must consider how to best to coordinate or leverage ITS efforts that are underway*** within different US DOT administrations. The creation of the FHWA Resource Centers is intended to improve the delivery of ITS information and expertise. This provides an excellent opportunity for partnering with the Department and creating multi-modal initiatives.

  - Interviewees also expressed interest in the ***expansion of formal academic programs*** offered by universities, community colleges and vocational schools to incorporate the following:

- Systems integration
- Managing contractors
- Contracting options
- Software/hardware operations
- Project management
- Data analysis, evaluation and management

➢ Strong interest in continued technical assistance. This would require ***strengthening the peer-to-peer program***. A first step would be to widely publicize its existence. It would also require FTA ITS specialists to be more proactive - regularly communicating the availability of this resource to their "customer base".

- ***Develop a program to create a Virtual Learning Environment.*** This would meet the audience's interest in receiving knowledge and specific information about technologies, application and deployments on a just-in-time or on an on-demand basis. It would satisfy the demand for immediate problem-solving that many individuals in the public sector face. Besides easy access, this provides individuals with a self-directed learning experience.

  Full development of this program would consist of:

  ➢ ***Developing web-based and electronic media tools***:

  This accomplishes the goal of accessibility and provides an opportunity to target audiences more directly. It also allows for audiences to tailor materials and programs to meet their own needs. It provides a continuous learning environment and allows for audiences to access materials and programs that are consistent and relevant, giving the “right information” to the “right people” at the “right time”

  ➢ ***Incorporating***:

  - Training-On-Demand consisting of ***interactive courses on CD-ROM and Internet with hyperlinks.***

  - Just-In-Time Training, providing ***targeted, tailored critical topic discussions - an electronic “encyclopedia”*** with examples and best practices to support decision making.

  - Technical Assistance with ***a Rolodex of experts*** (managed by Federal Staff); ***Web-site modules for Frequently Asked Questions*** (FAQ); and ***a managed discussion group*** site for difficult questions

  - Information Dissemination that has ***a search engine for navigating the Electronic Data Library***; and ***curriculum modules*** that outline recommended training and education sequences.

- ***Enhance & target activities with partners.*** Many of the transit properties recognize that their success with any deployment depends on their ability to tap into expertise that already exists in either the public or private sectors.

  - Since transit operators tend to be risk adverse, they want to implement technologies that are tried and true. ***Associations, universities, and vendors need to provide very tailored training or information on what works, and what will produce the greatest benefits***. At the same time, the door is open for these organizations to produce training on how to evaluate technology options, particularly those that might be cutting edge, and will be viable solutions in the long-term.

  - For the PCB program to effectively move forward with many of these recommendations, ***FTA Headquarters must more clearly define the ITS responsibilities for Regional staff***. At the same time, they must ***ensure that the ITS specialists have the knowledge, resources and tools that are needed*** to extend themselves to their "customer base".

5.3 Recommended Next Steps

- Enhance and expand existing training, education, technical assistance, and information dissemination

- Target resources to improve effectiveness of FTA Staff

- Target resources to continuously meet transit industry needs

- Establish virtual learning environments

- Target current work with partners and stakeholders to implement recommendations and leverage resources

The immediate need is to provide transit professionals with information that is tailored, supports them in their day-to-day endeavors, and is readily accessible. In the short term, some of the needs of FTA's customers could be met by placing individuals in the field who have the knowledge or can readily access the information or resources that are desired. This would require a commitment on the part of Headquarters to training its field personnel, and ensuring that their personnel has ready access to the information, tools, and expertise that is being demanded.

Investment in virtual learning environments would also move the FTA closer to satisfying their customers' demands for just-in-time or on-demand learning. However, this requires a substantial investment and long-term commitment that can be best met by establishing cooperative

relationships or partnerships with other US DOT administrations, universities, professional associations and vendors.

LIST OF ACRONYMS

APTA	American Public Transit Association
AVL	Automatic Vehicle Location
CAD	Computer-Aided Dispatch
FHWA	Federal Highway Administration
FTA	Federal Transit Administration
FAQs	Frequently Asked Questions
GIS	Geographic Information System
GPS	Global Positioning System
ITS	Intelligent Transportation Systems
ISTEA	Intermodal Surface Transportation Efficiency Act of 1991
JPO	Joint Planning Office
KSAs	Knowledge, Skills and Abilities
MPO	Metropolitan Planning Organization
NTI	National Transit Institute
PCs	Personal Computers
PCB	Professional Capacity Building
PR	Public Relations
RFPs	Requests for Proposals
TEA-21	Transportation Efficiency Act for the 21st Century
TMC	Traffic Management Center
US DOT	United States Department of Transportation

APPENDIX A - INTERVIEW GUIDE

Staff Roles & Responsibilities (20 minutes) (Specific Project(s)?)

A. Confirm type of agency — mission / function.

B. ITS elements / technologies (List): _____ .

Planned
Designed
Procured
Installed
Operated
Maintained

Circle experience/state of project

Position Who are the people on staff with this project?	**Roles and Responsibilities** What do they do?	**Background/Skills** Why selected?	**Staff or Contractor Why?**

What roles on this project are missing? Why?

2. Knowledge and Skills (30 minutes)

Handout checklist: What are the most critical knowledge areas/skill areas this project needs to be successful? Check off most critical in the first column. (Write anything that is missing.)

- Now circle the top 5 and rank them in column 2.
- Discuss the top 3 selections in order…

- What level of knowledge was needed?
- Ideally with who is it most appropriate to house this responsibility?
- Who has it now?
- Within the agency who else needs to know about this? At what level?
- Outside of the agency?

Knowledge Areas for ITS Projects **(Greatest Needs – Specific Project(s))**

		A	B	C
Tran. Planning Process	1. Regional Concept Of Operations			
	2. Identifying Organizational Barriers and Managing Change			
	3. Coalition Building with New Stakeholders			
	4. Comparing/Combining ITS and Capital Improvements			
	5. ITS projects in the MPO Regional Trans. Plan/TIP			
	6. Developing a Business Plan			
	7. Data Sharing between Agencies			
	8. Risk Management			
	9. Partnerships – Structuring Public/Private Agreements			
	10. Public Relations			
Project Planning/Design	11. Technology Analysis — Range of Options			
	12. Cost/Benefit Analysis			
	13. Analysis of Existing ITS Infrastructure			
	14. Using the National ITS Architecture for Planning			
Procurement / Funding	15. Sources of Funding — Fed/State/Local/Private			
	16. Writing Specifications—Technical and Legal Issues			
	17. Procurement Options: Design / Build/Lease Agreements, Shared Resources Agreements and RFPs			
Contracts Management	18. Managing Software Development and Costs			
	19. Managing Contractors: Developers and System Integrators			
Systems Engineering	20. System Analysis and Design			
	21. Consistency with National ITS Architecture and Standards			
	22. Requirements Management			
	23. System Integration			
	24. Quality Assurance			
Telecommunications	25. Capacity Analysis — Transmission:Wireline v. Wireless			
	26. Lease / Build Decision Making			
Installation/ Deployment	27. Acceptance Testing			
	28. Use of Prototypes			
	29. Training			
Operations Center	30. Operations Center Staffing Requirements			
	31. Management of an Operations Center			
	32. Human Factors			
Legal Issues	33. Privacy of Data and Identification			
	34. Liability Issues			
	35. Security Systems & Network Vulnerability			
	36. Intellectual Property Rights			
Maintenance	37. Software/Data Maintenance			
	38. Inspection Procedures for ITS equipment / systems			
Project Evaluation	39. Project Evaluation			

3. Other Agencies

A. What skill areas should other agencies provide?

B. What kind of role do you expect FHWA / FTA to play in deployment?

C. What kind of assistance do you currently receive from FHWA / FTA?

D. D. What do you need to know about ITS standards? Why?

4. Needs (20 minutes)

A. This activity is being conducted to provide guidance to allocate resources for training, education, and technical assistance. What are, and what do you anticipate to be, your most critical needs, that we might be able to address?

B. How is that assistance best delivered?

- Through Training
- Manuals/guidelines
- Scanning tours
- On-the-job training/Peer-to-Peer network
- professional associations

C. What are the barriers to delivering this assistance?

D. Who best delivers this type of support?

- Internal staff
- Federal agencies
- Universities
    - Commercial Vendors

5. Ideal--Given no funding constraints (10 minutes)

A. If you were called in to set up a staff for a similar project, what would the ideal team with the desired knowledge and skills look like?

- By position
- By background
- Specialist/Generalist

B. Would it be in-house or contracted out?

APPENDIX B - MATRICES - COMPETENCY CHARTS

ROLE MATRICES

This appendix contains matrices that describe ITS applications by role. It is important to understand when reviewing these charts what they are intended to represent. The roles are indicated by **A** or **S**. **S** indicates a high level of involvement during the deployment stage where it appears. **A** indicates a low level of involvement, but a necessary presence. These roles and their designations are intended to be "ideal". That is, the roles represent who would be involved throughout the deployment if available resources were not an issue. Many of the deployments studied during the needs assessment did not have the level of roles represented in the matrices. In some instances, the level of experience in deployment was too early to recognize that a certain competency was required. For instance, the desire for a PR/Marketing competency usually came from more experienced ITS practitioners. They had learned the critical importance of marketing a project, both within their own agency, as well as to the general public. In other instances, the importance of the management, distribution, and use of data was only being realized as the application moved into active operation.

The "ideal" roles should also not be viewed as directly corresponding to staff positions. Rather, they imply important skill sets that should be brought to the project. In the real world many of these roles can be found in one person, or contracted on, for short periods of time, during the appropriate deployment stage. Sometimes project managers handle the procurement process, from RFP development to final document, by themselves. The internal analytical capability may cover both data management as well as cost-benefit analysis. There was some consistency at sites as to which roles were contracted out versus those on staff. This was a result of public agency hiring freezes and the lack of knowledge and skills in these technical areas on staff. Typically, the roles of project manager, traffic engineers, electronic maintenance and systems support would be in-house whereas technical roles in systems analysis, design and integration were contracted out.

Competency Charts

Awareness: Basic awareness and understanding of general discipline terms, concepts, processes, resources, and objectives. ***Specialized:*** A thorough, technical understanding of the subject area.	Champions	Planners	Project Manager	Software Developers	System Designers/ Integrators	Contract Specialists	Legal Staff	Operator	Dispatcher
ITS VISION									
• ITS Awareness	**S**	**A**	**A**	**A**	**S**	**A**	**A**	**A**	**A**
• Identifying Stakeholders/Building Coalitions	**S**	**S**	**S**						
• National ITS Architecture	**S**	**A**	**A**	**A**	**S**				
• Partnerships	**A**	**S**				**A**	**S**	**S**	
• Financing	**A**	**S**	**S**			**A**	**A**	**A**	
• ITS Planning	**S**	**S**	**A**						
DEPLOYING & OPERATING ITS									
• Systems Analysis & Design	**A**	**A**	**A**	**A**	**S**				
• Technology Options	**A**	**S**	**S**	**A**	**S**	**A**	**A**	**A**	**A**
• ITS Standards	**A**			**A**	**S**				
• Software & Hardware Operations				**S**	**A**			**S**	**S**
• Software Development			**A**	**S**		**A**	**A**		
• ITS Human Factors				**A**	**S**			**S**	**S**
• Procurement		**A**	**S**			**S**	**S**		
• Managing Contractors			**S**				**S**		
• Systems Integration	**A**		**A**	**A**	**A**				
• Operations			**A**	**A**					
• Project Evaluation	**A**	**A**	**S**	**A**	**S**				
• System Support & Maintenance									
• Transportation Fundamentals	**S**	**S**	**S**	**A**	**S**		**A**	**S**	**S**
SUPPORTING ITS									
• Project Management			**S**						
• Data Analysis & Management		**A**	**A**	**S**	**A**			**A**	**A**
• ITS Legal Issues			**A**	**A**		**S**	**S**	**A**	**A**
• Marketing/Public Relations	**A**		**A**					**S**	**S**
• Writing/Communications	**S**	**S**	**S**	**S**	**A**	**S**	**S**	**S**	**S**
• Problem Solving	**S**	**A**	**A**	**S**			**S**	**S**	**S**

Awareness: Basic awareness and understanding of general discipline terms, concepts, processes, resources, and objectives. ***Specialized:*** A thorough, technical understanding of the subject area.	Champions	Planners	Project Manager	Software Developers	System Designers/ Integrators	Contract Specialists	Legal Staff	Operator	Dispatcher
CREATING CHANGE									
• Legislative and Policy Change	**S**	**S**				**S**	**A**		
• Organizational/Institutional Change	**S**	**A**	**A**						

Competency Charts

Awareness: Basic awareness and understanding of general discipline terms, concepts, processes, resources, and objectives. ***Specialized:*** A thorough, technical understanding of the subject area.	Drivers	Electronics Inspection and Maintenance Techs	Operations Manager/ Supervisor	Business Analysts	Data(base) Analysts/ Managers	Marketing/Public Relations Staff	Human Resources staff	System Administrators/ Support Technicians	Program/Agency Managers	Interjurisdictional Coordinators
ITS VISION										
• ITS Awareness	**A**	**A**	**A**	**A**	**A**	**A**	**A**	**A**	**A**	**A**
• Identifying Stakeholders/Building Coalitions					**A**	**A**	**S**		**S**	**S**
• National ITS Architecture					**A**				**A**	**A**
• Partnerships				**S**					**S**	
• Financing				**A**					**S**	
• ITS Planning			**A**		**A**				**A**	**S**
DEPLOYING & OPERATING ITS										
• Systems Design		**A**			**S**			**A**	**A**	
• Technology Options		**S**	**S**	**A**	**A**	**A**		**A**	**A**	
• ITS Standards		**A**			**A**					
• Software & Hardware Operations	**A**	**S**	**S**		**S**			**S**	**A**	
• Software Development					**A**			**S**		
• ITS Human Factors										
• Procurement				**A**					**A**	
• Managing Contractors		**A**	**S**						**S**	
• Systems Integration		**A**			**S**			**A**	**A**	
• Operations		**S**						**S**		
• Project Evaluation		**A**		**S**	**A**			**A**		
• System Support & Maintenance		**S**						**S**		
• Transportation Fundamentals	**A**	**A**	**S**	**A**	**A**	**A**	**A**	**A**	**S**	**S**
SUPPORTING ITS										
• Project Management									**A**	
• Data Analysis & Management	**A**			**A**	**S**			**A**	**A**	
• ITS Legal Issues				**A**				**A**		**S**
• Marketing/Public Relations						**S**			**S**	
• Writing/Communications		**A**	**S**			**S**			**S**	**S**
• Problem Solving		**S**	**S**		**S**			**S**	**S**	

Awareness: Basic awareness and understanding of general discipline terms, concepts, processes, resources, and objectives. ***Specialized:*** A thorough, technical understanding of the subject area.	Drivers	Electronics Inspection and Maintenance Techs	Operations Manager/ Supervisor	Business Analysts	Data(base) Analysts/ Managers	Marketing/Public Relations Staff	Human Resources staff	System Administrators/ Support Technicians	Program/Agency Managers	Interjurisdictional Coordinators
Creating Change										
• Legislative and Policy Change				**S**		**S**	**S**		**S**	**S**
• Organizational/Institutional Change		**A**		**S**		**A**	**S**		**S**	**S**

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