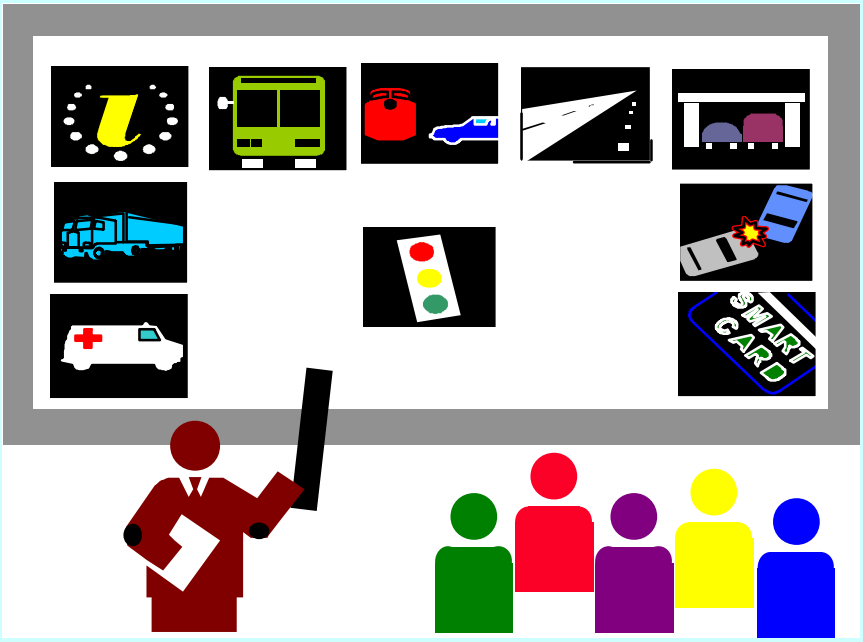
Building Professional Capacity in ITS:

Documentation and Analysis of Training and Education Needs in Support of ITS Deployment



US Department of Transportation
ITS Joint Program Office
ITS PCB Program

April 1999

FOREWORD

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

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

The ITS PCB Program is comprised of a partnership of 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 hoped 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 the 21st century transportation systems; and
- The most effective and cooperative programmatic ways to meet training and education needs.

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April, 1999

ACKNOWLEDGEMENTS

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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 the needs assessment. 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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Section I presents the purpose of the report, the objectives of the needs assessment, and its importance to the ITS PCB Program. This section provides background information on the ITS PCB Program partnership. This section also briefly discusses the research methodology used to gather information for this report. Appendix A supports Section I with a more detailed discussion of the research methodology, a copy of the interview guide, and a profile of the interviewees and their locations.

SECTION II — FINDINGS AND ANALYSIS

Section II summarizes the findings and analysis of nearly 200 interviews, conducted in the summer of 1998, to discern the training and education needs of transportation professionals engaged in ITS planning, design, deployment, operations, maintenance, management, and evaluation. Using seven different types of transportation agencies as models that are engaged in twelve "typical" ITS projects and activities, Section II provides answers to three key questions:

1) *Who* needs to know about ITS? — Twenty "ideal" ITS roles are defined that are required throughout the stages of ITS planning, deployment, operations, and management.
2) *What* do ITS professionals (existing and new hires) need to know? — Interviewees provided insight into the underlying fundamental knowledge and skills (i.e., competencies) that are essential for ITS activities. The needs assessment helped identify the top ten competencies required for ITS deployment.
3) *How* are the knowledge and skills best learned? — Traditional classroom training has played an important role in providing training to transportation professionals. However, external constraints associated with limited time, travel funding, and a fast-paced business environment, give rise to the need for "training-on-demand." The needs assessment helped to identify four categories of alternative delivery methods that can be used to build professional capacity for ITS. It also helped to identify the educational foundation perceived by today's professionals as needed by the professionals of the future.

These roles, competencies and delivery methods are the three foundational building blocks of developing a tailored, targeted, and accessible PCB program. Section II also presents a discussion regarding some of the cultural and institutional factors that can either facilitate change or present an obstacle to it. These factors are presented because interviewees frequently stressed how they can influence the effectiveness and success of ITS professional capacity building.

SECTION III — PCB PROGRAM STRATEGY

Section III presents a program strategy and recommendations for meeting theITS training and education needs of transportation professionals, now and in the future. This section is directed

specifically at the PCB Program and its partners on how to develop and deliver ITS professional capacity building.

APPENDIX A provides a more detailed discussion of the research methodology and profiles of the interview sites and their deployment activities.

APPENDIX B is a bibliography of the literature used in support of this needs assessment.

APPENDIX C describes in further detail, the specific action items that are needed to implement the recommendations provided in Section III. This appendix presents the action items according to a timeline, showing accomplished actions, actions underway, and future actions proposed for PCB partner organizations.

APPENDIX D is the report, *Building Organizational Professional Capacity in ITS: Guidelines for Staffing, Hiring, and Designing "Ideal" Project Teams.* This report uses two of the PCB building blocks — roles and competencies— to construct a set of staffing charts that describe the composition of "ideal" teams for ITS projects and activities to guide staffing and hiring decisions. It is also available as a separate report.

APPENDIX E is the report, *Building Professional Capacity in ITS: Guidelines for Designing an Individualized Training and Education Plan.* Again, using the ITS roles and competencies, this report presents a set of ITS curricula that recommend a course of learning for twenty ITS roles. It is also available as a separate report.

APPENDIX F is the report, *Building Professional Capacity in ITS: Guidelines for Developing the Future Transportation Professional.* This report assesses the needs of future transportation professionals and identifies actions that can be take by the academic community and others to develop future professionals. It is also available as a separate report.

OTHER SUPPORTING DOCUMENTATION

This report is supported by the following companion documents that offer the reader more information on building ITS professional capacity.

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

This companion report provides the results of the in-depth needs assessment from a transit and FTA perspective. It is based on the same interviews and database used in this report, but focuses them on transit-specific findings. The current and recommended roles of FTA staff are also described. This report will be available in May 1999 and will be accessible on the PCB web page at:

http://www.its.dot.gov/

2) The Catalog of U.S. DOT's PCB Program Courses and Seminars

This catalog describes the seminars, courses, and workshops currently available, or soon to be available, on topics related to ITS planning, design, deployment operations, maintenance, and evaluation. The offerings are available to federal, state, local, and private sector practitioners and made available by four PCB Partners: (1) the U.S. DOT which includes FHWA, FTA and OMC, (2) the National Transit Institute (NTI) in conjunction with FTA, (3) the National Highway Institute (NHI) in conjunction with FHWA, and (4) the National Training Center (NTC) in conjunction with OMC. The majority of the course and seminar materials provided by

the U.S. DOT PCB program are available to local instructors who may wish to modify and present them to meet local needs. The catalog is updated quarterly and can be accessed on the internet at:

http://www.its.dot.gov/pcb/98catalg.htm

The schedule and location of course/seminar presentations can also be accessed at:

http://www.nhi.fhwa.dot.gov/Schedule.cfm

3) The Catalog of ITS Education and Training Efforts at U.S. Universities

This catalog lists ITS courses, certificate programs, and courses containing ITS content at universities around the country. It was developed by Virginia Tech in cooperation with the U.S. DOT's PCB Program and is available on the internet site:

http://www.ctr.vt.edu/

4) The Catalog of Private Sector/Vendor Training on ITS

This catalog, released in January 1999, describes training courses and seminars offered by the private sector. It was developed by ITS America in cooperation with the U.S. DOT PCB Program and is now available by searching the followinginternet site for professional capacity building:

www. http://www.itsa.org/

5) ITS Electronic Documents Library (EDL)

The ITS-EDL is an electronic repository of documents on intelligent transportation system topics published by the U.S. Department of Transportation and can be accessed at:

http://www.its.fhwa.dot.gov/cyberdocs/welcome.htm

6) Newsletter of the ITS Cooperative Deployment Network (ICDN)

This electronic newsletter and sharedinternet resource provides a monthly status report on the major events in ITS. It is created and maintained by the National Associations Working Group for ITS (NAWG), a cooperative effort of organizations whose members are spearheading ITS deployment in the U.S. The newsletter includes up-to-date news, new insights, and resources for transportation professionals and agencies. The newsletter is provided monthly free of charge to anyone who registers for it. It can be accessed at:

http://www.nawgits.com/icdn/

The newsletter is emailed on the 15th of each month, and will include all items posted within the past 30 days. Occasional ICDN Special Alerts are issued when there's hot news that simply can't wait until the next regular newsletter. To sign up, simply access the above web page where there is a registration form and an option to "subscribe."

SECTION I — INTRODUCTION

SECTION AT A GLANCE:

— **Purpose of Report**
- ⇨ Exhibit I-1: Framework for Building ITS Professional Capacity
- ⇨ Exhibit I-2: Why PCB for ITS?

— **PCB Program Partnerships**
- ⇨ Exhibit I-3: PCB Program Partners

— **Research Methodology and Scope**

- ➢ Appendix A supports Section I with a more detailed discussion of the research methodology, a copy of the interview guide, and a profile of the interviewees and their sites.
- ➢ Appendix B, the bibliography, supports Section I with a listing of the literature used in support of the needs assessment effort.

SECTION I — INTRODUCTION

Over the last few years, the application of intelligent transportation systems (ITS) technologies and services to surface transportation has gained momentum. ITS employs advanced communications, information, and computer technologies to meet a number of strategic goals, including enhanced mobility of people and commerce, safety, and efficiency. Implementing ITS is a complex effort requiring the cooperation of many organizations and professionals within a locality, region, and state. As ITS grows in importance to the operation of surface transportation systems, so too grows the need to prepare existing and future transportation professionals to plan, design, deploy, operate, maintain, manage, and evaluate ITS effectively.

In 1996, the U.S. Department of Transportation (U.S. DOT) established the ITS Professional Capacity Building (PCB) Program — a partnership of public sector, academic, and private sector organizations — to enhance the capacity of transportation professionals, now and in the future, to develop and deploy ITS applications. In the summer of 1998, the U.S. DOT conducted a needs assessment comprising nearly 200 interviews with highway, traffic, and transit staff personnel in metropolitan areas to identify the specialized training and education needs of transportation professionals engaged now and/or planning to be engaged in future ITS deployment.

PURPOSE OF THIS REPORT

This report identifies the fundamental knowledge and skills required by transportation professionals to develop and deploy ITS effectively. It identifies how multiple partners, particularly those involved in the PCB Program, can provide the necessary training and education to enhance key competencies. As illustrated in Exhibit I-1, this report addresses three key questions:

- *Who* are the essential personnel working on ITS?
- *What* do these professionals (existing and new hires) need to know?
- *How* are the knowledge and skills best learned?

To answer these questions, the U.S. DOT conducted a needs assessment whose results also provided a basis for refining the strategy of the PCB Program. Based on the findings documented in this report, the challenge now is for the PCB Program partners to work on a concerted strategy to achieve the following objectives:

- Develop appropriate curricula and courses
- Deliver courses to as many professionals as possible
- Create a virtual and continuous learning environment
- Strengthen and expand the network of partners who build professional capacity for ITS
- Expand communications and outreach on the need for building professional capacity and on the availability of PCB resources

- Continuously improve the PCB program through measured progress, and mainstream the program's activities into established and ongoing training and education programs of its partner organizations.

The ultimate goal is for multiple organizations in the public sector, private sector, and academia to develop and deliver training, education, technical assistance, and information outreach on ITS that is:

- *Tailored* in content and job-relevant,
- *Targeted* to meet audience, and
- *Accessible* where, when, and as needed.

EXHIBIT I-1: FRAMEWORK FOR BUILDING ITS PROFESSIONAL CAPACITY

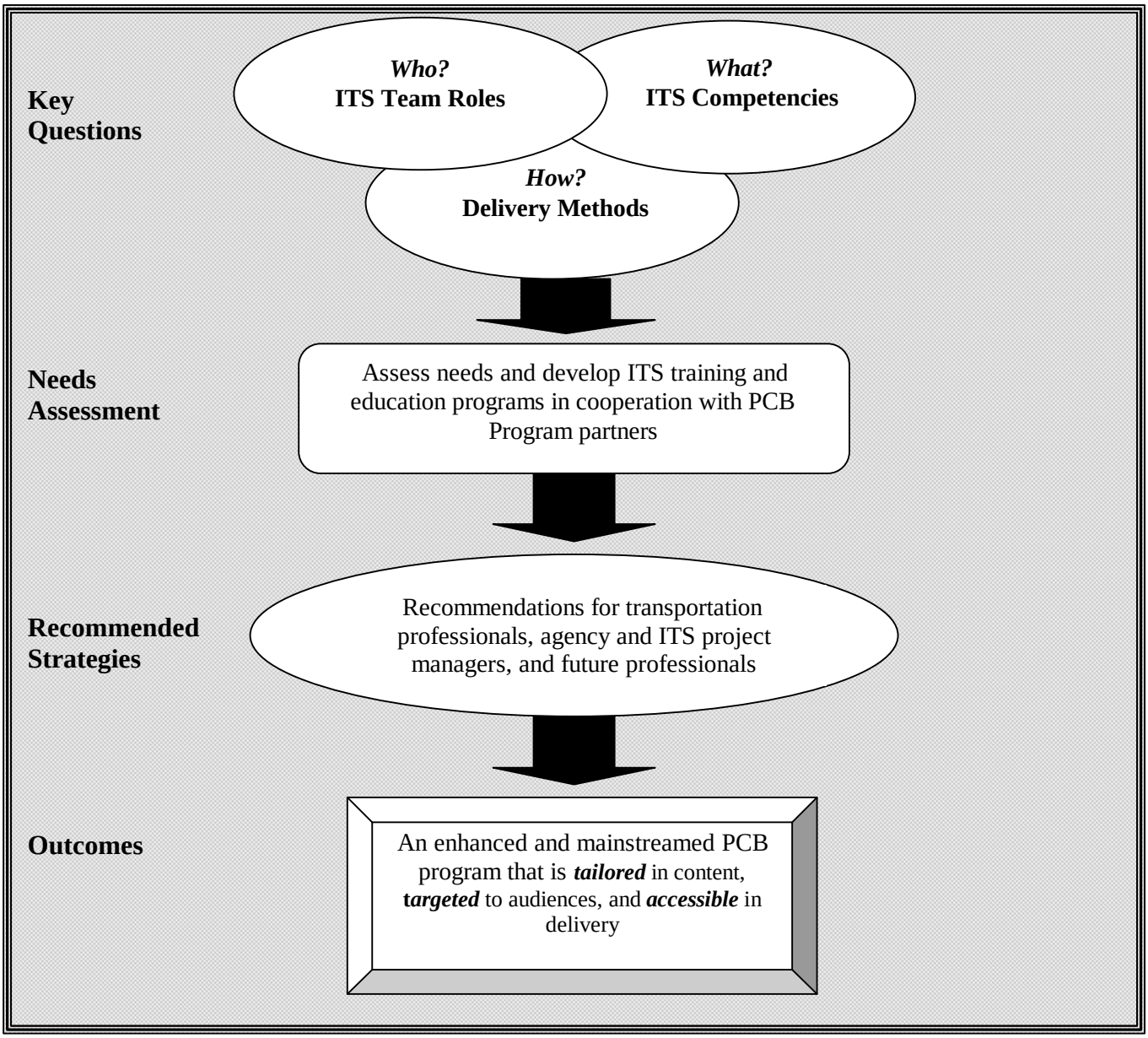

EXHIBIT I-2: WHY PCB FOR ITS?

Why PCB for ITS?

The introduction of ITS services and technologies will broaden the focus of many public sector transportation agencies from the building and expansion of physical infrastructure to include the operation and management of existing infrastructure. This expansive focus will fundamentally change the functions and routines of transportation professionals whose daily job it is to support the flow of passengers and goods within regions and across the nation.

In particular, ITS deployment will require skills that venture beyond the borders of the traditional civil engineering knowledge of many of today's surface transportation professionals. Most roles require a deep technical understanding of information, communications, and computer technologies as well as the design and installation of new ITS technologies and applications and their integration within existing "legacy" systems. In addition, effective systems design and analysis are essential to ensuring the success of ITS deployment.

ITS will also require unprecedented cooperation between public sector agencies as well as the public and private sectors, necessitating new skills in partnering, contracting, and negotiations. In fact, many of these institutional competencies have proven to be critical. They tend to cut across the various deployment and operations stages. They are not traditionally taught as part of the transportation eng ineering curricula. In the long-run, if ITS is to be successfully mainstreamed into transportation practices and policies, transportation professionals will need be able to affect organizational and cultural change.

A list of the pressing technical and institutional challenges are presented below:

TECHNICAL:

- ITS requires knowledge and skills across a range of highly technical topics. It requires expertise in information, communications, electronics, and automation technologies and systems integration.
- ITS also requires more extensive use of basic computer and software skills such as spreadsheets, database systems, word processing, or internet applications.
- ITS deployment rests upon a foundation of multidisciplinary knowledge, skills, and abilities.
- Knowledge and skills must keep up with the continuous evolution of technologies and innovative practices.

INSTITUTIONAL:

- ITS frequently requires multi-agency, multi-discipline, and multi-jurisdictional teams of professionals working interdependently.
- ITS emphasizes operations, rather than capital improvement.
- ITS calls for greater cooperation and partnerships within regions.
- ITS often requires shared resources among agencies and innovative public/private partnerships and funding.
- Because of their relative newness, the public and key decision-makers must become aware of ITS services and their potential benefits.

THE ITS PROFESSIONAL CAPACITY BUILDING PARTNERSHIP

The primary audience for this report are the many stakeholders involved in building professional capacity for ITS, particularly the partners involved in U.S. DOT's ITS PCB Program. The PCB Program is a collaboration of many organizations, which bring different strengths and expertise to bear on building ITS professional capacity. The PCB partners are drawn from the private sector, the public sector, and the nation's universities to develop and deliver the comprehensive, national transportation training and education initiatives required to create the transportation professional of the 21st century.

EXHIBIT I-3: ITS PCB PROGRAM PARTNERS

PUBLIC SECTOR ORGANIZATIONS	ACADEMIC INSTITUTIONS	PRIVATE SECTOR ORGANIZATIONS
• The ITS Joint Program Office • The U.S DOT ITS PCB Program • FHWA and NHI • OMC and NTC • FTA and NTI • ITS America (ITSA) • Non-profit professional associations • State and local programs • LTAP centers	• Undergraduate degrees at universities and colleges • Graduate degrees at universities and colleges • Continuing education • Community colleges • Technical and vocational schools	• Private sector training organizations • Vendors of ITS equipment • Consultants and corporations in the deployment, systems integration, and operations business • Professional associations with private sector membership

Public sector partners design and deliver training, technical assistance, and information outreach and dissemination programs. The public-sector effort has been led by the U.S. DOT's ITS PCB Program, which has relied heavily on the cooperative efforts of other public sector partners such as:

- The Federal Highway Administration's (FHWA) ITS programs and its training programs with the National Highway Institute (NHI) and the National Training Center (NTC), which provide training to FHWA and the Office of Motor Carriers (OMC) staff and state and local highway transportation professionals.
- The Federal Transit Administration's (FTA) ITS program and the National Transit Institute (NTI), which provides training to FTA staff and regional and local transit professionals.
- Non-profit organizations such as ITS America (ITSA), the Institute of Transportation Engineers (ITE), and Public Technologies, Inc. (PTI).

- FHWA's Local Technical Assistance Program (LTAP) centers, which provide transportation training and education to field staff.

The academic community includes universities, colleges, and vocational/technical schools who are incorporating ITS and ITS-related context into their courses and degree programs, and who also provide continuing education and technical training for professionals.

The private sector partners include training firms and professional associations whose memberships comprise many of the professionals working in surface transportation. These partners distribute ITS-related information to their members, provide training, and provide peer-exchange and networking opportunities through conferences, web-sites, and educational videos. Private sector partners also include consulting firms and vendors who provide professional capacity building through consulting, equipment training, technology demonstrations, and exhibitions.

NEEDS ASSESSMENT METHODOLOGY

In order to further the work of the ITS PCB Program, the U.S. DOT interviewed nearly 200 professionals working on ITS highway and transit projects by telephone and in person at ITS deployment sites in five metropolitan areas:

- Atlanta, Georgia;
- Minneapolis-St. Paul, Minnesota;
- Houston, Texas;
- San Francisco Bay Area, California; and
- Salt Lake City, Utah.

Additional research included four focus group meetings, two held in Washington, D.C., and two held at the ITE annual international meeting in Toronto, Canada, which included representatives from:

- Washington, D.C.;
- Phoenix, Arizona;
- Portland, Oregon;
- Menlo Park, California;
- the States of Maryland and Virginia; and
- consultants from multiple ITS deployment projects around the country.

Those interviewed spanned a range of involvement in ITS from several years of deployment experience to those who are just starting the process. Also, interviewees came from different types of agencies and from many different levels within their organizations. Since this effort focused primarily on metropolitan highway, traffic, and transit applications, the findings do not reflect the full range of needs in rural areas or by commercial vehicle operators.

The U.S. DOT team also conducted an extensive literature review to better understand ITS professional capacity building (bibliography listed in Appendix B), and reviewed the many

training and education resources that have been developed in response to known ITS needs. These resources were identified using the following sources:

- Research reports documenting ITS professional capacity building, by the U.S. DOT and PCB partner organizations.
- *The Catalog of U.S. DOT PCB Courses.*
- *The Catalog of University Courses.*
- *The Catalog of Private Sector Courses.*
- FHWA and FTA ITS programs for technical assistance, such as the Peer-to-Peer program or the Scanning Reviews.
- ITS Program information outreach conducted by the U.S. DOT and professional associations such as:
  - ⇨ The National Associations Working Group (www.nawgits.com) and its monthly electronic newsletter, the ITS Cooperative Deployment Network (www.nawgits.com/icdn/).
  - ⇨ ITS America (www.itsa.org) and its electronic newsletter Access ITS (www.itsa.org/home.nsf).
  - ⇨ Professional associations conferences such as ITE, ITS America, or American Public Transit Association (APTA).
- Web Sites of the universities who host ITS Research Centers of Excellence, and many other universities who conduct ITS research and have a dedicated website for ITS information.

SECTION II — ITS PROFESSIONAL CAPACITY BUILDING NEEDS: FINDINGS AND ANALYSIS

SECTION AT A GLANCE:

- **Who Needs to Know?— Identifying the PCB Audience**
  - ⇨ Exhibit II-1: Agencies involved in ITS Deployment
  - ⇨ Exhibit II-2: Ideal ITS Roles
  - ⇨ Example: Defining an ITS Role
- **What do Professionals Need to Know? — Identifying PCB Content**
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  - ⇨ Exhibit II-4: Range of ITS Competencies
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- **How are the Knowledge and Skills Best Learned? — Identifying Effective Delivery Methods**
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  - ⇨ Exhibit II-6: Comments on the Delivery Role
- **Cultural and Institutional Factors**
  - ⇨ Organizational Change
  - ⇨ Staffing and Human Resources
  - ⇨ Policy and Legislative Reform

- Appendix D supports Section II by providing further detail on how the twenty "ideal" ITS roles can be used to effectively staff and/or hire teams to deploy ITS projects and conduct ITS activities. This appendix is also issued as a separate report entitled, *Building Professional Capacity in ITS: Guidelines for Staffing, Hiring and Designing Ideal Project Teams.*
- Appendix E supports Section II by providing more detailed definitions of the ITS competencies and roles, and by using them to construct a set of twenty ITS curricula to provide guidance on learning for each role. This appendix is also issued as a separate report entitled, *Building Professional Capacity in ITS: Guidelines for Designing Individualized Training and Education Plans.*
- Appendix F supports Section II by recommending competencies for developing the next generation of professionals. Using the findings presented in Section II, this appendix discusses the new and expanding needs of future transportation professionals at all levels of the industry. This appendix is also issued as a separate report entitled, *Building Professional Capacity in ITS: Guidelines for Developing the Future Transportation Professional.*

SECTION II — ITS PROFESSIONAL CAPACITY BUILDING NEEDS: FINDINGS AND ANALYSIS

Given the multi-modal nature and functions of surface transportation systems, agencies and individuals have a wide range of needs for enhancing their capabilities to develop and deploy ITS projects and programs. In addition, their capabilities to implement ITS technologies and services vary tremendously even within agencies. The interviews confirmed that transportation professionals are looking for ways to enhance their capacities to make ITS work for them. But they need education, training, technical assistance, and information that are *tailored, targeted,* and *accessible*.

From the needs assessment, twenty roles emerged as critical to the success throughout the planning, deployment, and operation of ITS. The interviews and survey data also identified the critical knowledge and skills required to plan, design, deploy, operate, maintain, manage, and evaluate ITS. Twenty-seven competencies (i.e., bundles of knowledge and skills applied to a specific topic) emerged as critical for developing and deploying ITS, in addition to understanding the technical ITS program areas such as advanced traveler information systems. Those interviewed were able to rank the competencies in order of criticality, enabling U.S. DOT to develop a "top ten" list of training and education needs.

Throughout the course of the interviews, one theme repeated itself again and again — the method by which professional capacity is built is as important as the content. Interviewees frequently requested "just-in-time" and "on-the-job" training, education, technical assistance, and information dissemination. Interviewees also provided advice about which organizations and agencies should provide ITS training and education.

Although interviewees were asked to focus on professional capacity required for ITS, the discussions revealed cultural and institutional issues that fell outside of the interview scope. Interviewees frequently discussed needs, such as changes in internal and external agency relationships or reform of state and local legislation. These concerns are reported in this section because interviewees stressed that these cultural and institutional factors could impede efforts to build professional capacity for ITS.

WHO NEEDS TO KNOW? — IDENTIFYING THE PCB AUDIENCE

There are a variety of roles and functions that are required to plan, design, deploy, operate, maintain, manage and evaluate ITS technologies and services. Being able to identify the roles people play is critical to understanding what competencies they need to perform effectively in their jobs, and at what level those competencies are needed (i.e., at an awareness or specialized level). Essentially, the "ITS roles" become a way of targeting specific audiences for training, education, and outreach, and for tailoring content appropriate to those audiences.

The following table presents seven types of agencies that are typically involved in ITS projects and activities. As identified by the interviewees, these agencies tend to be the dominant players in ITS. There are, however, agencies, firms, projects and activities not on this table — such as police and emergency agencies, and commercial vehicle operators — that are equally as significant to the planning, design, deployment and operations of ITS, but were not included in the scope of the needs assessment. In the near future, the PCB Program partners will investigate further the training and educational needs of these other critical ITS stakeholders.

Exhibit II-1: Agencies Involved in ITS Deployment

Transportation Agencies	Typical ITS Projects and Activities Covered in the Interviews
State Departments of Transportation (DOTs)	• Planning and Design Activities • Deploying, Integrating, Operating, Maintaining, and Evaluating ITS Infrastructure
Transit Agencies	• Deploying and Operating Transit AVL Systems • Deploying and Operating Transit Automated Trip Planning Systems • Operating Transit Data Management Systems
Metropolitan Planning Organizations (MPOs)	— ITS Outreach and Coordination Activities — ITS Planning and Mainstreaming Activities — ITS Awareness and Policy Activities • ITS Deployment Activities
Local City/County Departments of Transportation (DOTs), also known as Departments of Public Works (DPWs)	• Deploying and Operating Traffic Signal Control Systems
Transportation Management Centers (TMCs), the generic version of Traffic Operations Centers, Operations Control Centers, etc.	• TMC Operations using the ITS Infrastructure
Federal Transit Administration (FTA) Regional Offices	• ITS Education and Outreach • ITS Activities in Support of State and Local Agencies
Federal Highway Administration Resource Centers and Division Offices.	• ITS Education and Outreach • ITS Technical Assistance Activities in Support of State and Local Agencies

From the interviews, the following critical findings emerged:

- *Interviewees collectively identified twenty roles needed for ITS deployment.* Exhibit II-2 categorizes these twenty roles in terms of the stages of ITS development and deployment as well as cross-cutting roles. The roles should not be viewed as directly corresponding to staff positions. Rather, they imply important skill sets that should be brought to a project.

  A more detailed description of each role appears in Appendix E, a report entitled, *Building Professional Capacity in ITS: Guidelines for Designing an Individualized Training and*

Education Plan. Appendix E also contains a curriculum designed to respond to the needs of each role.

Exhibit II-2: Ideal ITS Roles

Roles needed for developing a Regional Concept of Operations and Planning for ITS • Champions • Federal Field Staff • Planners Roles needed for the ITS project stages: Design, Procurement, Installation, Operations and Maintenance, Management and Evaluation • Project Managers • Software Developers • Systems Designers and Integrators • Operators • Dispatchers • Drivers • Electronics Inspection and Maintenance Technicians • Operations Managers and Supervisors	Cross-Cutting Roles • Business Analysts • Data(base) Managers and Analysts • Contracts staff • Legal staff • Marketing and Public Relations staff • Human Resources staff • System and Network Administrators/Support Technicians Creating Change: Roles for Mainstreaming ITS • Program/Agency Managers • Inter-jurisdictional Coordinators

- *Individuals frequently play more than one role as part of their jobs.* In the field, many of these roles are played by one person, or contracted out, for varying lengths of time, during the appropriate deployment stage. For example, in one city, a project manager provided marketing and public relations expertise while simultaneously managing an ITS deployment project.
- *For many of the roles, individuals have had little formal training or on the job preparation.* Many of the roles have evolved without specific staffing requirements in mind and no job descriptions.
- *Many roles require the same types of competencies, but at varying levels*. For example, planners, systems integrators, and maintenance technicians must all understand the National ITS Architecture and ITS Standards. However, some roles require only a basic level of awareness of the general framework while others require a specialized level of knowledge. For example, a specialized knowledge would require knowing how to integrate components through wireline and wireless media.

- The interviews revealed that, in deploying ITS, *the most effective performance resulted when the competencies were divided among a team of people*. In this respect, no one person has to know everything, which allows each team member to focus on those areas that are most important for their job responsibilities.
- *There was some consistency at sites as to which roles were contracted out versus kept in house.* Typically, the roles of project manager, traffic engineers, electronic maintenance, and systems support tended to be in-house, whereas the more technical roles in systems analysis, design, and integration tended to be contracted out. This was often a result of public agency hiring freezes or salary caps, and/or the lack of knowledge and skills in these technical areas on staff. However, staffing for these roles is not consistent within either public agencies or the private sector.

The following pages provide an example of an ITS role — an ITS Project Manager — as defined in Appendix E: *Building Professional Capacity in ITS: Guidelines for Designing an Individualized Training and Education Plan.* This report provides a similar definition for each ITS role identified in Exhibit II-2.

The following example presents a description and a bulleted list of the role's primary functions and responsibilities in ITS deployment. The roles are defined broadly, so as to be inclusive of private sector and public sector highways, traffic and transit personnel. However, if there are significant distinctions between the public and private sector roles, they are mentioned, as in the following example for project manager.

EXAMPLE: DEFINING AN ITS ROLE

Roles and Responsibilities of an "Ideal" ITS Project Manager

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. Many of the interviewees played this role full-time; some were only part-time project managers, or had to employ project management skills in support of other deployment roles.

ITS Project Managers activities frequently begin in their role the planning and design stage 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, playing an instrumental part in the decision to deploy ITS. Others begin once the decision to deploy has been made by senior Program or Agency Managers. Once deployed and functional, Project Managers either transfer the working system to 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 that deployed systems are expected to resolve, and a detailed knowledge of how to apply ITS technologies. They are responsible for ensuring that 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 process and existing operations.

Functions and Responsibilities:

- Manage ITS project deployments from planning and 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 the 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 administrators and support staff, and external agency team members.
  - Determine the scope of the 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 Program/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.

EXAMPLE: DEFINING AN ITS ROLE (CONT'D)

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 competencies regarding information technologies, systems integration and engineering, telecommunications, or software development. 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 perspective, including agency management and organizational change, limitations to and management of public funds, a comprehensive understanding of the transportation system, and coordination of the ITS deployment with other ITS activities.

- Private sector Project Managers must ensure that they and their staff have an understanding of transportation fundamentals, including vocabulary, traffic/transit engineering basics, and analysis of flow and capacity. They must be able to understand and meet contracted transportation 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 a similar public sector 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.

What do Professionals Need to Know? — Identifying PCB Content

Professional capacity in ITS consists of developing new knowledge and skills. The knowledge and skills can be bundled to form competency areas — areas in which knowledge and skills are applied to a specific function or responsibility. Transportation professionals require these competencies as they move through the stages of ITS deployment: planning, design, installation (and testing), operations, maintenance, management and evaluation.

Competencies tend to be a combination of both technical and institutional knowledge and skills. For instance, technical knowledge and skills provide professionals with the ability to select the best technology options, manage contractors, or deploy systems that integrate data from other agencies. However, institutional knowledge is needed for using procurement options to select the best technologies and working across jurisdictional and organizational lines to leverage resources, among many other activities.

The following issues emerged during the interviews as critical findings for determining how to build competencies for ITS:

- *From a survey of the interviewees, the needs assessment developed a top ten list of critical ITS competencies.* This listing can be found on the following pages as Exhibit II-3. The top ten needs list was generated from all of the interviews and, therefore, represents the needs of the broadest audience of professionals working on ITS transit and highway projects in metropolitan areas. The top ten needs list can serve as an important guide for curricula and course development. Interestingly, although interviewees did not explicitly include the National ITS Architecture or ITS standards among their top ten needs, they did recognize the essential need to address systems integration and design. Therefore, it is important when developing training and education for the National ITS Architecture or ITS standards, to place these topics in the context of self-identified needs, such as systems integration or systems design.

- *It is important to tailor training and education for specific audiences.* For example, a project manager/operations engineer at a state DOT identified a need for non-technical, short, feasible explanations to promote his ITS projects to civic leaders and legislators. He noted that the PCB training materials could easily be tailored to meet this need and expressed an interest in their availability. "Top ten" competency lists were also developed for the seven different types of agencies, and can be found in Appendix D (the report entitled, *Building Professional Capacity in ITS: Guidelines for Staffing, Hiring, and Designing "Ideal" Project Teams*).

EXHIBIT II-3: TOP TEN ITS TRAINING AND EDUCATION NEEDS

Setting Priorities for ITS Professional Capacity Building: Top Ten Needs

The required fundamental knowledge and skills for ITS are best captured by a survey conducted during the interviews (the survey is included in Appendix A) and analyzed using a relational database. The results of the survey produced a "top ten" list of ITS training and education needs that prioritizes ITS subjects that are of most consequence to field personnel.

1) **Systems Integration**: At the broadest level, interviewees use this term to describe the complex technical undertaking faced by linking individual transportation deployments and organizations together into a comprehensive regional transportation system. This topic also referred to interviewees' experiences with or expectations about "plugging" technologies together.

2) **Organizational/Institutional Changes**: Adapting to change is an important aspect of building professional capacity. In one city, an agency planned to train its staff on a new automated system for use in a transit telephone-based itinerary planning department, through a course called "Coping with Change." Interviewees also reported that professional must be equipped to overcome organizational and institutional barriers, such as narrowly defined mission statements that translate into rigid specification requirements; procurement, and contracting policy procedures that require lengthy review; as well as narrowly defined job classifications.

3) **Technology Options:** Interviewees cited the need to learn how to choose the most appropriate and cost-effective technologies to satisfy the greatest number of system users; to estimate both the costs and the benefits of the system; and to understand the capabilities, limitations, and risks of various technology options. Interviewees were also concerned about the life cycles, costs, and projected obsolescence of technologies. Interviewees especially expressed concern with receiving training on ITS technologies and systems once they were installed. Understanding end users is also essential. In one city, cameras were installed to enable monitor traffic at a traffic management center, but not provide film footage on TV broadcasts (which require different types of phone lines and cameras to produce quality needed for television). Yet the film ended up on the nightly news, when it was never intended for that use. Another case highlights an effective options analysis — a transportation division held a vendor fair, comprising four days of presentations from vendors, with no guarantees. This provided staff with a good idea of what was available and helped immeasurably when writing the specifications for their systems.

4) **System Analysis & Design:** This subject concerns the ability to define user needs (including identifying the users), and being able to design the network infrastructure and the software that operates the network in a way that meets those needs. For example, in one city, more than half way through the procurement of an advanced transit system, a non-technical project manager realized that linkages to other parts of the organization (scheduling and planning) as well as links to the oversight agency (the local lead agency) were not part of the package. She wished she had realized sooner how important this could be, and felt the vendors took deliberate advantage of her technical ignorance because including those links were the most difficult part of the design. She thought a questionnaire/checklist could have helped her. Also, she would have been willing to take a course because of the importance and cost of the project.

EXHIBIT II-3: TOP TEN ITS TRAINING AND EDUCATION NEEDS (CONT'D)

5) **Managing Contractors:** Interviewees spoke frequently about the misunderstanding and miscommunications between public agencies and contractors. Both public and private interviewees ascribe some of this to unfamiliarity with vocabulary and processes. Both are aware that problems frequently begin with the writing and interpretation of technical and/or functional specifications included in the request for proposals (RFPs), and perpetuate throughout the development of detailed contract documents unless expectations are precisely understood. One engineer conveyed that construction contractors often do not have the correct background or training for ITS installations. On one project, a roll of fiber optic cable fell off a truck and the contractor planned on installing it anyway. He had no idea that fiber optic cable is fragile glass that can break upon impact. A State DOT traffic management engineer observed that the various groups within his agency — such as consultant services, construction, and procurement people — did not have the understanding of the technology basis of the bids. They needed to know things like how to require an "acceptance" period; what to do when signals work but the interfaces don't; low bid is not the only selection criteria and that software features and related support are more important; warranty periods need to be longer; training for maintenance needs to be more extensive.

6) **Financing:** This subject concerns both the availability of funding as well as the limitations of projects funded by grants. It also includes the issue of how to leverage scarce resources to realize project goals.

7) **Writing/Communications:** This includes both verbal and written clarity, particularly between the public and private sectors. Interviewees emphasized that their most important need was in writing specifications. Both public and private sectors discussed the importance of distinguishing between functional and operational requirements versus simply specifying technological options. Many interviewees spoke of their desire to have "verbal technical writers" on their project teams.

8) **ITS Planning and the Regional Concept of Operations:** The definition of this subject is focused on more effective management of the existing transportation system. Interviewees spoke about how metropolitan areas continue to be committed to increasing capacity and improving the overall safety and performance of the system. They identified this subject as including the shift from construction to alternative solutions, some of which incorporate advanced technologies. Regional planning and partnering is particularly difficult for the maintenance end of the project. Often, maintenance staff are not included in the planning stages. One state DOT is developing a new process, with policies and procedures, for any future ITS projects to insure all relevant staff are included.

9) **Coalition Building with New Stakeholders:** Interviewees stressed the importance of this consideration for any regional effort — learning how to build and maintain consensus is key to successful deployments.

10) **Data Analysis & Management:** Interviewees revealed that agencies that implement ITS are soon overwhelmed with the large amount of information available to them. Key concerns were the analysis, evaluation, and management of the information, especially as it applied to systems operations and customer satisfaction programs. One transit manager expressed being overwhelmed with what to do with the data — what kinds of reports to request; how to analyze the data to make management decisions; how and where to distribute the data.

- The interviews helped to identify essential competencies for ITS. Each ITS competency is defined in more detail in Appendix E, which is the report entitled, *Building Professional Capacity in ITS: Guidelines for Developing an Individualized Training and Education Plan.* Appendix E also includes a resource guide that identifies the available training and education for each competency area.

EXHIBIT II-4: RANGE OF ITS COMPETENCIES
(The top ten ITS training and education needs are noted in parentheses.)

Competencies needed for developing a Regional Concept of Operations and Planning for ITS

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

Competencies needed for the ITS project stages: Design, Procurement, Installation, Operations and Maintenance, Management and Evaluation

- **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

Cross-Cutting Competencies

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

Creating Change: Competencies for Mainstreaming ITS

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

ITS Specific 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

- *Each competency is a combination of both technical and institutional knowledge and skills.* The level at which they are needed is dependent upon the person's role, and crosses the spectrum from awareness to specialized. For example, the third most critical competency mentioned throughout the interviews was that of understanding ITS technology options. This competency breaks down into the following combination of knowledge and skills:

Technical knowledge and skills are needed for selecting the best technology options:

- An understanding of the *range of options* available.
- An understanding of the technologies' *performance capabilities.*
- An ability to *write the proper specifications* into the RFP or contract.
- The ability to confirm that the manufacturer's *QA/QC or Acceptance Testing* results are valid .
- An understanding of the *maintenance procedures and issues* involved with the selection.
- An ability to *maintain the technologies.*
- An understanding of *electrical engineering and electronics.*

Institutional knowledge is needed for using procurement options to select the technology that best meets the needs and working across agencies:

- An understanding of the *benefits of the technologies* and the *ability to communicate* those benefits to decision makers.
- An understanding of the *level of training* to request as part of the procurement, along with which *operations and maintenance guidebooks.*

- *The interviews revealed a need, by interviewees, to understand the sequence of learning for ITS.* Using the ITS roles and ITS competencies, model "curricula" were developed to assist individuals in achieving the recommended competencies. They will be tested with transportation professionals for reasonableness.

  The ITS curricula, presented in Appendix E, are designed around U.S. DOT training and education courses and seminars, including those developed by the ITS PCB Program, the National Highway Institute, the National Transit Institute, ITE and ITS America. The curricula provide a sequence for learning at two levels — an **Awareness Level** which provides training to acquire knowledge at an awareness and overview level, and a **Specialized Level** that provides knowledge of the theoretical principles involved in ITS as well as "how-to" instruction for skill building.

- *Cross training and multi-disciplinary training is essential.* A principle engineer at a traffic management center cited the need for cross training on his staff. He had both the computer science expertise from college students and the electronics expertise from 2-year associate degree professionals, but still needed them to learn from one another to be the most effective. He also found having an educational cooperative exchange with the local university to be an effective recruiting and training opportunity.
- *Many of the topics are not uncommon to transportation projects and operations in general.* However, ITS adds a level of complexity that makes these issues more apparent, and in some

cases, more important to resolve. For example, the head of a systems engineering group at a transit system, found that a dual career path in both managerial and technical areas would be beneficial. A sabbatical to send these individuals back to school to update their skills in both business and the latest technologies would be very useful. "If people are given leave for jury duty, or military service," he asked, "then why not for continuing education?" For the new engineers on the job who are promoted to managerial or supervisory jobs, they do not understand basic business fundamentals. They need to know how to perform cost/benefit analyses, prepare budget proposals and make decisions on "return on investment" criteria. As a result, it's important to mainstream ITS content within existing traditional training and curricula.

- The professionals interviewed *cited many technical and institutional factors that exist within their environment that present barriers to successful deployment and limit the effectiveness of professional capacity building efforts*. These barriers include the need for organizations to change their culture, for instance, to allow for and reward teamwork and interagency cooperation.

Continuing with the role of the ITS Project Manager, the following pages present an example of the how competencies are recommended at the awareness and specialized levels, and how a curriculum can help a newly appointed Project Manager build a solid foundation in ITS competencies. A similar curriculum has been developed for each ITS role and is presented in Appendix E, *Building Professional Capacity in ITS: Guidelines for Designing an Individualized Training and Education Plan*.

EXAMPLE: IDENTIFYING REQUISITE ITS COMPETENCIES AND CURRICULA

ITS Project Managers at State DOTs

The following competencies are recommended to build the breadth and depth required for ITS Project Managers at State DOTs. The top ten competencies are noted in bold. Also, this example presents the ITS curriculum for the ITS Project Manager to build the ITS professional capacity needed to fulfill the role's functions and responsibilities, as outlined previously.

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

Using the Project Manager's competency recommendations in the box above, the curriculum presented on the following page can be established. The following symbols are used:

P Denotes specific ITS courses developed by U.S. DOT and its partners in the ITS PCB Program and offered by U.S. DOT, NHI, NTI, ITE, and ITSA. It also denotes relevant reports that can be found on the ITS Electronic Document Library (EDL) web site: (http://www.its.dot.gov/welcome.htm).

* Denotes suggested general training and education courses that have been identified as available through universities, vendors, professional associations, and/or available through the general U.S. DOT training program.

– Recommends courses that have not been identified as available. These courses may already exist or may need to be developed. These courses also act as suggestions for PCB partners seeking to develop new and relevant ITS training or education.

EXAMPLE: IDENTIFYING REQUISITE ITS COMPETENCIES AND CURRICULA (CONT'D)

The Project Manager provides an example of a more complicated curriculum, given both the breadth and depth they require for their role. The recommended core training and education for Project Managers**:

Awareness Training	
	P ITS Awareness Seminar (NHI, internet: http://www.nawgits.com/nawg/itsaware/)
	P An Introduction: National ITS Architecture and Interim Guidance on Conformity (U.S. DOT)
	P Deploying Integrated ITS — Metropolitan (NHI, internet: http://www.its.dot.gov/pcb/deploygd.htm)
	P Deploying Integrated ITS — Rural (NHI)
	P ITS Software Acquisition (NHI)
	P NTCIP and ITS Standards — What Do They Mean for You? (ITE)
	P ITS and the Transportation Planning Process (NHI)
	P ITS Public/Private Partnerships (NHI)
	P ITS Telecommunications Overview (NHI)
	P Operating and Maintaining ITS (ITE)
	P Lessons Learned in ITS Procurement (NHI)
	Ú Courses on the software development process (U.S. DOT, vendors, universities)
	Ú Courses on software integration (vendors, universities)
	Ú Courses on systems engineering, installing and integrating hardware and software (vendors, universities, technical/vocational schools)
	Ú Courses on project management (U.S. DOT, universities, junior colleges)
	Ú Courses on data management and databases (universities)
	Ú Courses on operating and maintaining networks and software, and inspection and testing of systems (vendors, technical/vocational schools)
	Ú Courses in public sector financial management: contracts, cost/benefit analysis, budgeting and accounting (U.S. DOT, universities, junior colleges)
	Ú Course in marketing/public relations basics (universities, junior colleges)

Specialized Training	
	P Using the National ITS Architecture for Deployment — Public Sector (U.S. DOT)
	P Standards Training Modules (U.S. DOT)
	P Advanced Transportation Management Technology Workshop (FHWA)
	P Managing Systems Integrators (ITSA)
	P Shared Resources for Telecommunications (NHI)
	P Planning the Integration of Transit and Traffic ITS Applications (NTI)
	ITS Topic Specific: **P** Freeway Management Systems (NHI) **P** Incident and Emergency Management Systems (I-95) **–** Advanced Traveler Information Systems **P** Advanced Signal Control Systems (NHI) **–** Electronic Toll Collection Systems **–** Highway-Rail Crossings
	Advanced Technology Options: **P** Video Communications Systems (vendor) **P** Traffic Surveillance Systems (ITSA) **P** Traffic Control Software and Signalization (NHI) **P** Computerized Traffic Signal Systems (NHI) **P** Advanced Traffic Signal Controllers (NHI) **P** HOV Facilities (NHI)
	P Use of the CORSIM Computer Traffic Simulation Model (U.S. DOT) **–** Other models as they become available
	Ú Advanced course in writing business plans/project plans, writing specifications (U.S. DOT, universities, professional associations)
	Ú Advanced course in negotiations (U.S. DOT, universities, professional associations)
	Ú Advanced course in procurement and legal issues (U.S. DOT)
	– Workshop in writing ITS contracts and specifications
	– Workshop in ITS legal issues

(** Many of the checked (✓) courses will be available on the PCB web page - http://www.its.dot.gov - as of Summer 1999.)

HOW ARE THE KNOWLEDGE AND SKILLS BEST LEARNED? — IDENTIFYING EFFECTIVE DELIVERY METHODS

Interviewees identified the need for PCB delivery to meet the criteria of accessibility and timeliness for general learning as well as specific "how-to" problem-solving needs. The need was frequently expressed as having professional capacity building "just in time" and "on the job" or "at the site" throughout the interviews. The interviewees themselves recommended delivery across a range of innovative methods that better fit their idea of how and when learning is needed.

Because of these needs, the definition of ITS professional capacity building was expanded to include other forms of delivery beside traditional training and education methods. The new definition encompasses methods that can be classified into four categories: training, education, technical assistance, and information outreach or dissemination.

Exhibit II-5: Range of Ideal Delivery Methods

Method	Objectives	Delivery Options
Training	Targets the development of specific knowledge or skills to support "today's jobs"	• Traditional classroom • Computer-based training • Satellite broadcast of courses • Job rotation or exchange programs through/with agencies, professional associations, or private sector firms
Education	Provides fundamental principles and knowledge	• University and college semester courses, labs, and degree programs • Certificate programs for continuing education • Technical and vocational school courses, labs and degree programs • Apprenticeship/internship programs
Technical Assistance	Provides "hands-on" learning aimed at solving specific problems	• Mentoring • Scanning Reviews • Peer-to-Peer Network • Assistance from Federal Field Staff • Consultant/Contractor assistance
Information Outreach and Dissemination Programs	Enhances awareness of topics and resources	• Web site with reports, information and technical assistance • Papers with best practices, lessons learned, and successful approaches • Vendor sponsored programs: displays, exhibits, training • Electronic data libraries • Electronic newsletters

Interviewees frequently cited the importance of delivery methods in building professional capacity for ITS:

- *Frequently, practitioners do not need formalized training or education in response to a specific question or to address a specialized need.* Simply stated, they need to know the right information, at the right time, from an accessible place as quickly and conveniently as possible. Thus, practitioners said that professional capacity building methods need to expand beyond training and education to include technical assistance and targeted information dissemination programs.
- *In particular, the interviews revealed a very high demand for increased technical assistance.* Interviewees overwhelmingly preferred this type of help to "classroom training," feeling that it was much more effective and provided a more personalized and deeper approach to the issues. In particular, interviewees in operational roles wanted expanded opportunities for technical assistance. The Peer-to-Peer program and Scanning Reviews — consistently mentioned federal programs — were highly praised for their ability to transfer knowledge and skills in an effective way. They helped people better carry out their jobs, see the range of what is available and how it is applied. In addition, it provided a means for people to talk to their peers about common experiences.
- *Interviewees requested access to education, training, technical assistance, or information that will satisfy their need while the need is current.* Interviewees want information and learning to be available on demand. Following the recent rounds of downsizing, professionals find themselves even less able to take time to participate in off-site or lengthy training. Tight project schedules and the shortage of trained or qualified staff also contribute to a need for immediate access to information that often runs counter to existing educational methods. The traditional 'classroom' medium is appropriate for many situations, but today's professional have requirements that may best be filled by other media that complements the traditional classroom medium. These include computer-based training, satellite broadcasts, videos, and such other innovative media. In one interview, a project manager, who was writing an RFP for trip planning software, wished for a web site with a listing of critical issues to consider.

- *Professionals desire to learn from their peers who have already experienced the processes and challenges they are about to face.* In particular, interviewees expressed a desire for a more extensive focus on technical assistance programs such as the Peer-to-Peer Program and the Scanning Reviews, but at a level closer to actual deployment activities as opposed to senior level awareness. Many of the highly successful ITS professionals were self-taught. They learned by contacting other peers, going on scanning reviews, and learning on their own time. One interviewee spent a day of her vacation visiting TMC facilities in another state. She commented that she learned more in that one afternoon than she had in numerous conferences and courses. Mentoring or job exchange opportunities should be provided. They want to discuss their problems and consult with fellow practitioners, rather than from an academic setting or background. Practitioners who had accessed existing technical assistance programs related the value of being able to see, touch, and experience the operations of deployed systems, as well as to interact with their experienced peers to discuss processes, lessons learned and best practices. Interviewees requested an expansion of

technical assistance programs to include more innovative efforts such as job exchanges or mentoring programs.

- *Professionals want training that is accessible, but access means different things to different people*. For a project manager of transit operations in a northern state, accessible meant having training near a major airline hub, or within easy driving distance of her work location. She gave as an example a large metropolitan area Chicago which is regionally accessible versus a rural area where a conference was held because accommodations were cheaper, although it was very time consuming to reach. For a transportation electrical superintendent it meant being able to go directly to prints, plan designs, operations manuals, or a maintenance troubleshooting plan immediately when a device failure occurred. He wanted information at his fingertips, a need that an Internet clearinghouse site would serve particularly well..
- *Not surprisingly, the method of delivery and the preferred media vary based on the content, information, or skills to be transferred.* For example, most interviewees believed that the fundamental principles of software development or systems engineering should be taught in a university setting. However, a short video presentation describing project benefits may be all that is necessary to keep high level executives informed.
- *Interviewees requested a central clearinghouse that would include an easy search engine with access to successful approaches, best practices, examples, checklists, lessons learned, and benefits.* Rather than not knowing enough about useful learning tools, interviewees spoke of the information overload of reports, brochures and the like that are not targeted to meet job relevant needs. While the demand for information is high, it must be delivered effectively and in a timely manner. One interviewee said:

  > "I wish there was a web site that would maintain an updated list all of the Freeway Service Patrols in the country with contact numbers. We are always wondering who else has done this or that. Finding up to date information is difficult."

- *Interviewees found that education was most effective for learning the fundamental principles about a topic.* The analysis of the top ten competencies can be used to design academic courses that better equip the "future transportation professional" and provide job-relevant continuing education to existing professionals. This means that traditional transportation studies will need to expand beyond traditional civil engineering basics to incorporate topics such as systems engineering, telecommunications, business, software development, political, and verbal and written communication skills. While engineering curricula are already very intense, lectures or exposure to these newer topics are essential to providing a "complete" transportation education.

- *Interviewees had strong opinions about what works best and why, including issues such as the credibility of deliverer, their ability to answer questions with authority, and their experience.* These comments are summarized in Exhibit II-6

EXHIBIT II-6: COMMENTS ON THE DELIVERY ROLE

Agency	Role in Delivery of ITS PCB
U.S. DOT	Interviewees said there is definitely a role for the U.S. DOT to play in ITS professional capacity building. There were many components to this role: • Interviewees felt that U.S. DOT (headquarters and field staff) were uniquely situated to present courses covering policy and funding issues. • Interviewees recognized and appreciated the federal role in providing funding for course attendance. • The federal capability to develop and deliver courses that could not be developed by smaller agencies. • There was a general consensus that U.S. DOT should continue to fund special programs and projects such as the Peer-to-Peer Program, scanning reviews, and FHWA's technology trailer and OMC's technology truck.
Universities, Colleges, Vocational and Technical Schools	Interviewees felt that universities have a role in providing training and continuing education for transportation professionals: • Many provided examples of training programs that support their agencies, such as the TMC operators program at San Luis Obispo in California. • Interviewees also provided insight into how universities could shift their focus to changing industry needs. For example, decision makers who hire staff desire more technically-grounded, systems-oriented new hires from both university and college engineering programs and technical and vocational school technicians programs.
Private Sector Training	Interviewees discussed the role of commercial firms that provide technical training, vendors who provide equipment and maintenance training, and consultants who may be hired to provide specialized training. They noted that these sources usually are the best choice for very specialized or technical needs: • One agency found a way to require training as a stipulation in their procurement contract. Agency staff could then receive "official" manufacturer supplied and certified training to maintain the new equipment. • Another agency required combined training classes where agency staff were trained alongside consultant staff, thus assuring that both partners in the project had equal knowledge. • Public sector interviewees worried about the use of consultants and competitive issues. However, most felt that consultants frequently had more advanced understanding of the technology.

EXHIBIT II-6: COMMENTS ON THE DELIVERY ROLE (CONT'D)

Innovative Suggestions	• Mentoring or job exchange opportunities should be provided. • Many professionals read journals, go to conferences, and join ITS America committees or committees of other professional associations. This is frequently possible at the project manager level and above. However, other positions, especially at the technical level, have limited opportunities to pursue activities off-site. "Typical" staff do not go to TRB or other large conferences. There was a great deal of interest in programs that would provide opportunities for people "the next level down" to visit "key" or model operational sites. • Because peer to peer was considered the best form of education and knowledge exchange, numerous suggestions were made regarding the creation of an electronic "rolodex" of peers and experts, segmented by region and ITS project. • Another innovative suggestion, from quite a few interviewees, was the creation of job exchange programs within professional associations or with the local MPO aiding in the exchange. Also, federal interns rotating through local agencies would give them valuable experience when overseeing grantees in the future.

CULTURAL AND INSTITUTIONAL FACTORS

The process of building professional capacity — identifying essential roles, developing curricula and courses, and delivering training and education through accessible media — does not take place in a vacuum. Professional capacity building activities can introduce change, albeit positive, in the staff and the workplace by introducing new knowledge, skills, and ways of doing business. As such, agencies embarking on the path of building the capacity of transportation personnel must grasp the cultural and institutional factors that can either facilitate positive change or stand in its way.

The needs assessment uncovered a number of cultural and institutional that factors influence the effectiveness of professional capacity building. In particular, interviewees identified four categories of concerns:

- Organizational Change
- Staffing and Human Resources
- Contracting and Procurement
- Legislative and Policy Reform

Organizational Change

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

- Openness to change, implemented with the full support of decision-makers and management;

- Institutionalized values and shared attitudes among employees;
- Teamwork and cohesion among employees from different departments and external agencies;
- Openness to new technologies or strategies;
- An atmosphere where "risk-taking" is permissible (organizations can consider solutions or technologies that are not "tried and true"); and
- An interest in delivering improvements that continuously meet "customer" needs.

Interviewees found that changes such as these tend to occur more readily and successfully with the emergence of a champion or an advocate (such as a legislator or senior level manager) who can:

- Provide a vision;
- Is willing to campaign among decision-makers and work with legislators and the business community;
- Can recognize that their success requires good public relations initiatives, so that the public understands the benefits of the technology; and
- Can establish a long-term strategic direction, provide day-to-day direction, and redirect funding to support ITS planning and deployment.

Staffing and Human Resources

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

- Creation of job classifications and descriptions, that enable them to hire individuals with computer science, electrical engineering, system development and integration, and database management skills;
- Adoption of competitive pay scales and compensation packages that enable them to recruit individuals who are fresh out of undergraduate and graduate programs, attract individuals who are mid-career with technological expertise, and retain valued employees;
- An educational and training strategy that caters to mid-career employees who are searching for on-the-job challenges; and
- Human resource professionals who understand the technical requirements of the new class of positions that are needed, and are able to follow through with an effective recruitment strategy.

Contracting and Procurement

Two areas were of particular concern — (1) standard procurement and contracting procedures, and (2) partnerships. 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 use of the most current technology;
- The creation of partnerships 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; and
- 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. One interviewee noted that by the time responses to his RFPs were in and the contracts awarded, the technology described in the RFP was obsolete, necessitating the time and cost of immediate change orders.

In particular, interviewees indicated that the complexity of ITS programs has made it necessary for their organizations to begin employing different procurement strategies. For example, an agency moving forward with a deployment must decide whether to assign contracts to the best qualified contractors/consultants or to contract with a consortium of contractors, which would create the responsibility for bringing the "right" players together and coordinating their participation.

Often low-cost bid procurement is not the most effective method for meeting the needs of ITS technology purchases. For example, software procurements must consider compatibility and extendibility. Contracting with the lowest cost provider could result in the acquisition of technology that is out-of-date. In addition, the selection of the low-cost provider sometimes excludes value-added services — access to troubleshooting help, hardware and software updates, maintenance support — that are essential for the continued well-being of the ITS application.

Policy and Legislative Reform

Interviewees frequently spoke of state and local policies that impede ITS development and deployment activities. In order for professional capacity building to be effective, certain policies were highlighted that require change. 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, and the need for new statewide legislation (and public policy), which enables agencies to modify operating and business practices.

Given that many ITS-related programs are multi-jurisdictional and require shared responsibility, a great need exists for public agencies to form partnerships with other agencies, as well as private sector organizations. Moving forward with partnerships that permit a sharing of

responsibility, particularly the risks and rewards associated with development costs, has not always been possible without modification to a state's constitution or the passage of new legislation. Consequently, participants from the public and private sectors must understand up-front what legal restrictions might exist at the federal, state, and local government levels. Interviewees called for changes in policies to:

Foster legislation which:

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

Promote recognition among policy-makers 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, need to be heavily considered. Value-added services include a provider's commitment to a continuing level of support and to troubleshooting problems following deployment.
- Considering functionality (along with the acquisition and application of technology) when developing a deployment strategy will result in more effective, and longer lasting solutions, particularly since technology is advancing at a rapid pace.
- Unlike highway, road, or transit construction projects, there is no established 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 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.
- There needs to be a greater commitment to the operations and maintenance functions of the transportation agencies. Without a local funding source, such as a dedicated sales tax, many operating agencies (particularly transit) are unable to move beyond the maintenance of day-to-day operations, and initiate more cutting-edge efficiency projects. Instead, the current financing of the day-to-day operations, equipment maintenance, and deployments of new technologies are heavily dependent upon the availability of federal grants.

SECTION III — PCB PROGRAM STRATEGY

SECTION AT A GLANCE:

— The PCB Program Strategy

1) Develop Curricula and Courses
   - ⇨ 1a) Curricula Development
   - ⇨ 1b) Course Enhancements
   - ⇨ 1c) Course Development

2) Deliver Courses

3) Create a Virtual and Continuous Learning Environment
   - ⇨ Exhibit II-1: What is a PCB Virtual Learning Environment?

4) Expand and Strengthen the PCB Partnerships

5) Expand PCB Communications and Outreach

6) Continuously improve the PCB Program

— Conclusion

- Appendix C supports Section III with a detailed listing of specific action items that are recommended to the PCB Program partners implement the PCB Program Strategy.

SECTION III — PCB PROGRAM STRATEGY

The mission of the PCB Program is to assist existing and future transportation professionals, working in the public and private sectors, to develop the knowledge, skills, and abilities to plan, design, install, operate, manage, maintain and evaluate ITS more efficiently and effectively. Towards this end, the PCB Program will continue to provide training and education that is ***tailored*** in its content, ***targeted*** to meet audience needs, and ***accessible*** where, when, and as needed. Given the findings and analysis of the needs assessment, this section presents six strategies for moving the PCB Program toward its goals.

THE PCB PROGRAM STRATEGY

The six strategies of a comprehensive PCB Program are:

1) Develop new curricula and courses
2) Deliver new courses
3) Create a virtual and continuous learning environment
4) Expand and strengthen the PCB partnerships
5) Expand PCB communications and outreach
6) Continuously improve the PCB Program

The success of each strategy relies upon the willingness of the PCB Program partners to undertake actions that best correlate with their strengths and expertise. Each strategy includes a series of priority actions and mainstreaming actions:

- Specific priority actions correlate to pressing ITS training and education needs that need to be addressed in the near-term (present – FY 2000)
- Mainstreaming actions ensure that other organizations are including ITS training and education into their programs. These items will be addressed in the longer-term (FY 2001-2002).

Appendix C presents a timeline of detailed actions. The timeline lists those actions completed during 1996-1998. It includes the actions that are underway in 1999. And, it lists the specific actions included in the FY 2000 budget and those proposed for FY 2001-2002. A critical measure of success for the PCB Program is the mainstreaming of these activities within the conventional training and education programs of the U.S. DOT and PCB Program partners. At the end of FY 2002, it is envisioned that the ITS PCB training and education, as currently defined, will be completely mainstreamed; and that the U.S. DOT PCB Program will be "sunset," having achieved its goals.

1) DEVELOP NEW CURRICULA AND COURSES

The mission of the ITS PCB program is to provide ITS training and education for transportation professionals. Training and education depend upon having the appropriate and relevant courses available that enable professionals to build essential competencies. This includes enhancing existing transportation courses to include ITS content as well as developing new courses directly related to the ITS challenge. In addition, professionals seek guidance a path of learning, what courses to take, what level of proficiency, and what sequence of study.

Developing ITS training and education courses and ITS curricula, therefore, is the primary strategy of the PCB Program. There are three sub-components to this strategy:

1a) Develop model ITS curricula
1b) Enhance existing courses
1c) Develop new courses

The results of implementing this first strategy will be the following:

- There is a more clearly defined set of responsibilities for curriculum and course development by U.S. DOT, universities, professional associations, and the private sector.
- Training courses are developed and enhanced by FHWA business units and FTA program offices in conjunction with NHI, NTI, and NTC, and other PCB Program partners to meet needs. These courses can be tailored to provide job-relevant training to professionals.
- Universities establish extensive education programs and curricula, providing the basic education for new entrants to the public and private sector.
- Ongoing university initiatives establish new undergraduate and graduate level programs.
- Private sector establishes a curriculum and provides extensive, hands-on training; universities, colleges, junior and technical and vocational use the findings of the needs assessment to develop training and education programs.

1a.) Develop Model ITS Curricula

This component is focused on developing guidelines on ITS curricula for existing professionals in the public and private sectors, and creating model curricula for use within the academic community for developing future transportation professionals.

Priority Actions:

- Develop a draft set of curricula (provided in Appendix E of this report).
- Convene a series of workshops to review and critique curricula by the PCB Program partners (scheduled for Spring and Summer 1999).
- Once finalized, modify and distribute the ITS curricula among transportation professionals to use as guides for developing individualized ITS training and education plans.

- Distribute among PCB Program partners to be used as the basis for developing ITS training and education programs.

Mainstreaming Actions:

Once the ITS curricula are validated, the PCB Program will publish the curricula on the PCB Program web site. Further distribution will rely upon the PCB Program partners who will be invited to modify and distribute the curricula to their constituents and members. Successful mainstreaming can be measured by the following criteria:

- ITS curricula will be a basis for PCB Program partners' training and education programs (both in the public and the private sector).
- Comprehensive university model curricula for future professionals will be fully implemented.
- Curricula will address the needs of transportation professionals involved in metropolitan, rural and commercial vehicle ITS programs.
- The private sector will develop curricula and professional certification for their members (e.g., ITE's new traffic engineering certification).
- FHWA and FTA will use the curricula as guidance for agency career track development (e.g., FHWA's recent Resource Center reorganization and staffing).
- State DOTs and local transportation agencies will use the curricula to help determine typical ITS staffing requirements and competencies.

1b) Course Enhancements

Existing courses can be enhanced to:

- Continually update materials to reflect new developments.
- Tailor and target training and education programs to increase relevancy to audiences.
- Diversify the delivery methods to include technical assistance programs, continuing education initiatives, long distance learning, and information outreach and dissemination programs.

Priority Actions:

- *Enhancements and updates need to be made to existing training and education courses, which are on target, but can more fully satisfy the needs identified in this report.* One such initiative already underway through the U.S. DOT and NHI is the tailoring of the course, "Deploying Integrated Intelligent Transportation Systems." Modules are being incorporated to present either a focus on Metropolitan ITS or Rural ITS. Another example is the tailoring of an introductory course on the National ITS Architecture. FTA is addressing the more specific information needs of field staff by tailoring the "Introduction to the Architecture" course for this specific audience.

- *PCB partners should incorporate lessons learned, successful approaches, and best practices into existing training and education courses.* Appropriate case studies for problem-solving are already being incorporated. A set of case studies, referred to as

"sponge studies" that document successful approaches to ITS deployment, will be available from the ITS Joint Program Office beginning in Spring 1999. Each study will be incorporated as learning materials into the relevant PCB training courses.

Mainstreaming Actions:

PCB Program partners should take existing training and education and modify the courses to fit the needs of their members, or the needs of their local ITS deployments. The U.S. DOT will enhance existing training to encompass metropolitan, rural and commercial vehicle ITS applications. Once fully developed, the materials will be made available to PCB Program partners for further use, modification, and distribution. Successful mainstreaming can be measured by the following criteria:

- ITS PCB training courses will reflect up-to-date successful approaches and best practices.
- The ITS PCB Program will make the various training course modules available to PCB partners to structure new courses based on target audiences' needs.
- The U.S. DOT PCB Program will play a limited role in further course development and enhancements.

1c) Course Development

Developing the ITS curricula also provides an opportunity to identify the "gaps" in ITS training and education as well as the "gaps" in providing accessibility through delivery. New development efforts will be needed to fill in these gaps, including the completion of high-priority courses currently under development by U.S. DOT and PCB partners.

Priority Actions:

- *New courses that address the top ten needs will be required.* Topics that build competencies in the top ten list include:
  - Principles of systems engineering;
  - Principles of telecommunications engineering;
  - Transportation basics and fundamentals;
  - ITS project management;
  - Bridging public-private sector differences;
  - Data analysis and management for ITS;
  - ITS standards training;
  - ITS planning tools.

- *The PCB Program and its partners must continue to develop and deliver new courses that contain the most job relevant content and that address the top ten competencies.* Courses currently under development are:
  - An Introduction to the National ITS Architecture and Interim Guidance on Conformity with Architecture and Standards (now available; see the catalog for scheduling at: http://www.its.dot.gov/pcb/98catalg.htm)

  - The National ITS Architecture: An introduction for FTA Senior (now available; see the catalog for scheduling at: http://www.its.dot.gov/pcb/98catalg.htm)
  - ITS Software Acquisition (now available; see the catalog for scheduling at: http://www.its.dot.gov/pcb/98catalg.htm)
  - Lessons Learned in ITS Procurement
  - Use of the CORSIM Computer Traffic Simulation Model
  - Procuring and Managing Systems Integrators (ITS America)
  - Sensors, Data Exchange and Interoperability (ITS America)

- *The PCB Program and its partners will pilot a series of long distance learning initiatives to evaluate their effectiveness.* The following initiatives are under development (more detail is provided in Appendix C):
  - Three interactive CD-ROMs
  - Video Conferencing / Satellite Transmission of ITS training
  - Web-based Training
  - Evaluation of long-distance Learning media for the ITS PCB Program through pilot initiatives.

Mainstreaming Actions:

The U.S. DOT PCB Program will take a more targeted role in course and media development over time, expecting that the groundswell of activities by PCB Program partners will adequately fill the gaps. In order to ensure that the priority gaps are filled, the U.S. DOT PCB Program will provide seed funding for interesting course development efforts that address the priority areas. Successful mainstreaming can be measured by the following criteria:

- The U.S. DOT PCB Program will ensure that existing training and education encompasses all of the ITS competencies, with the top ten needs receiving highest priority in that development.
- Existing PCB training and education will be available on the PCB web site with links to more detailed and informative sites.
- Partner organizations will offer ITS training and education through long-distance media.

2) DELIVER NEW COURSES

Delivery of ITS training and education is the second strategy of the PCB Program. Delivery can take many forms. At this point in time, the predominant form of ITS PCB delivery is the traditional classroom style. While it is appropriate for some courses, such as the three-day, hands-on *Using the National ITS Architecture for Deployment* course, other forms of delivery media are needed. The PCB Program must incorporate the use of advanced teaching technologies in the design and delivery of training and education programs, as well as develop instructors skilled in teaching with these technologies.

Additionally, in the future, courses developed for classroom delivery must be based on the principles of Instructional Systems Design (ISD), which provides instruction that is appropriate to meet modern adult education requirements. This includes the training and certification of qualified instructors. Together, the combined use of advanced teaching technologies and skilled instructors can overcome many of the barriers to building professional capacity building.

An important question is which organizations should deliver ITS training and education in the future. As ITS training and education is distributed to the many partners for modification and increasingly sophisticated refinements at the local level, the existing courses remain an important introduction to ITS for new entrants to the field. Thus, the existing U.S. DOT PCB Program courses will be transitioned to its FHWA and FTA partners for continued delivery as the U.S. DOT PCB Program begins to limit its role.

The results of implementing this strategy are the following:

- Fully developed distance learning is in place by the year 2002 as part of U.S. DOT learning initiatives in conjunction with partners.
- FHWA Resource Centers have fully-trained staffs to offer training and technical assistance; Division Office personnel approaching same capability. FTA Regional Offices have trained staff to offer training and technical assistance, and are able to utilize the resources of the FHWA Resource Centers.
- By incorporating courses and scheduling into partner organizations, and by widening the choices for distance learning delivery, delivery of tailored courses can be targeted to meet audiences' needs.

Priority Actions:

- *Continue to deliver existing courses.* Work with partners NHI and NTI to transition the scheduling and delivery activities into their established training program.
- *Improve classroom delivery* by working with NHI and NTI to update existing courses and modify them according to ISD principles.
- *Train and certify instructors* in field and at U.S. DOT headquarters. Create an awareness of how to utilize and teach with advanced teaching technologies such as satellite broadcast equipment.

Mainstreaming Actions:

The U.S. DOT PCB Program will move the scheduling and delivery of developed courses into partners' training programs, especially NHI, NTI and NTC. U.S. DOT will oversee the regular update and posting of the PCB catalogs of courses, university courses, and private vendor courses to the web. It is expected that other PCB Program partners will continue to contribute to the catalog postings and make their ITS training and education available to transportation professionals. Successful mainstreaming can be measured by the following criteria:

- Course offerings and scheduling will be incorporated into partner organizations.
- Partner organizations' catalogs will market the ITS courses and the U.S. DOT's PCB Course catalog will be phased out.

3) CREATE A VIRTUAL AND CONTINUOUS LEARNING ENVIRONMENT

Interviewees related that many barriers constrain their attendance at training and education courses. New delivery methods are desired that deliver more accessible and convenient training and education. They desire learning "anywhere, at any time", and materials at varying levels in order to continuously build knowledge and skills. The same communications, information, and computer technologies that underlie ITS are also the cornerstone of an "information infrastructure." This infrastructure can provide a virtual and continuous learning environment.

EXHIBIT III-1: WHAT IS A PCB VIRTUAL LEARNING ENVIRONMENT?

What is a PCB Virtual Learning Environment?

A virtual learning environment consists of providing a mix of the following components to promote accessibility to ITS training and education:

- A proactively managed Internet web site with interactive PCB courses, a feedback mechanism for questions, FAQ modules, links to more detailed sites.
- Satellite broadcasts of scheduled PCB courses from the U.S. DOT, NHI and NTI, and universities.
- CD-ROMs of PCB courses.
- Videotapes and video broadcast over the internet of PCB courses from the U.S. DOT and universities.

Benefits for the PCB Program include:

- Provides consistent information across a wide audience.
- Provides continuous learning opportunities at a variety of levels.
- Measures demand and track frequently asked questions.
- Quickly responds to new needs and updates materials in a timely fashion.
- Keeps delivery costs low – administration of program and students is efficient and cost effective.
- Uses staff more efficiently – no need to have instructor/presenters traveling constantly.
- Provides access to a wider audience – geographical and time barriers are overcome.
- Increases participation – much easier to manage large student load.

Benefits for the student include:

- Self-paced learning.
- Convenience – courses can be taken at any time, day or night, weekends, etc.
- Overcomes constraints of funding, time, and travel and geography – expenses are typically low, there is less "down time" as there is less need to be away from the job, and courses can be taken anywhere at any time.
- Course availability – many courses can be offered at the same time.
- Up-to-date information – course content is easily updated.
- Peer & expert interaction – discussion groups and ease of communication through email.

The primary result of implementing the third component is accessible professional capacity building.

Priority Actions:

- *Develop the PCB web site.* The PCB web site will be a proactively managed site with a feedback mechanism for questions, a series of Frequently Asked Questions (FAQ) modules, and linkages to other sites. Linking all PCB resources also provides "one-stop shopping" for professionals.
- *Work with PCB partners to develop pilot state programs to reach target audiences with more opportunities.* The U.S. DOT PCB Program will provide seed funding to develop these pilot programs.
- *Develop and assess distance learning media to complement the web site activities.*

Mainstreaming Actions:

Once the PCB web site is developed, it will be transferred to a partner organization for upkeep and maintenance. Pilot state programs will work cooperatively with PCB partners to reach larger audiences. An assessment of distance learning media will allow PCB program partners to develop new training and education using other means besides traditional classroom learning. Successful mainstreaming will be evaluated by the following criteria:

- A group of "pilot states" and possibly regions (e.g., the I-95 Corridor Coalition) will implement ITS education and training tailored for individual state and local needs.
- The PCB Program will have established a network of PCB partners with the required distance learning infrastructure, making it possible to reach the widest audience of transportation professionals.
- This network will be linked through the ITS PCB web page, allowing transportation professionals to easily access training, education, technical assistance programs, and information as needed.
- Once fully established, the U.S. DOT PCB Program will transfer the management, upkeep and maintenance to partner organizations.

4) EXPAND AND STRENGTHEN PCB PARTNERSHIPS

Addressing longer-term actions for enhancing and improving the PCB Program will require more formal clarification of the roles and responsibilities of the PCB Program and its partners. As we look to the future of the PCB Program, it is essential that all partners be engaged and assume roles appropriate to their strengths and expertise. The recommendations for enhancing, expanding, and evolving the PCB Program require leveraging the capabilities and commitment of its partners. The PCB partners who are participants in implementing professional capacity building fall into three categories: public sector, academia, and the private sector.

These partners have and will continue to play a critical role in a wide variety of program activities such as:

- Developing, updating and/or tailoring ITS professional capacity building training and education programs using the ITS curricula;
- Delivering ITS courses to target audiences;
- Building awareness of ITS PCB within their memberships through outreach and communications;
- Helping their members gain access to PCB information and materials;
- Using this report's framework of roles, competencies and delivery methods, more fully assess the needs of their constituent members to help expand the audience scope of the PCB Program; and
- Ongoing monitoring of the demands and interests of their membership.

The results of implementing the fourth component are:

- A network of partners linked through technology, that allows transportation professionals to access the right level of job-relevant training "on-demand," and expands the scope of available PCB resources.
- In-depth analyses of transportation professionals ITS training and education needs, provided by PCB partner organizations, that are specific to target audiences.

Priority Actions:

- *Further define the role of partners.* The preliminary roles are defined on page 5 of this report. Forums for further discussion will be held to assess how partners wish to be more fully involved.
- *Ask partners to continue to assess the needs of their members* using the needs assessment framework provided by this report.
- *Leverage distance learning infrastructure already in place.*
- *Seed fund partners for new PCB initiatives*
- *Coordinate with partners in new course development.* For example, there are two new courses currently under development with ITE and ITS America.
- *More fully involve the LTAP centers as a way to reach a larger audience of transportation professionals.*

Mainstreaming Actions:

The U.S. DOT PCB Program will provide seed funding to partners for new PCB initiatives. The U.S. DOT PCB program will work to establish a network of cooperative relationships to leverage existing distance learning infrastructure. The U.S. DOT PCB Program will provide partners with its training materials to incorporate into their existing training and education programs. Successful mainstreaming can be measured by the following criteria:

- Universities, colleges, junior and technical and vocational use this and other needs assessments to develop training and education program to meet transportation needs and provide a source of students with an ITS understanding to the professional world.
- A network of professional capacity building organizations exists, with each partner participating based on its unique strengths and expertise.
- Partner organizations will continue to conduct more targeted needs assessments of their constituent members.

5) INCREASE PCB PROGRAM COMMUNICATIONS AND OUTREACH

There is a greater need to better communicate the availability of the ITS PCB program training and education resources and to reach a wider audience of transportation professionals. The needs assessment revealed that:

- *Greater effort must be placed on making professionals aware of the vast amount of information available.* An additional problem at the opposite end of the spectrum is the information overload of reports, brochures, and the like that are not targeted to meet job relevant needs.
- *More tailored executive summaries on topics are needed.* Field staff desire tailored executive summaries and short presentations targeted to their needs, and electronic versions of reports that are searchable by key words. They also desire to have information available on a variety of media such as a centralized clearinghouse, an electronic library, and a web site.

The result of implementing the fifth component is that widespread knowledge about the ITS PCB program and its resources will have been generated throughout the transportation industry.

Priority Actions:

- Provide outreach and communications about the types of skills needed for ITS applications and the types of resources available to increase proficiency.
- Market the availability of PCB materials for training, presentations and marketing.
- Update three catalogs for the U.S. DOT PCB courses, university courses, and private sector courses.

Mainstreaming Actions:

- Place the PCB materials on the PCB web site for use by partners in outreach, communications and marketing.
- Provide regular updates on PCB information to the National Associations Working Group for the ICDN newsletter, ITS America for the Access ITS web site, and to other associations such as ITE or APTA.
- Place the catalogs on the web site for ease of access and updating. Encourage a partner organization to eventually take over the management, upkeep, and maintenance of the PCB web site.

Successful mainstreaming will be evaluated by the following criteria:

- All new information on ITS PCB will be transmitted electronically through established partners' electronic infrastructure, such as the ICDN.
- Professional associations will help communicate the opportunities available to transportation professionals for ITS PCB, creating a more targeted access to specific audiences.

6) CONTINUOUSLY IMPROVE THE PCB PROGRAM

The PCB has continuously evolved as the ITS technology and program have developed, and as the number of partners expands and the activities are mainstreamed. The ultimate goal is to phase out the currently defined program, once having reach a wide audience of transportation professionals involved in ITS, with clear indications of success.

To generate a sense of how well the program is responding to ITS training and education needs, activities to evaluate the program will need to be instituted.

The results of implementing this sixth strategy include:

- Eventual "sunset" of the ITS PCB Program, as currently defined, with the knowledge that the partners have created a successful ITS PCB Program and mainstreamed the components into their own training and education programs.
- ITS training and education programs have become an integral part of Operations, Management and Maintenance training and education activities.

Priority Actions:

- Evaluate the program through a PCB web-site evaluation mechanism that notes whether web-based training meets needs in a tailored, targeted and accessible way.
- Collect student feedback from courses to evaluate whether the training was appropriately tailored, targeted and job-relevant.
- Note whether the transportation industry is finding qualified future professionals. This might include a case study with PCB partners to evaluate whether the change in university and other academic curricula is providing knowledge and skills related to ITS and operations and management.
- Expand PCB training to meet needs of other audiences such as commercial vehicle transportation professionals. This involves the tailoring of training course modules and associated lessons learned, best practices, and successful approaches to the audience.
- Be ready to address the needs of the Rural ITS Program and the Intelligent Vehicle Initiative as they emerge. Other future expansion may also include the air system (airports) and surface inter-modal systems.

Mainstreaming Actions:

It is envisioned that U.S. DOT and other PCB partners — professional associations, State and local governments, and universities — will take on the responsibility of training and educating current and future generations of transportation professionals in ITS as part of their ongoing training and education programs. The above measures of evaluation can be used to determine whether these goals are being met by the year 2002, when the PCB Program phases out.

CONCLUSION

The world is changing at an increasingly rapid rate, driven in part by advances in technology. By utilizing technology, transportation agencies will be challenged to create a continuous learning environment that can adapt and leverage technologies as they change and improve to meet the needs of their customers. Building this professional capacity will require an environment and infrastructure that can facilitate learning, not only through technology, but most importantly through a tightly woven network of individuals and institutions that can link transportation professionals to resources and to each other on an as needed and just-in-time fashion.

The result of implementing this PCB Program strategy is that individuals and institutions, working at all levels — local, State, regional, and national — will be able to realize and have the competencies to ensure that ITS realizes its full potential to create more efficient, safe, and effective surface transportation systems.

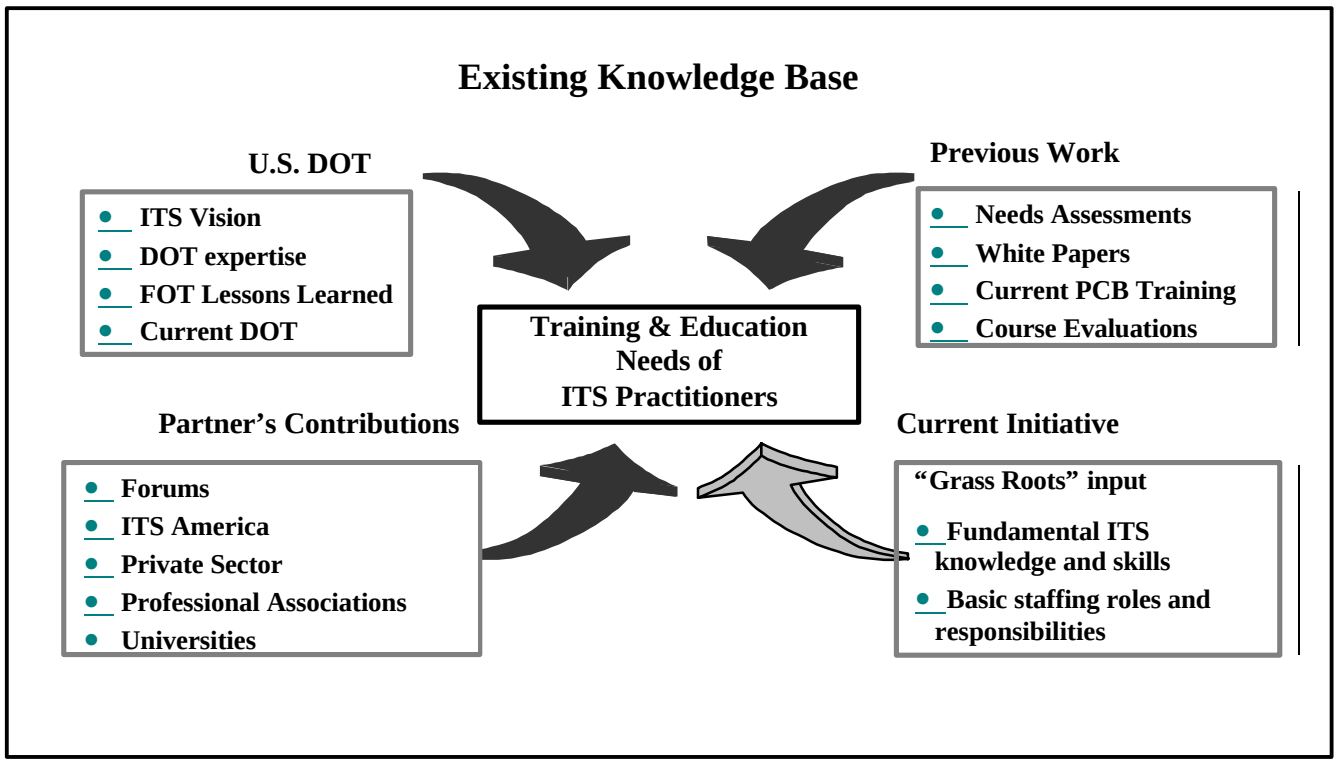
APPENDIX A: RESEARCH METHODOLOGY

A.1 The Research Methodology

The challenge in developing the research methodology was to understand how to add *depth and breadth* to the existing knowledge base. It required that the effort:

- include a wider than previous audience of professionals across ITS projects, agencies/firms, job levels, and deployment stages; and
- gather more in-depth details about their roles and the supporting knowledge and skills.

The methodology developed involved many components for collecting and analyzing information. The first component was a literature review of the large body of work previously undertaken to better understand ITS professional capacity building, as well as of the resources that had been developed in response to known needs.[1]



[1] A listing of the literature sources is provided in the Bibliography, Appendix B.

Second, a series of discussions was held with experts in training and education[1]. These discussions formed the foundation for generating an interview guide that was focused more specifically to two key professional and technical audiences:

- public sector agency staff, and
- private sector firm contractors and consultants.

Third, an interview guide was designed to elicit the following information:

1) The **role of the agency or firm** in ITS deployment and ongoing operation. This information reveals the more specific staffing and competency needs of both projects and agencies.
2) The **role of the interviewee** on the project, including his/her experience, qualifications, and educational background. This information was needed to develop a range of ideal ITS roles.
3) The **fundamental knowledge and skills** required for the role, given the type of deployment. This information formed the basis of the range of ITS competencies.
4) The "**ideal" staff roles and background,** if the project could be staffed without concern for finances, to identify the needs and shortages in expertise and staffing

A survey was included as part of the interview guide. Interviewees were asked to review a list of thirty-nine "ITS knowledge areas" that were developed through a comprehensive literature review and expert panel before the interviews started. The survey was intended as a means of generating more detailed discussion on fundamental knowledge and skills areas. It also provided interviewees with an opportunity to rank their priorities. Lastly, the interviews were conducted.

A.2 Scope of the Interviews

The following criteria were use to define the scope of the interviews:

- ITS program areas and the types of ITS projects;
- Geography and varying levels of deployment progress;
- Diversity of agencies;
- Categories of professionals.

ITS Program Areas and Types of ITS Projects

The study targeted deployments of Metropolitan ITS Infrastructure as these sites tend to be the furthest along and incorporate many of the same PCB needs required by rural or commercial vehicle operations. Importantly, this work establishes a framework that can easily be adapted to studying the needs of professionals in the other program areas.

The Metropolitan ITS Infrastructure program is comprised of nine elements, or types of systems that provide services. Eventually, the interviews covered six out of nine elements:

[1] Expertise was provided by staff at the National Highway Institute, FHWA's Office of Personnel and Training, the National Transit Institute, FTA, independent consultants, and university research faculty in ITS.

Metropolitan Element	Covered in Interviews?	
	Yes	*No*
Incident Management Systems	R	
Freeway Management Systems	R	
Emergency Management Systems	R	
Advanced Public Transportation Systems	R	
Advanced Traveler Information Systems	R	
Electronic Toll Collection Systems		R
Electronic Fare Payment Systems		R
Traffic Signal Control Systems	R	
Highway-Rail Crossings		R

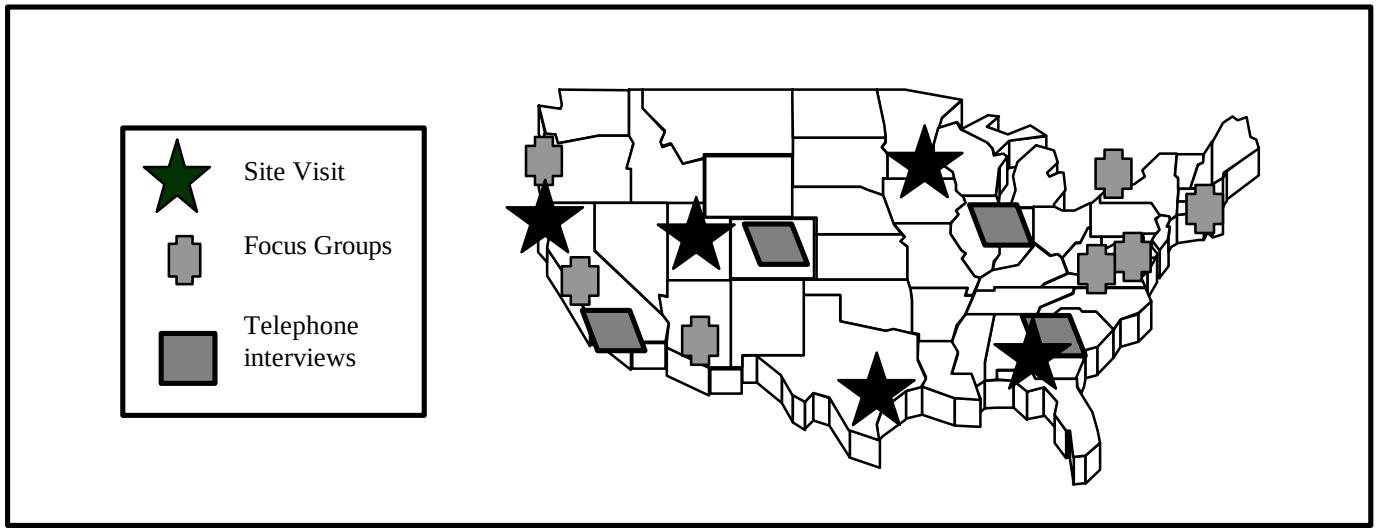
The Highway-Rail Crossings metropolitan element was not covered due to the lack of projects in this area. The Electronic Toll Collection and Electronic Fare Payment elements, while well-developed areas nationally, were not well enough represented in the interviews to provide an evaluation.

In addition, a number of deployments that cut across the Metropolitan elements were examined:

- Transportation Management Centers (TMCs);
- Smart Corridors;
- Road/Weather Information Systems (R/WIS).

Geographic Scope and Varying Levels of Deployment Progress

The geographic scope of this effort was designed to be national, through the use of site visits, focus groups, and telephone interviews. Previous studies indicated how experience and perspective can vary based on geography of the deployment. The following map illustrates the extent of coverage:



The criteria used for selecting sites was a combination of:

- **Levels of site deployment**. Five sites were eventually chosen to include a range of high, medium, and low deployment progress. A site profile is included below on page A-6.
- **Experience and perspective of agencies and practitioners**. Each site plan included a mix of various transportation agencies and firms. In addition, two focus groups were arranged — one on transit and one on traffic operations. Experienced public and private practitioners were invited to participate.
- **Invitations by practitioners**. The needs assessment effort took advantage of generous offers of participation made by PCB Steering Committee members that included their respective staffs.

Diversity of Agencies

The interviews revealed that the roles agencies played within a region, and among regions, varied according to the size of the agency, its operating budget and funding limitations, and its mission. Like agencies in different regions often faced very different political climates and organizational arrangements. Nonetheless, in order to simplify comparisons, the following categories were used to classify organizations:

- State DOTs (SDOTs)
- Transit Agencies, both multi-modal, and bus only
- Metropolitan Planning Organizations (MPOs)
- City/County DOTs, also known as Departments of Public Works
- Transportation Management Centers (TMCs), also known as Transportation Operations Centers (TOCs)
- Federal Field Staff at FTA Regional Offices
- Federal Field Staff at FHWA Regional and Division Offices.[1]

Categories of Professionals

In order to capture the wide variety of needs across a diverse audience, approximately 200 individuals were interviewed either one-on-one or during focus group sessions. These individuals held a variety of positions in public agencies, private firms and universities including, but not limited to:

- Senior executives and program managers
- Project managers
- Consultants
- Analysts
- Operators
- Field technicians and maintenance staff
- Professors.

[1] Note: Regional Offices were still operational during the interview effort. They have since ceased operation and four Resource Centers have been established. The Resource Centers will have staff dedicated to ITS and will include the ITS Specialist position that was in effect during the interviews. From this point, the report will refer to the Resource Centers.

The interviews also included professionals who were not specifically associated with an ITS deployment or operations project, but were part of a more regional effort that required inter-agency cooperation.

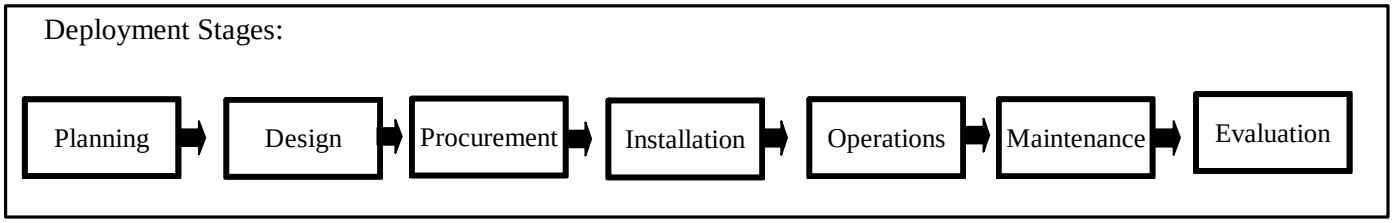
Sample Size

The interview process attempted to capture the current mix of individual backgrounds with their corresponding levels of experience and responsibility. It was not meant to be a scientific sample, but rather representative of the roles, knowledge, and skills required by a range of transportation professionals involved in ITS. While the information has been categorized according to agencies, audiences, and ITS projects, and used to prioritize needs, it is recognized that some categories of interviewees do not have adequate sample sizes to present "scientific" results.

A.3 Assumptions

The following assumptions were used to generate the interview guide(s):

1.) The process of deployment for transportation projects can be divided into seven somewhat discrete stages: Planning, Design, Procurement, Installation, Operations, Maintenance, and Evaluation.



2.) Identifying the deployment stages helps to recognize the following:

- When cross-agency interaction and cooperation happens or needs to happen
- The individual roles that make it happen, and when they are needed
- The competencies that support those individual roles.

3.) An understanding of more than just content is necessary. Also required is the understanding of *who* has the needs (roles) and *how* those individuals most effectively receive professional capacity (delivery methods). These three categories of needs — content, roles, and delivery — form the basic "building blocks" that shape a relevant professional capacity building program.

Limitations

a.) This study specifically addresses professional capacity building for Metropolitan ITS infrastructure deployment and operations. Future efforts will need to address transportation professions involved in the deployment and operations of CVISN, Rural ITS infrastructure, IVI and other areas as they emerge.

b.) This study focused on practitioners "from the field" who work day-to-day in support of ITS deployment, operations, and maintenance. Future efforts will need to address those professionals who work within U.S. DOT headquarters to provide policy and set direction for the ITS Program.

Regarding the survey that was used as part of the interview process, there were a number of suggestions for items to be "added" to the list of thirty-nine knowledge areas. Most of these suggestions were project or agency specific. The survey, however, was not modified, so that it would remain consistent throughout all of the interviews.

APPENDIX A — SITE PROFILES

The goal in conducting the interviews was to talk to as many people as possible, at different kinds of agencies and at different levels within each organization. The team did not design a statistically "random" sample. With the limited time and budgetary constraints the assessment team worked with, the willingness and availability of the interviewees was a key factor to the success of the project. Every effort was made to minimize the impact of the interviews on the local agencies while at the same time making an effort to cover the broad spectrum of agencies with some depth.

Site Interview Profile

The majority of interviews were held with practitioners at their agency

INTERVIEW LOCATIONS	Level of Deployment	Interviews
Atlanta, Georgia Minneapolis-St. Paul, Minnesota Houston, Texas	High	69
San Francisco Bay Area, California	Medium	62
Salt Lake City, Utah	Low	25

Focus Group Profile

Three focus group meetings were held to bring together practitioners from different agencies or locations.

Agency Type	Location	Representing	Participants
Transit-Public and Private Agencies	Washington D.C.	• Washington D.C • Maryland, Virginia • Private Sector, including experience in Salt Lake City and Texas	8
Highway-Public Agencies	Toronto, Canada (ITE Annual Meeting)	• Phoenix, AZ • Portland, OR • Virginia DOT • Menlo Park, CA	5
Highway-Private Consultants	Toronto, Canada (ITE Annual Meeting)	Deployment projects across the Nation	3

Telephone Interviews Profile

In addition to site visits and focus groups, telephone interviews were held with a variety of practitioners:

Agency Type	Location	Representing	Participants
Private Sector Consultants	Maryland, New York City, Los Angeles, Cincinnati	• Private Sector, including experience in Atlanta, Maryland, Salt Lake City, and other sites	4
Highway-Public Agencies	Salt Lake City Denver, CO Los Angeles Santa Clara Valley, CA	• Salt Lake City • Southern California • Santa Clara Valley, CA	6
University	Utah	• Salt Lake City	1

Altogether, 183 interviews were formally conducted with practitioners engaged in deployment and operations activities.

Diversity of Agencies

The survey team recognized that the actual role transportation agencies play within a region, and among regions, varies according to the size of the agency, operating budget, funding limitations, and mission. Similar agencies in different regions of the country often face very different problems due to geography, weather, political climate,source of funding and organizational structure. An effort was made to obtain interviews across various sized agencies of the following types.

Agency Type	# of Interviews
State DOTs	55
Transit Agencies, both multi-modal, and bus only	46
Metropolitan Planning Organizations (MPOs)	20
City/County DOTs, also Departments of Public Works	13
Transportation Management Centers	17
FTA Regional Offices	5
FHWA Resource Centers and Division Offices	9
Private Sector Firms	14
Universities	4

Specific breakdowns are not available by role because of the wide variety of position descriptions and the fact that many of the interviewees did not fit cleanly into one category or another (many had two or more roles). Also, in many cases multiple individuals participated in the same interview, while in others the interviews were “one on one.”

APPENDIX A — INTERVIEW GUIDES

Introduction to both Public Sector and Private Sector Guides

I. Introduction (5 minutes)

Who we are

Let us introduce ourselves. We are staff from the Volpe National Transportation System Center, in Cambridge, MA. The **Volpe Center** is the research and special projects arm of the DOT.

We are conducting a project for the **Joint Program Office** that addresses the unique training and education needs of Intelligent Transportation Systems (ITS) deployment. ITS is the research, development, testing, and deployment nationwide of information technologies and computer systems, and the integration of those systems to more efficiently manage surface transportation.

Why we are here

Our interest in talking to you today is to learn **what skills, knowledge and staffing** you needed to be successful in the planning and deployment of your ITS project.

US DOT has already established a comprehensive set of training seminars and short courses covering the ITS program. However, there is a clear need to acquire more detailed information, leading to the implementation of more comprehensive training and education initiatives in the areas you see as the greatest priorities. We want to **use your experience and expertise to assist other transportation professionals** in meeting the challenges you have met, as well as understanding what you may need in the future.

Handout: Specifically, we want to address

- fundamental knowledge and skill areas required for ITS deployment
- new and evolving agency and private sector roles and responsibilities
- staffing issues that need to be considered at all levels and for all activities
- prioritization areas for education and training
- changes in inter-agency and intra-agency, and private/public sector relationships that are generated by changes in transportation technology and the resulting shift in focus to operations and management
- present and future learning initiatives and most appropriate delivery methods

Why you are here

To **help us understand** outcomes as applied to your project(s), specifically, knowledge base and skills required for this project

The newness of advanced technology applications that are now available has required you and other members of your (in-house or contracted) staff to **develop or acquire new expertise**. We want to understand the following:

- what **expertise you possessed prior** to becoming involved in advanced technology-related projects;
- **what you have had to learn** since becoming involved;
- what are the **fundamental knowledge and skills** required for successful ITS deployments;
- **how** you think **resources should be allocated** in training and education for ITS.

What's in it for you

- Help other agencies based on your hands-on experience
- Help to allocate training and education resources by US DOT and others
- Help you and your organization understand your future ITS workforce requirements

II. Time: The interview will last 1 – 1.5 hours.

III. What we'll do with the data

Ground Rules:

- All information is confidential.
- The final results will be merged together, and no one agency/company will be identified.
- No other staff at the agency/company gets access
- If a tape is used, it will eventually be destroyed.

Products:

The products to be developed and made widely available to organizations include:

- Typical staffing requirements for "typical ITS projects"
- Knowledge, Skills, and Competencies required for different people
- A Training and Education Curriculum for ITS
- Recommendations on training and education roles and responsibilities

As we start, the interview will be very specific to capture as much detail as possible. Again, the emphasis is on what is unique to ITS deployments.

Interview Guide – Public Sector

1. 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 andRFPs			
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			

Column A = For checkmarks indicating knowledge areas critical to interviewee's position.
Column B = For ranking the top five knowledge areas 1-5.
Column C = For checkmarks indicating knowledge areas critical to ITS in general, from interviewee's perspective.

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. 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)

E. 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?

Private Sector Interview Guide

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

A. What type of ITS does your agency focus on, if any area is specific?

B. On which types of ITS projects have you worked with the public sector? (ITS technologies, elements)

Position Who are the people on staff with these projects?	**Roles and Responsibilities** What do they do?	**Background/Skills** Why selected?

2. Private Public Sector Issues

A. What has been the role of the private sector on these projects?

B. What are the detailed technical and non-technical skills of your agency that makes projects successful?

C. What is the role of the public sector agencies in ITS deployment? What are their core competencies that support their role?

D. What kind of knowledge/skills do you expect from the public sector? Who should have these knowledge/skills in the public sector? Which should be required?

E. What have the challenges been in working with the public sector in terms of a lack of skills/knowledge/staffing issues?

F. What skills/knowledge do you think the public sector hires you for?

G. How does your company stay on the cutting-edge of technology/knowledge?

H. What Knowledge and Skills do you seek in hiring new entrants (BS, MS,PhD levels) to your firm?

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

		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 andRFPs			
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			

Column A = For checkmarks indicating knowledge areas critical to interviewee's position.
Column B = For ranking the top five knowledge areas 1-5.
Column C = For checkmarks indicating knowledge areas critical to ITS in general, from interviewee's perspective.

3. Needs (20 minutes) – (use as appropriate)

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, the most critical ITS needs, that US DOT might be able to address?

B. How is that assistance best delivered?
- Through Basic Education
- **Through Training**
- **Manuals/guidelines**
- **Scanning tours**
- **On-the-job training/Peer-to-Peer network**
- **Professional associations**
- Other

C. What are the barriers to delivering this assistance?

D. Who best delivers this type of support?
- Internal staff
- US DOT agencies
- Universities
- Commercial Vendors

4. 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

APPENDIX B: BIBLIOGRAPHY

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APPENDIX C: TIMELINE AND ACTION ITEMS TO SUPPORT THE PCB PROGRAM STRATEGY

1a) Curricula Development Action Items

FY 1996-1998: Accomplished	FY 1999: Underway	FY 2000: Planned	FY 2001-2002: Proposed for Mainstreaming
• Established a PCB curricula development plan based on a need to address three tracks of learning needs: Current Professionals (Track 1), Future Professionals (Track 2), and Elected & Appointed Officials (Track 3)	• Develop and distribute the first version of the "ITS Curricula" proposed in this report for consideration by PCB partners and transportation professionals (Summer 1999). • Convene workshops with PCB partners to review the findings and highlight any issues regarding the curricula • Provide input to professional associations such as ITE for curriculum development and professional certification • Provide input to FHWA and FTA for agency career track development • Work with university partners to develop model curricula for educational programs	• Finalize revisions to the ITS "curricula" and deliver them through PCB partners for public sector, private sector and academic use. • Continue to work with universities to develop and implement model curricula. • Work with PCB partners to expand the ITS curricula to include commercial vehicle and rural transportation professionals.	• ITS curricula are used as a basis for PCB Program partners' training and education programs to address needs of current professionals (both public and private sector). • Comprehensive university curricula fully implemented to address needs of future professionals. • A comprehensive set of ITS curricula are in use, including commercial vehicle and rural, and clear educational linkages between urban, rural and commercial vehicle programs are established.

1b) Course Enhancements

FY 1996-1998: Accomplished	FY 1999: Underway	FY 2000: Planned	FY 2001-2002: Proposed for Mainstreaming
(Courses were first under development based on known needs during this time period.)	• Current U.S. DOT PCB courses and seminars are undergoing review to update the course materials and incorporate the findings in this report. • Current courses are being tailored and enhanced to include TEA-21 initiatives and lessons learned from deployment. • Modify courses to reflect ISD learning principles. • Modify courses to utilize advanced teaching technologies and train instructors in their use. • Train and certify ITS PCB instructors at DOT headquarters and in the field. • Encourage PCB Program partners to review and revise their existing educational materials for similar incorporation of lessons learned, successful approaches, and TEA-21 initiatives.	• Continue to update and tailor existing courses. • Modify existing courses to reflect ITS commercial vehicle and rural activities.	• Training courses reflect up-to-date successful approaches and best practices and are tailored to specific audience needs, including commercial vehicle and rural. • U.S. DOT's PCB Program has transferred course enhancement activities to PCB partner organizations.

1c) Course Development

FY 1996-1998: Accomplished	FY 1999: Underway	FY 2000: Planned	FY 2001-2002: Proposed for Mainstreaming
• Developed a seven seminars and three two-to-three day short courses based on known needs of specific ITS topics.	• Continued to develop and deliver new courses that contain more job-relevant content and that address some of the top ten competency areas. The following are currently under development and will be available in FY 1999: ⇨ Introduction to the National Architecture and Guidance on Conformity. ⇨ Introduction to the National Architecture for FTA Senior Staff. ⇨ Use of the CORSIM Traffic Simulation Model. ⇨ ITS Software Acquisition. ⇨ Lessons Learned in ITS Procurement. • Planning the development of new courses: ⇨ Turbo Architecture. ⇨ ITS Standards modules. • Coordinating with ITE, ITSA in new course development to be available in FY 1999: ⇨ Managing Systems Integrators. ⇨ Advanced Sensors. • Providing input on ITS competencies to FHWA and FTA for career track development, to private sector organizations to establish certification programs, and to public transportation agencies to aid in hiring and contracting.	• The PCB Program plans to provide "seed" funding to encourage the fulfillment of training and education "gaps" within the top ten competency areas. The proposed focus for new course development is on: ⇨ ITS and the principles of systems and telecommunications engineering; ⇨ Transportation fundamentals; ⇨ Project management for ITS; ⇨ Bridging public and private sector organizational/institutional differences; ⇨ ITS and data analysis and management; ⇨ ITS planning tools. • Creation of new hands-on initiatives. In addition to training courses, workshops, labs and case studies are proposed to address needs related to the following topics: ⇨ Managerial/Administrative Skills: Problem-solving, managing contractors, negotiating skills, writing specifications, institutional issues. ⇨ Technical Skills: Equipment installation, maintenance, troubleshooting. • Work with the commercial vehicle and rural ITS Program partners to identify their needs for future course development or course modifications.	• PCB Program partners are using the needs assessment report to identify "gaps" and develop new courses. • Limited U.S. DOT involvement in new course development.

2) Course Delivery

FY 1996-1998: Accomplished	FY 1999: Underway	FY 2000: Planned	FY 2001-2002: Proposed for Mainstreaming
• Delivered available training activities to expanded audiences through U.S. DOT, national associations, State and local governments, and academia. Through FY 1998, over 5000 transportation professionals received some form of ITS PCB training.	• Transitioning the course scheduling function to the following PCB Program partners: ⇨ NHI ⇨ NTI ⇨ NTC • Working on an assessment of distance learning media that includes piloting different forms to evaluate their technical feasibility and their success in reaching target audiences. • Establishing the first set of "pilot" PCB programs in the field that will take existing PCB training materials and modify them to meet local needs. Also working to help "pilot" sites assess local needs.	• Planning to focus on training for FHWA Division and Resource Center, and FTA Regional Personnel to support the effort to move ITS leadership to the field. • Continuing to train and certify DOT instructors at DOT headquarters and in the field. • Planning to provide "seed" funding to encourage "pilot state" programs to establish themselves around the nation.	• A group of "pilot states" and possibly regions (such as I-95 Corridor Coalition) actively implementing ITS education and training, tailored for individual State and local needs. • Course scheduling activities fully transitioned and ITS training courses scheduled and delivered by PCB Program partners, specifically, NHI, NTI, and OMC.

3) Creation of a Virtual and Continuous Learning Environment

FY 1996-1998: Accomplished	FY 1999: Underway	FY 2000: Planned	FY 2001-2002: Proposed for Mainstreaming
• Assessed the various forms of distance learning and other delivery media	• Working on an assessment of distance learning media that includes piloting different forms to evaluate their technical feasibility and their success in reaching target audiences. Beginning with the following course as a pilot: ⇨ The National ITS Architecture: An Introduction for FTA Senior Staff. • Placing all existing courses and technical assistance programs on the ITS Program's web site. Developing a web page for the ITS PCB Program as the initial component of a "virtual learning environment" for transportation professionals. • Working with PCB Program partners to initiate development of distance learning media for PCB delivery. Providing "seed funding" for a series of "pilot" initiatives that include: ⇨ Three interactive CD-ROMs for the following courses: – *ITS Awareness Seminar*. – *ITS Telecommunications Overview* (an SBIR initiative). – *Use of the CORSIM Model for Traffic Simulation.* ⇨ Video Conferencing / Satellite Transmission of ITS training: – *Public/Private Partnerships Seminar* to be broadcast via Tel-8 on May 4, 1999. ⇨ Web-based Training – I-95 Corridor/CITE Program has an introductory course on ITS underdevelopment by the University of Maryland – RPI is developing three courses for FHWA. – ITS America is in the process of researching the delivery of two new courses over the web.	• Plan to create Frequently Asked Questions (FAQs) modules for the proposed web site. • Plan to implement distance learning delivery of existing courses in cooperation with PCB partners NHI, NTI, and OMC. • Plan to develop a managed ITS PCB web page, including hyperlinks to more detailed sites. • Plan to encourage PCB partners to link their PCB efforts to the ITS PCB web page. • Plan to create a rolodex of deployment-related experts.	• Ensure the operations of a virtual learning environment to supplement traditional classroom activities with distance learning initiatives. This includes an operational ITS PCB web site that links PCB partners and PCB materials together for professionals to easily access. • A regular series of publications are readily available in traditional written form on CD-ROM, on the world-wide web and all other media forms. • Fully developed distance learning in place as part of U.S. DOT distance learning initiatives in conjunction with partners. • The ITS PCB web site management is transferred to a PCB program partner. • There is movement by U.S. DOT to become a continuous learning organization, incorporating the distance learning foundation established by the ITS PCB Program

4) Expand and Strengthen PCB Partnerships

FY 1996-1998: Accomplished	FY 1999: Underway	FY 2000: Planned	FY 2001-2002: Proposed for Mainstreaming
• First definition of PCB partner role provided through discussion at PCB Steering Committee meetings, ITS America's Training and Education Committee, and in the PCB *Framework and Overview* report (December 1997). • First pool of instructors for ITS training established that included U.S. DOT, university, and consultant personnel. • Began discussions with PCB program partners NHI and NTI on transitioning the PCB training, course development, and scheduling activities as an effort to mainstream ITS.	• Definition of PCB partner roles expanded and provided in this report. Further definition of roles to occur during a planned series of forums to discuss ITS curricula and future course developments. • Instructor pool continues to expand with train-the-trainer and certification activities underway in FY 1999 in cooperation with NHI, FHWA and FTA. • Establishing the first set of "pilot" PCB programs in the field that will take existing PCB training materials and modify them to meet local needs. Also working to help "pilot" sites assess local needs. Currently, two states (Florida and California) and one region (I-95 Corridor) are under development. • University initiatives underway to establish new undergraduate and graduate level programs. • NHI has accepted the majority of ITS PCB training and scheduling activities.	• ITS Education and Training in the early stages of becoming an integral part of Operations, Management and Maintenance, Education and Training activities. • Expand pilot states; Utah and Virginia have plans for near-future development. • More private-sector training to present hands-on learning. A catalog of existing private sector professional capacity building efforts is available on the ITS America web site. • Plan to establish a network of university-based "ITS Institutes" for training middle management and technical professionals. • Continue efforts to mainstream the ITS PCB Program into existing transportation programs by engaging and involving a host of other Partners who can offer more local opportunities to tailor and target materials and deliver professional capacity building. This includes expanding "Technology Transfer" activities through LTAP Centers and the professional associations.	PCB Partners fully engaged in the roles they have defined for themselves in ITS training and education. Successful engagement can be evaluated by the following criteria: • The NHI and NTI operate in conjunction with FHWA and FTA in developing and delivering ITS courses; LTAP Centers have become an integral part of the ITS program; FHWA Resource Centers and Division Offices and FTA Regional Offices have fully trained staffs to offer training and technical assistance; FTA Regional Office staffs working with FHWA Resource Centers to provide training and technical assistance to partners. • Universities throughout the country offer multi-disciplinary graduate transportation programs; Universities have established extensive education programs and curricula, providing the basic education for new entrants to the public and private sector. A network of university-based "ITS Institutes" functions throughout the country to intensively train and mainstream middle management/technical professionals. • Junior colleges and technical schools develop and present technician training programs to meet transportation needs, and they provide a source of students for universities. • Private sector transportation companies work with U.S. DOT and universities to coordinate, develop, and deliver various curricula to meet industry needs; The private sector has established a "curriculum" and is providing extensive, hands-on training. • Professional associations have established clear lines of interaction with U.S. DOT to develop and deliver training courses that meet high priority needs, and to develop ITS curriculum and certification programs that meet the needs of their memberships.

5) Increase PCB Program Communications and Outreach

FY 1996-1998: Accomplished	FY 1999: Underway	FY 2000: Planned	FY 2001-2002: Proposed for Mainstreaming
• Articles published in Public Roads, ITS America, DOT newsletter describing the goals and efforts of the ITS PCB Program. • Developed three separate catalogs of ITS training and education courses: ⇨ The U.S. DOT ITS PCB Catalog which includes NHI, NTI and OMC offerings. ⇨ The Catalog for Intelligent Transportation Systems Education and Training Efforts at U.S. Universities. ⇨ The ITS Supplier Course Catalog which includes private sector and vendor-based training. • Numerous university web-sites established that link students, faculty, researchers, and transportation professionals to ITS educational opportunities at universities. • Numerous presentations on ITS training, education and the PCB Program delivered around the nation, including to the Cxx for University Transportation Centers (CUTC)	• Development of the ITS PCB web site. • Frequent PCB Program updates provided through the ICDN newsletter. • Forum on the future of transportation education and future professionals held at the annual TRB meeting.	• A more proactive “marketing ” of the availability of training to partners and through the PCB Program partners to their memberships, especially universities to reach prospective students. • ITS America in co-operation with its members, universities, training institutions, and U.S. DOT is initiating an ITS America Education & Training Program designed to result in the award of an ITSA Certificate of Study in ITS Technologies.	• University undergraduate transportation programs attract increasing numbers of students to transportation majors

6) Continuously Improve the PCB Program

FY 1996-1998: Accomplished	FY 1999: Underway	FY 2000: Planned	FY 2001-2002: Proposed for Mainstreaming
• Initial evaluation methods included analyzing student feedback through questionnaires at the end of training sessions.	• Developing U.S. DOT strategies to become a continuous learning organization. • Revising existing ITS PCB training and classroom delivery methods to include ISD principles.	• Continued revision of existing ITS PCB training and classroom delivery methods to include ISD principles of learning. • Web site to be developed with feedback mechanism to answer questions in a timely manner and to capture the following types of information: – Student proposals for revisions and up-dates to web-based training, – Desired new training needs and initiatives – Track the characteristics of users (e.g., type of agency, job level) – Track whether web-based courses meet student's needs.	• Begin to "sunset" the U.S. DOT PCB program • Transition completed to phase out of U.S. DOT PCB program • Continuous learning environments have been established at U.S. DOT, among State and local agencies and in the private sector.

APPENDIX D: REPORT

BUILDING PROFESSIONAL CAPACITY IN ITS: GUIDELINES FOR STAFFING, HIRING, AND DESIGNING "IDEAL" PROJECT TEAMS

APPENDIX E: REPORT

BUILDING PROFESSIONAL CAPACITY IN ITS: GUIDELINES FOR DESIGNING AN INDIVIDUALIZED TRAINING AND EDUCATION PLAN

APPENDIX F: REPORT

BUILDING PROFESSIONAL CAPACITY IN ITS: GUIDELINES FOR DEVELOPING THE FUTURE TRANSPORTATION PROFESSIONAL

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