

4. METHODOLOGY AND RESULTS

The WBT research methodology was initially developed to identify and report on the potential of incorporating WBT into the transit industry through identifying best practices and lessons learned. The resulting research findings are intended to assist the transit industry in making decisions about how to take advantage of the Internet to improve staff training and certification. The report does not prescribe the content or the means for the transit industry to adopt WBT, but rather provides an overview of the subject and identifies baseline resources for interested transit agencies.

Because WBT is such a broad, multifaceted topic, developing a suitable methodology was challenging. Perspectives change continually in the public and private sectors, as do the technologies, applications, and service providers that support WBT. It is important to note that WBT is grounded in adult education theory and instructional design. However, the project scope did not allow the project team to explore these fundamental subjects while still adequately researching WBT. One definition of instructional design; however, underscores the complexity of WBT when considered in the transit environment:

Instructional design is the systematic development of instructional specifications using learning and instructional theory to ensure the quality of instruction. It is the entire process of analysis of learning needs and goals and the development of a delivery system to meet those needs. It includes development of instructional materials and activities; and tryout and evaluation of all instruction and learner activities.³

Nonetheless, some of the questions that guided the methodology and the subsequent research process are related to adult learning and instructional design:

- When is a human presence (i.e., an instructor or teaching assistant) required or advantageous?

³ From Instructional Systems Designers, Inc.'s website at <http://www.isdesigners.com/systems.htm>.

- Should the course be self-paced or follow a set schedule?
- Do the advantages of flexibility in offering courses outweigh the advantages and increased student commitment that come from face-to-face meetings with an instructor?
- Are the flexibility and any savings in offering a WBT course worth the up-front costs of creating such training?
- Will web-based training be as effective as in-person training programs in developing the required competencies and in determining how those competencies should be tested?
- To what extent does the choice of web-based training over conventional on-site, instructor-led training depend on the type of training to be conducted, the audience to be taught, and the audience's available hardware and software technology?

Consistent with the project team's working hypothesis, the findings and recommendations resulting from this research are based on a methodology that included the following phases:

1. Review prior institutional efforts,
2. Perform a literature search,
3. Create a TTR webpage,
4. Develop a telephone survey for SMEs who have experience, with one or more aspects of the topic,
5. Identify representative SMEs to survey,
6. Conduct detailed surveys of the SMEs, and
7. Synthesize SME information with previous research findings.

The project team's original Work Plan called for a two-stage survey approach. Results from the SME survey were going to be used to create and field a subsequent telephone

survey of transit agency trainers and human-resources personnel. However, preliminary research findings and the first SME telephone surveys quickly revealed that surveying transit agency staff who lacked the background of the SMEs would likely produce limited, if not misleading, findings. Instead, the number of SMEs invited to participate was increased to build a more substantial high-level knowledge base.

4.1 Review Prior Institutional Efforts

The project team reviewed TCRP, U.S. DOT, NTI, and APTA projects and activities that related to both online and traditional training. This review helped clarify the scope of the research effort. Two particularly important TCRP reports and one APTA report are discussed with the literature review findings. The principal U.S. DOT source was the ITS Professional Capacity Building Program of the Joint Program Office for ITS, whose webpage is shown in Figure 1.⁴ The NTI course listing page is shown in Figure 2.⁵

Each of these sources became central components of the WBT project, providing important information, sources of WBT information, and leads for potential SMEs. Overall, each source supported the notion of adopting new training technology, including those technologies necessary for teaching basic and advanced skills and knowledge sets. Another significant effort that proved instructive was the Training and Human Resources Development website, developed by CUTA and shown in Figure 3. CUTA provides excellent insights into how WBT topics can be designed for transit staff at all levels of an agency. CUTA's training program approach emphasizes the importance of exchanging information and ideas among WBT participants:

All CUTA programs combine basic and advanced concepts and techniques with extensive opportunities to relate learned material to the transit environment familiar to each participant. The intense, but practical, approach

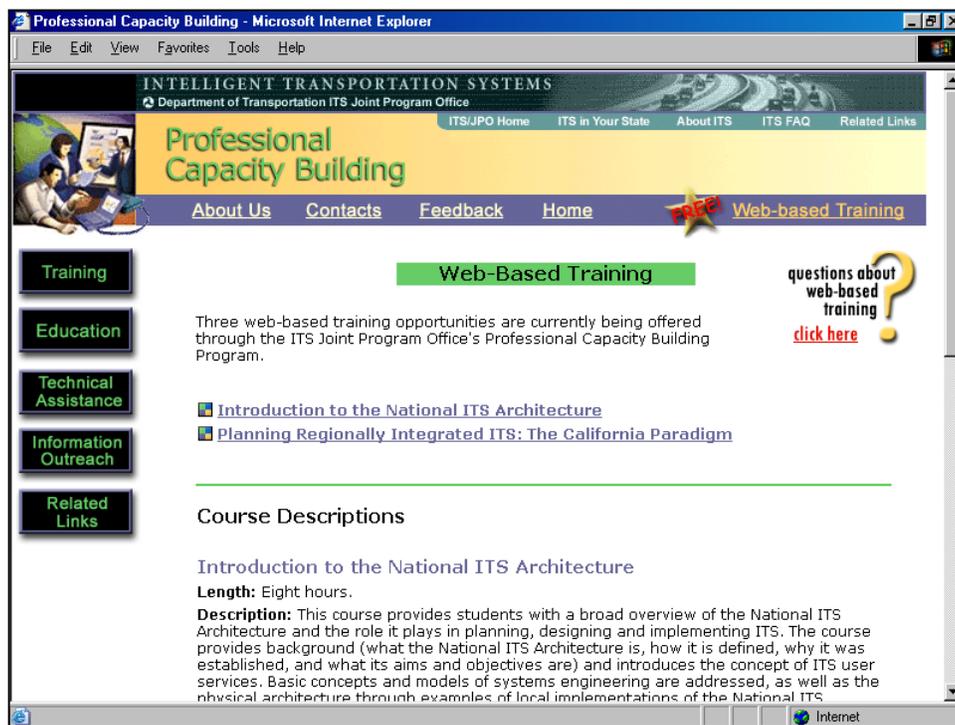
⁴ The Professional Capacity Building Program's course descriptions can be found at http://www.pcb.its.dot.gov/web_based.asp as shown in Figure 1.

⁵ See NTI course descriptions at <http://www.ntionline.com/Training.asp>.

offers the chance to apply individual techniques using class exercises, simulations, and practice sessions.⁶

The Association’s WBT course offerings include both technical and professional and upper management topics such as “Transit Planning—Basics,” “Transit Planning—Advanced,” “Transit Scheduling,” and “Workplace Health and Safety Law for Transit Professionals.”⁷ Readers are encouraged to visit CUTA’s TransitTraining.com, shown in Figure 4, for further information.⁸ Note especially the link to the demo WBT course that is available to any user.

Figure 1. ITS Professional Capacity Building Program Webpage.



⁶ Quote from CUTA’s Training and H.R. Development webpage at <http://www.cutaactu.ca/trnginfo.htm>.

⁷ See full list of CUTA’s traditional and WBT courses at <http://www.cutaactu.ca/training.htm>.

⁸ See <http://www.transittraining.com/>.



Figure 2. NTI Online Course Page.

Figure 3. CUTA's Traditional and Online Training Courses.



Figure 4. CUTA's TransitTraining.com Webpage.



4.2 Perform Literature Search

In addition to reviewing the material cited above, the project team performed a literature search that focused on key research documents and Internet sources. This research was used to

- Describe the broad landscape within which the research effort occurred,
- Identify essential WBT issues,
- Create the TTR webpage for use throughout the project,
- Identify potential SMEs to participate in the telephone surveys, and
- Obtain information necessary for designing the survey components of the project.

Key transit and other transportation documents that were used in this research included the following:

- *TCRP Report 77: Managing Transit's Workforce in the New Millennium* (TCRP Project F-09)⁹;
- *TCRP Report 29: Closing the Knowledge Gap for Transit Maintenance Employees: A Systems Approach* (TCRP Project F-05)¹⁰;
- "A Research and Technology Strategic Plan for the American Public Transportation Association: A Report and Recommendation to the APTA Executive Committee"¹¹; and
- *NCHRP Synthesis 296: Impact of New Information and Communication Technologies on Transportation Agencies* (NCHRP Project 20-5, Topic 31-08).¹²

TCRP Project F-09 looked at the overall workforce needs of the transit industry. A key theme of the research was the need for training. *TCRP Report 77* makes a number of points about the overall U.S. economy that are relevant to the transit industry and to WBT:

- Training for technical skills in a wide variety of job types is the most desirable training opportunity;
- Interpersonal skills, customer service, and leadership skills training, among others, are also popular;
- Candidates for entry-level, white collar jobs increasingly need basic analytical, communications, and organizational skills;
- There are core skill sets for "benchmark" transit agency positions, including mechanics, planners, bus operators, engineers, and information systems staff;

⁹ View or download at http://gulliver.trb.org/publications/tcrp/tcrp_rpt_77.pdf.

¹⁰ View or download at http://www.nationalacademies.org/trb/publications/tcrp/tcrp_rpt_29.pdf.

¹¹ View or download at <http://www.apta.com/cmmnt/rsrchtec/stratpln.pdf>.

¹² View or download at http://gulliver.trb.org/publications/nchrp/nchrp_syn_296.pdf.

- Training can serve as both a recruitment and retention strategy, especially under conditions of labor scarcity; and
- Transit agencies need to look at training as a business strategy.

TCRP Report 29 focused on fulfilling training needs for transit maintenance personnel. The main thrust of the report is summarized in the introduction to “Chapter 3: Guidelines for Creating a High-Skill Transit Maintenance Organization.” The passage states as follows:

The maintenance departments of public transit agencies in North America face a growing skills problem. The proliferation of new technologies in their vehicles and new regulatory requirements (e.g., reduced emissions and wheelchair access) are generating new skill demands that much of their existing workforce is ill-prepared to meet. The specialized nature of these skill requirements makes it difficult to hire individuals with all of the necessary competencies from the external labor market. Thus, the onus is on transit agencies themselves to find ways of closing the skills gap...Otherwise, agencies may find that they are wasting their training dollars—as workers quickly forget skills that are not put to use—and that training is counterproductive, as employees become frustrated by raised expectations that are not translated into better jobs or financial rewards.¹³

The points raised in this report support another theme of that study: transit agencies need to become “learning organizations.” One can argue that this perspective strongly supports the use of WBT in the transit industry, especially if it is flexible and relatively easy to update and reduces the loss of knowledge and skills between training and application.

More summary findings in *TCRP Report 29* provided direction for the WBT research, including the following:

¹³ *TCRP Report 29: Closing the Knowledge Gap for Transit Maintenance Employees: A Systems Approach*, Transportation Research Board of the National Academies, Washington, DC (1998); p. 30.

- “Examine the skill-creation capacity of transit maintenance agencies (both from internal training programs and external education providers)”;
- “Explore the relationship between improvements in skill levels and transit maintenance performance and the extent to which maintenance managers evaluate the effectiveness of their training efforts”;
- “Understand the major barriers to the successful implementation of high-skill maintenance organizations”; and
- “Identify and analyze the most promising innovations in skill development and use.”¹⁴

APTA’s report, which details the work of the Research Plan Task Force, also provided direction to the WBT research. Several findings are worth quoting for their potential relevance to WBT research:

One result [of its risk avoidance] is that the industry has been slow to adapt and adopt new technologies and innovative practices. Implementation of technology is not viewed as a priority by many and is difficult to sell given many other projects transportation systems face....But much of the technology which can enhance transportation operations already exists. The most appropriate position for the industry may be one of being ready to identify, seize, and adapt technology as changes present themselves. This requires the industry to be alert to the world around it....In addition, the skills needed to accommodate modern technology are at a premium, which makes recruitment and retention in the public sector difficult....There needs to be research on effective methods of introducing technology to the maintenance workforce, and on the training needs of that workforce.¹⁵

NCHRP Synthesis 296 discusses training issues mainly from the perspective of (nontransit) transportation agencies such as departments of transportation; nonetheless, it provides

¹⁴ *TCRP Report 29*, p. 1.

¹⁵ “A Research and Technology Strategic Plan for the American Public Transportation Association: A Report and Recommendation to the APTA Executive Committee,” APTA, Washington, DC (2001); pp. 2–3.

three key insights about Information/Communication (I/C) technologies relevant to transit WBT research:

State DOTs often face critical skill shortages and staff training needs that are only exacerbated by the proliferation of the new I/C technologies....To benefit from these new I/C technologies, state and local transportation agencies must either retrain existing staff to upgrade their engineering and management skills or hire new staff with the requisite skills....[It] has been apparent for a number of years that new I/C technologies not only are challenging state and local transportation agencies and organizations in terms of staff skills and training, but also are offering new mechanisms for delivering the very skills and training that are needed.¹⁶

The synthesis also states that information and communication technologies “can reduce training requirements, reduce operator skill requirements, and lead to the elimination of redundant or unnecessary equipment.”¹⁷

Other useful sources of information used for the research include the following:

- “Ten Things We Know for Sure about Learning Online” by Delahoussaye and Zemke;
- “The Ideal Online Course” by Alison Carr-Chellman and Philip Duchastel^{18,19};
- *Web-Based Training* by Margaret Driscoll; and
- *Designing Web-Based Training* by William Horton.²⁰

A brief summary of the literature search findings is provided in the subsections below.

¹⁶ NCHRP Synthesis 269: *Impact of New Information and Communication Technologies on Transportation Agencies*, Transportation Research Board of the National Academies, Washington, DC (2001); pp. 29–30.

¹⁷ Ibid, p. 23.

¹⁸ An abstract of this article can be found at <http://students.ou.edu/B/Jami.P.Beshear-1/carr.html>.

¹⁹ This article can be ordered online from Edge Hill at <http://www.edgehill.ac.uk/ims/index.htm>.

²⁰ See Appendix A for a full bibliography of cited sources.

4.2.1 Potential Transit Topics for WBT Are Vast

Two important findings of the initial research are that the need and potential for transit training is extremely broad and that the resulting list of subjects that could be addressed by WBT is vast. To choose particular topics, however, would have required the elimination of other topics.

Eliminating some topics would have skipped a necessary step of basic research on WBT and, therefore, compromised the ability to provide the overview of the transit WBT potential necessary to support further research and next steps.

The literature shows that this complexity results from at least four variables:

1. Differing transit agency training needs and resources;
2. Multiple organizational levels that could benefit from WBT, from upper management to line staff;
3. Organizational areas in transit competing for resources; and
4. The required skill and knowledge sets that result from the first three variables.

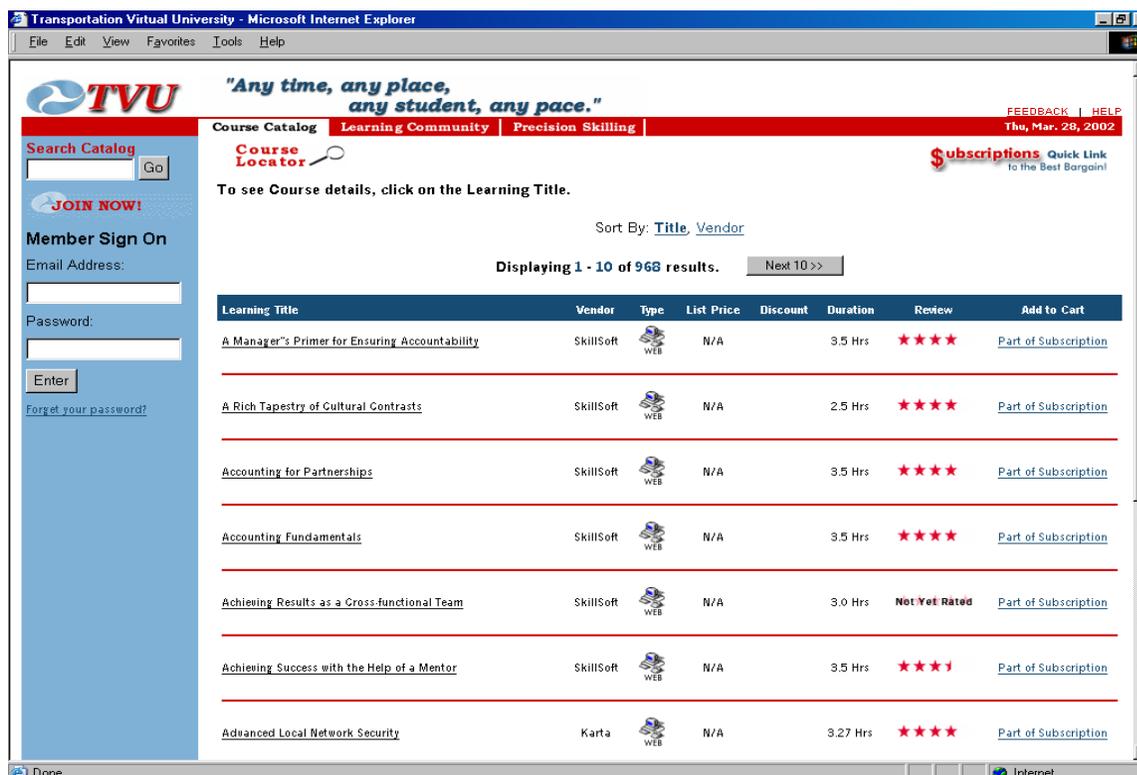
Table 1 shows the potential complexity of researching WBT and demonstrates why the project team decided to approach the research at a high level. Each cell in the matrix represents the product of the intersection between transit organizational areas and organizational levels (including each staffing level within). Within each cell, one would have to answer questions about responsibility, key issues and training needed, appropriate types of training, applicability to WBT, and other issues to adequately understand how to undertake WBT research or development. The symbol in each cell denotes that the number of possible solutions is exponential. (CUTA's WBT offerings listed above, training needs mentioned in the other literature sources, and the NTI website illustrate this complexity.²¹) If an agency considers subjects beyond those directly related to public transit, such as those found at U.S. DOT's new Transportation Virtual University (shown in Figure 5), the permutations are even more staggering.

²¹ See NTI Online at <http://www.ntionline.com/Training.asp>.

TABLE 1 Transit Training Complexity Matrix

	<i>Organizational Levels</i>			
	Executive/ Managerial	Supervisory	Technical/ Professional	Operating/ Line Staff
<i>Organization Areas</i>	Executives, senior and middle managers, etc.	Garage supervisors, foremen, road supervisors, etc.	Planners, analysts, engineers, project managers, etc.	Bus operators, mechanics, customer service agents, etc.
Operating Equipment	n ^y	n ^y	n ^y	n ^y
Operators/ Operations/ Planning	n ^y	n ^y	n ^y	n ^y
Customers/ Customer Service	n ^y	n ^y	n ^y	n ^y
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Figure 5. U.S. DOT Transportation Virtual University Course Locator.



4.2.2 WBT Applications and Technology Are Still Young and Changing Rapidly

The web is a relatively new and rapidly evolving medium for training, even in the private sector. There is still controversy about many aspects of WBT, starting with the definition of the term and the modalities it encompasses. The competing approaches, applications, technologies, and hybrids thereof were too numerous to investigate in detail.

The previously quoted article from *The New York Times* illustrates the rapid change in WBT:

Although various forms of computer-based training have been around for years, Cushing Anderson, the program manager for learning services research at the International Data Corporation, said that “the technologies have improved to the point where many of the technological obstacles that were faced two or three years ago have been removed.” While information technology classes represent the bulk of e-learning, he said, International Data expects a shift to other subjects in the next two years.²²

The variety of applications and technologies that can be used to implement WBT in the transit industry is as diverse as the training modes mentioned above. Moreover, a quick search of the Internet proves that there is an extensive number of WBT development firms and products. This finding encouraged the project team to concentrate on higher-level WBT issues.

4.2.3 Major Types of WBT

The WBT landscape includes a much wider range of modalities than is discussed in this report. Instead of making the research project more confusing with potentially esoteric explanations and debates among training professional about the nuances of WBT approaches and applications, the

²² “Employee Training, Without, the No-Doz.”

project team chose to focus on four major, generally accepted types of WBT. These are described by the well-regarded Instruction Systems Design and WBT expert, Margaret Driscoll. Adapted from her book *Web-Based Training: Using Technology to Design Adult Learning Experiences*, these approaches are summarized in Table 2 and are also described in greater detail on the Types of WBT link in the TTR webpage.²³

TABLE 2 Four Types of Web-Based Training

Web / Electronic Performance Support Systems (W/EPSS)	<ul style="list-style-type: none"> • Self-paced (no instructor), just-in-time instructions (e.g., online job aids) • Look up information when and where it is needed, rather than master information to remember it later • Self-paced, just-in-time instruction (e.g. online job aids) • Relatively inexpensive to develop, once the initial site has been designed • Can complement other WBT modes
Web / Computer-Based Training (W/CBT)	<ul style="list-style-type: none"> • Uses a CBT-type approach, but delivers the courseware over the web, rather than on CD-ROM • Self-paced online lessons and modules (no instructor), with measurable performance goals • Well suited for drill and practice of repetitious skills, often includes test items
Web / Virtual Asynchronous Classes (W/VAC)	<ul style="list-style-type: none"> • Led by an instructor, requiring multiple sessions over a period of time • Does not require participation at a particular time • Emphasizes group interaction; learners collaborate on projects and exercises, often using e-mail and message boards • Does not require participation at a particular time (therefore, “asynchronous”)
Web / Virtual Synchronous Classes (W/VSC)	<ul style="list-style-type: none"> • Led by an instructor, one or many sessions • Instructor and learner(s) “meet on the web” at a particular time, typically using a telephone and Internet connections • Many sophisticated web conferencing systems are available, with varying capabilities and costs

To make matters more interesting, many training programs combine several of these elements—for example, a web/virtual synchronous class (W/VSC) could include web/computer-

²³ For a review of this and other related books, see http://www.e-learninghub.com/Driscoll_WBT.html.

based training (W/CBT) lessons and be supported by web/electronic performance support systems (W/EPSS) after the instructor-led training is complete.

In “Ten Things We Know for Sure about Learning Online,” the authors, Delahoussaye and Zemke, address the fact that training experts now emphasize the value of the EPSS approach. They conclude that “performance support systems lead to less training and smaller modules.”²⁴ They also identify a trend to deliver “blended training,” which combines a traditional classroom course with pre-class and post-class assignments delivered over the web. Some WBT sources use the term “blended” to refer to mixing aspects of WBT models or hybrid approaches.

The project team thinks the advice of long-time online training expert William Horton is worth heeding: “Although WBT is too new to have an extensive track record or research history, we can use past experience with related technologies and techniques that apply to WBT.”²⁵

4.3 Create Transit Training Resource Webpage

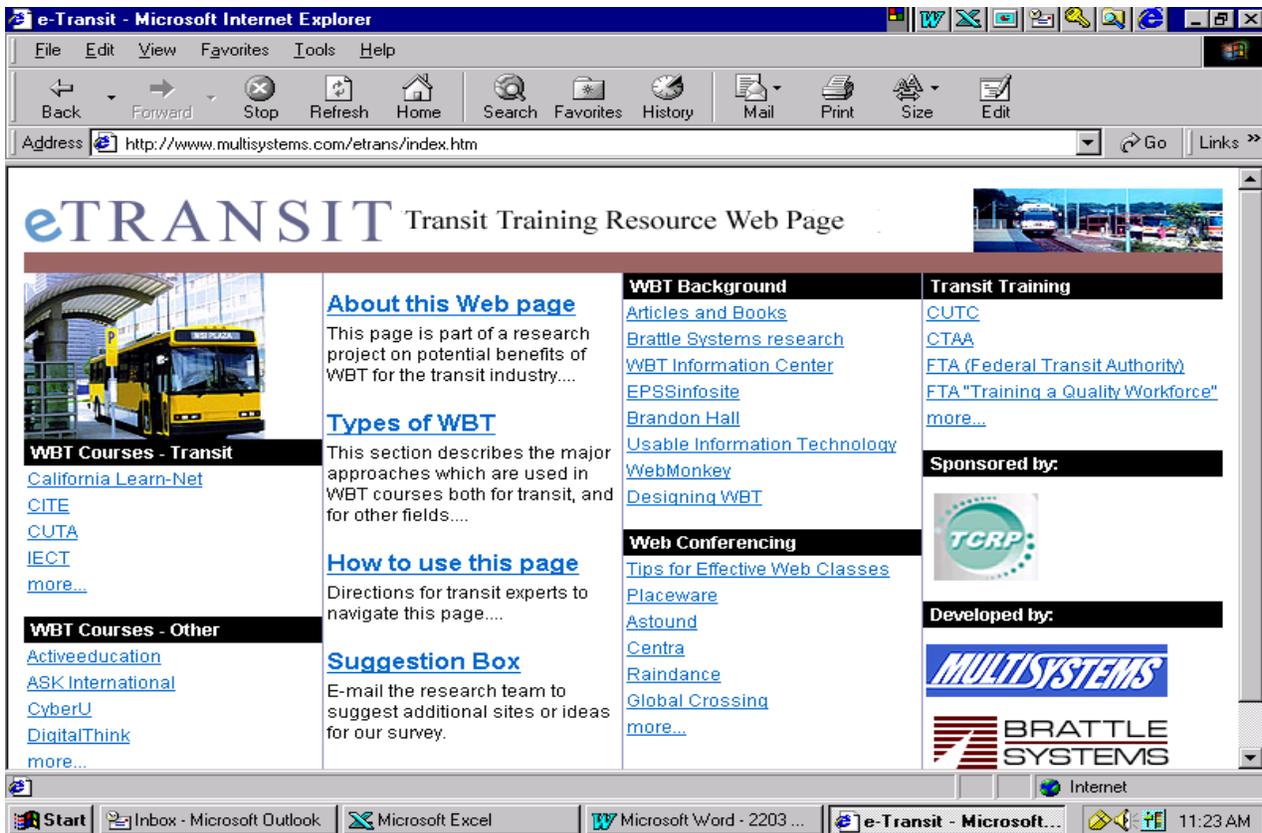
Because the WBT industry is evolving rapidly and any group of SMEs would likely vary widely in terms of its WBT background, the project team developed a TTR webpage to establish a common language for the survey process. SMEs were asked to visit the page before the telephone survey so that baseline terminology and concepts could be defined, thus making the survey process more efficient. A Suggestions link, which automatically launches an e-mail message addressed to project team staff, was provided on the TTR webpage to answer any questions or address suggestions the SMEs might have before the survey. Like the review of institutional efforts and the literature search, creating the TTR helped the project team to prepare for the SME surveys by focusing its own definition of WBT, as explained above. Developing the webpage also structured the process of finding, prioritizing, and organizing information and resources related to WBT.

²⁴ Delahoussaye, M. and R. Zemke. “Ten Things We Know for Sure about Learning Online.” *Training*: September 2001; pp. 49–59.

²⁵ Horton, William K. *Designing Web-Based Training*. New York: John Wiley and Sons, November 1999.

Figure 6 shows the TTR home page.²⁶ Much of the content the project team developed for the TTR appears in pop-up windows that describe how to use the TTR, summarize the main types of WBT that would be discussed during the SME surveys, give directions on how to use the webpage effectively, and provide a wide selection of public and private information resources and services. Because the amount of published WBT information readily available on the Internet is so vast, the project team could only include a small portion to cover basic concerns. Readers are encouraged to use the TTR while reviewing this report and to use its numerous links to explore the concepts in detail.

Figure 6. Transit Training Resource Page.



²⁶ To view the TTR, go to <http://www.multisystems.com/etrans/index.htm>.

Several specific TTR links worth noting include the WBT Information Center (WBTIC), which has a WBT primer,²⁷ a resource link,²⁸ and a resource center called “Web Online.”²⁹ Another useful resource is a basic sample WBT course entitled “Designing Effective Electronic Courses.”³⁰ The course includes audio instruction, which explains text and diagrams and incorporates several types of practice modules that users can use to test their comprehension of the subject matter.

4.4 Develop SME Survey

Developing a suitable SME survey instrument was challenging due to the complexity of the research environment, as described in previous subsections of Section 4. In addition, the diversity of SMEs, which is discussed in the next section, required asking questions of general relevance rather than highly specific questions. The survey was organized into sections to mirror the key analytical issues of this research project: (1) objectives and promise, (2) value creation, and (3) implementation issues related to WBT.

4.5 Identify and Recruit Representative SMEs

A group of SMEs with experience in some combination of transit (or general surface transportation) training, ITS, and WBT was identified and recruited to provide professional views regarding WBT practice. The review of prior institutional efforts, the literature review, and project team contacts were used to develop an initial list of potential SMEs. In fact, five of the SMEs were identified in this way; three of these people were involved in the TCRP projects cited earlier and two have been involved with the Professional Capacity Building (PCB) process. Two other SMEs have been involved with CUTA’s online training efforts described above. Others were recommended by SMEs who had already agreed to participate. In the end, 11 of the 12 SMEs originally identified participated in the research. See Table 3 for a list of the SMEs; see Appendix B for full contact information for the SMEs.

²⁷ See <http://www.filename.com/wbt/pages/process.htm>.

²⁸ See <http://www.filename.com/wbt/pages/resources.htm>.

²⁹ See <http://www.webbasedtraining.com/wbt/pages/wbtonline.htm>.

³⁰ For the sample course, go to <http://www.designingwbt.com/ILACourse/course/index.htm>.

TABLE 3 List of Subject Matter Experts

Name and Title	Affiliation(s)	Background Summary
Anderson, Mark Manager of Training	San Diego Transit	Developer and teacher of NTI courses. Pioneered work in the use of CBT in the transit industry and created the Partnership Program Model training initiative.
Brahms, Thomas	Institute of Transportation Engineers (ITE)	Developer of WBT courses.
Davis, Mary J., Ph.D. President	McGlothin Davis, Inc.	Principal Investigator for TCRP Project F-09, "Managing Transit's Workforce in the New Millennium." Member, APTA Human Resources and Research and Technology Committees and Diversity Council. Ten years experience as senior manager in transportation operations. Consultant to public transportation agencies nationwide. Frequent presenter at APTA and other conferences on a variety of human resource and organizational effectiveness topics.
Fletcher, Dennis Director, Transit Studies	ENTRA Consultants	Lead instructor and developer for several CUTA traditional and WBT service planning and scheduling courses. He has been conducting online courses for 2 years at CUTA's TransitTraining.com
Frankle, Kathleen Program Manager	Center for Advanced Transportation Technology, University of Maryland	Program Manager for the Center for Advanced Transportation Technology. Manager of the Consortium for ITS Training and Education. Developed PCB WBT course "Introduction to the National ITS Architecture." Developing an entry-level WBT transit course for 2002.
Giguere, Ronald PCB Coordinator	ITS Professional Capacity Building Program, Joint Program Office, U.S. DOT	PCB Training Program Coordinator. Has also taught technical aspects of National Highway Institute courses.
Moon, Brian Research Associate	Klein Associates, Inc.	Principal Investigator for TCRP Project A-20B (2), "Training for New Technology."
Ruddick, Scott Manager, Education and Training	CUTA	Responsible for all CUTA training programs. Previously headed up the Safety and Training Office at Orion Bus Industries and was employed as a Training Officer at GO Transit. Implemented several large-scale training programs in customer service, safety awareness, and performance management, among others. Originator of TransitTraining.com, the Internet's first learning portal devoted to the training needs of the transportation professional.
Schweiger, Carol L. Principal	Multisystems, Inc.	Experienced in training transit and transportation agencies on the subject of ITS for public transit, including with U.S. DOT's PCB program and NTI. Strong interest in WBT and its value to the transit industry. Sees WBT as an important evolution in training for the transit industry.
Steiger-Howe, Linda Program Director, Technology Transfer Program	Institute of Transportation Studies, Technology Transfer Program University of California, Berkeley	Program Director of the Institute of Transportation Studies Technology Transfer Program. Developed PCB WBT course "Planning Regionally Integrated ITS: The California Paradigm." Involved in a "just-in-time" training initiative.
White, Chelsea C., III, Ph.D. IsyE Professor Transportation and Logistics	School of Industrial and Systems Engineering, Georgia Institute of Technology	Formerly Director of the Intelligent Transportation Systems Research Center at the University of Michigan. Editor of the <i>IEEE Transactions on Systems, Man, and Cybernetics</i> ." Fellow of the IEEE. Co-author of <i>Optimum Systems Control</i> (second edition).

Although it might have been ideal to include only SMEs with transit WBT experience, not enough qualified transit industry experts could be identified for that to be accomplished. Recognizing that individual SMEs would have more or less experience with training, transit, or WBT, the project team approached the diversity in background and perspective as a positive element of the research. This required the project team to address general WBT issues while still obtaining the information needed to fulfill the research objectives.

Each potential SME was contacted by telephone and sent an e-mail message that briefly summarized the project background and goals and included a link to the TTR webpage. After agreeing to participate, each SME received a second, more detailed e-mail from the interviewer that included the survey questions and another link to the TTR home page to reinforce its importance in the survey process.