Southwest Region University Transportation Center

Assessment of a Regional Transportation Education Alliance to Improve Mobility

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16. Abstract
The emphasis in surface transportation is shifting from a construction-based paradigm to a more operations based approach to mobility. This increased emphasis on transportation system operation and management requires a skill set not available in traditionally trained students. A need exists to improve undergraduate education experiences to foster new skills and to also create interest among students to pursue advanced degrees in transportation. Currently, most university programs have minimal expertise in transportation and course material is often limited or nonexistent. An opportunity exists to take advantage of expertise at universities for the benefit of the entire transportation program. This study presents results from an investigation of a number of issues related to undergraduate education and provides an approach to improving undergraduate transportation education through appropriate alliances of universities to encourage more students to pursue graduate education. Results include an assessment of current education needs in the Southwest University Transportation Center region. The report also looks at educational resources in transportation education at universities in the region and outlines potential delivery mechanisms for needed curriculum. It also provides recommendations on fostering continued collaboration between universities to enhance education and encourage students to seek transportation as a viable career choice.

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ASSESSMENT OF A REGIONAL TRANSPORTATION EDUCATION ALLIANCE TO IMPROVE MOBILITY

Final Report

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ABSTRACT

The next generation of transportation professionals will come from current and future groups of undergraduate and graduate students in our universities. Thus, it is critical that universities take a proactive role in educating and preparing these future transportation professionals to work effectively and efficiently in the 21st century. The emphasis in surface transportation is shifting from a construction-based paradigm to a more operations based approach to mobility. This increased emphasis on transportation system operation and management requires a skill set not available in traditionally trained students. A need exists to improve undergraduate education experiences to foster new skills and to also create interest among students to pursue advanced degrees in transportation. Currently, most university programs have minimal expertise in transportation. Course material is often limited or non-existent. An opportunity exists to take advantage of expertise at universities, such as Texas A&M University, for the benefit of the entire transportation education program. This study presents results from an investigation of a number of issues related to undergraduate education and provides an approach to improving undergraduate transportation education through appropriate alliances of universities to encourage more students to pursue graduate education. Results include an assessment of current education needs in the Southwest University Transportation Center region (Arkansas, Louisiana, New Mexico, Oklahoma, and Texas). The report also looks at educational resources in transportation education at universities in these states. Finally, based on the results of the needs and resource assessments, the report outlines potential delivery mechanisms for needed curriculum and provides recommendations on fostering continued collaboration between universities to enhance education and encourage students to seek transportation as a viable career choice.

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The study team wishes to acknowledge the cooperation and input of the various universities, state agencies, local agencies, and private consultants who responded to the study surveys. Their input was critical to the success of this project and their assistance was appreciated.

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EXECUTIVE SUMMARY

The next generation of transportation professionals will come from current and future groups of undergraduate and graduate students in our universities. Thus, it is critical that universities take a proactive role in educating and preparing these future transportation professionals to work effectively and efficiently in the 21st century. The emphasis in surface transportation is shifting from a construction-based paradigm to a more operations based approach to mobility. A need exists to improve undergraduate education experiences to foster new skills and to also create interest among students to pursue advanced degrees in transportation.

Currently, many university programs across the country have minimal expertise in transportation. In these programs, course material is often limited or non-existent. Furthermore, faculty members who are already overburdened do not have the time to develop additional transportation-related materials for use in their classes. Thus, an opportunity exists to take advantage of expertise available at some universities for the benefit of the entire transportation education program. The objective of this study was to determine ways in which this expertise can be packaged and disseminated to those universities that have a need for it. While the focus of the study was the Southwest University Transportation Center (SWUTC) region, the results of the study are applicable nationwide.

A questionnaire survey was used to examine the educational needs of the various types of employers that hire transportation professionals. Its focus was to assess the level of transportation-related knowledge the employer expects of undergraduates hired into entry-level positions within the organization. The information sought from the questionnaire included whether or not the employer hires undergraduate engineering students into transportation-related entry-level positions, and the academic department and university they prefer for prospective hires. Respondents classified desired knowledge in eleven transportation topics as thorough, brief background, or none. The topics listed were traffic engineering, traffic operations, geometric design, highway capacity, pavements, transportation planning, public transportation, highway safety, human factors, ITS awareness, and multi-modal issues. They identified three of these topic areas that were most critical when hiring undergraduates and provided additional

transportation topics of importance that were not listed in the survey. Respondents also identified knowledge deficiency in these topics as major, minor, or none. The employer respondent then listed which topics with "major" knowledge deficiency were the most critical when hiring undergraduate students and provided additional topics with deficiency that were not listed on the survey.

Responses were received from every state in the region and from both public and private organizations. For all of the transportation topics, the majority of responding employers expects new graduate students to have a minimum level of brief background knowledge. In some cases, a significant number (though not a majority) of respondents expect thorough knowledge of the topic. The most critical topics necessary for hiring were traffic engineering, traffic operations, geometric design, transportation planning, and highway capacity. At least ten respondents found some knowledge deficiency (either major or minor) in each of the transportation topics, the most prevalent being traffic operations, traffic engineering, and highway capacity.

A questionnaire survey was also used to examine the transportation education resources at universities in the SWUTC region. Its focus was to assess the general transportation course offered to undergraduate students in a civil engineering program. The information sought from the questionnaire included whether a university program offered a general transportation course to undergraduate students and whether the course is mandatory for all students within the department. Respondents classified transportation topic coverage as thorough, brief overview, or not covered. The topics were identical to those used in the employer survey. Respondents were asked to note the primary reason for not covering a topic and identify which topic areas not covered should be added to the curriculum. Faculty were also asked to identify a preferred material format if materials were made available for use in the classroom.

Responses were received from each state in the region, all of which offer a general transportation course. Of those responding nearly half require the course for all undergraduates. The majority of responding universities (over 70%) provide a minimum of brief background knowledge of each transportation topic except ITS awareness and multi-modal issues. Three topics are taught at every respondent university: traffic engineering, traffic operations, and geometric design. Topics receiving the most "thorough" instruction were traffic engineering, geometric design, pavements, and transportation planning. Over 50% of respondents do not cover ITS awareness or multi-modal issues in their course. Most faculty have limited time to

cover all topics in depth in an introductory course, which was the primary reason for not covering a topic. Those topics faculty believed should be added to the curriculum were ITS awareness, transportation planning, multi-modal issues, and human factors. Preferred formats for course material were lecture notes, presentation slides, and video clips.

The report recommends that four transportation topics receive high priority for action by an education alliance: traffic engineering, traffic operations, highway capacity, and transportation planning. Moderate priority topics include pavements, public transportation, highway safety, ITS awareness, and multi-modal issues. Low priority topics are geometric design and human factors. Universities and employers can take various actions to bridge the education gap based on the topics addressed in this report. First, universities with expertise in the areas identified can develop educational material that maximizes the knowledge gained by the student. They can utilize various formats to deliver that knowledge and work to ensure that material is available to all universities within the region and the nation. Second, a regional task force comprised of representatives from the professional and academic communities can work to identify expected KSAs and devise plans for meeting those expectations. Some of this work has already begun at the national level through the efforts of the U.S. Department of Transportation Professional Capacity Building (PCB) Program, under the direction of Tom Humphrey. This regional task force can build upon the needs assessment currently underway by the PCB program to ensure the specific needs of the regional are included. Members of the task force can also participate in the Forum on Transportation Education and Training, the first of which will be held in January 1999. This forum is an opportunity for academic institutions, government agencies, industry partners, and professional organizations to identify the forces affecting transportation and its educational needs and formulate broad guidelines for curriculum development based on these needs. Finally, the universities and employers in the region can create an alliance that has as its primary goal to address the educational needs of the region on a continuing basis. This alliance can collaborate on educational initiatives and work toward establishing a clearinghouse of educational and informational resources for the transportation profession. This clearinghouse would serve as a central location where faculty, students, and professionals can access information critical to developing and enhancing KSAs. The alliance can also ensure that the aforementioned actions become part of the fabric of the profession as a necessary component.

A variety of delivery mechanisms exist for disseminating information to students, many of which utilize electronic media and the Internet. It is difficult to prioritize delivery mechanisms as they relate to the various transportation topics identified in this report. Each mechanism serves a specific purpose and is intertwined with the topic and the desired KSA level of the university students. It is recommended that the delivery mechanisms be determined on a case by case basis as each topic area is addressed. However, a general recommendation is to maximize the utilization of electronic media, such as the Internet, electronic list servers, newsgroups, bulletin boards, digital libraries, and electronic clearinghouses. These methods can deliver information to a broad audience and are an efficient use of resources. With minor effort, many of these methods can be utilized by university faculty to disseminate information to both students at a "home" university or to others across the country.

The results presented in this report begin to develop a framework for creating an alliance between universities in a region to meet the educational needs of the profession. While the focus was on the SWUTC region, the guidelines and action items are applicable across the nation. By creating alliances and working to accomplish the actions set forth in this document, universities across the country can broaden student exposure to the transportation profession, encourage students to seek transportation as a viable career choice, enhance transportation education at the undergraduate level, and encourage students to pursue graduate education in transportation. Finally, it is important to recognize that the alliance concept works to meet the goals and objectives of the national PCB program, especially as they relate to educating the future professionals that will design, build, operate, manage, and maintain the transportation infrastructure of the 21st century.

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1. INTRODUCTION

The next generation of transportation professionals will come from current and future groups of undergraduate and graduate students in our universities. Thus, it is critical that universities take a proactive role in educating and preparing these future transportation professionals to work effectively and efficiently in the 21st century. The emphasis in surface transportation is shifting from a construction-based paradigm to a more operations based approach to mobility. This increased emphasis on transportation system operation and management requires a skill set not available in traditionally trained students. A need exists to improve undergraduate education experiences to foster new skills and to also create interest among students to pursue advanced degrees in transportation.

1.1 BACKGROUND

Currently, many university programs across the country have minimal expertise in transportation. In these programs, course material is often limited or non-existent. Furthermore, faculty members who are already overburdened do not have the time to develop additional transportation-related materials for use in their classes. Thus, an opportunity exists to take advantage of expertise available at some universities, including Texas A&M University, for the benefit of the entire transportation education program. The objective of this study was to determine ways in which this expertise can be packaged and disseminated to those universities that have a need for it. While the focus of the study was regional, the results of the study are applicable nationwide.

1.2 PURPOSE

The purpose of this study was to investigate a number of issues related to education and determine an approach to improve undergraduate transportation education through appropriate alliances of universities and to encourage more students to pursue graduate education. The study was conducted by Texas Transportation Institute (TTI) staff and involved the following major

tasks: an assessment of current education needs in the Southwest University Transportation Center region (Arkansas, Louisiana, New Mexico, Oklahoma, and Texas); an assessment of educational resources in transportation education at universities in these states; a review and assessment of potential delivery mechanisms for needed curriculum; and development of recommendations for fostering continued collaboration between universities to enhance education and encourage students to seek transportation as a viable career choice.

2. CURRENT EDUCATION NEEDS

The Southwest University Transportation Center (SWUTC) region includes a diversity of transportation needs. Each state has a transportation infrastructure unique to its urban and rural geographical makeup. Furthermore, this infrastructure is constantly expanding and improving to meet the needs of the motoring public. Thus, each state has unique needs with respect to the knowledge, skills, and abilities (KSAs) its transportation professionals require to perform their role in maintaining that infrastructure. The first task in developing a means of forging an education alliance was to assess the education needs as seen from the perspective of the various types of agencies, organizations, and firms that employ transportation professionals.

2.1 SURVEY METHDOLOGY

A questionnaire survey was used to examine the educational needs of the various types of employers that hire transportation professionals. Its focus was to assess the level of transportation-related knowledge the employer expects of undergraduates hired into entry-level positions within the organization. A total of 65 surveys were mailed to state, city, and county governments, metropolitan planning organizations, and private sector employers in Arkansas, Louisiana, New Mexico, Oklahoma, and Texas. The survey was sent to a senior-level staff member or contact with a cover letter explaining the purpose of the research study and the objectives of the survey. A copy of the cover letter and survey sent to transportation employers is included in Appendix A.

2.2 TOPICS INVESTIGATED

The information sought from the questionnaire included whether or not the employer hires undergraduate engineering students into transportation-related entry-level positions. If they hire such individuals, the employer was asked to indicate the academic department from which most of these individuals graduate and preferred universities for prospective hires.

The second section of the survey investigated the level of knowledge an employer expects undergraduates to have in various transportation topics. Respondents classified desired knowledge in eleven transportation topics as thorough (extensive knowledge of topic expected with ability to solve applicable problems), brief background (general overview of topic expected), or none (little or no knowledge expected for entry-level position). The transportation topics listed were traffic engineering, traffic operations, geometric design, highway capacity, pavements, transportation planning, public transportation, highway safety, human factors, ITS awareness, and multi-modal issues. Respondents also identified three of these topic areas that were most critical when hiring undergraduates and provided additional transportation topics of importance that were not listed in the survey.

The third section of the survey solicited the opinion of the employer regarding current knowledge deficiency in the same eleven transportation topics. Respondents identified knowledge deficiency as major (recruit knowledge of topic is well below the expected level), minor (recruit knowledge of topic is slightly below the expected level), or none (acceptable knowledge of topic is found in recruits). The employer respondent then listed which topics with "major" knowledge deficiency were the most critical when hiring undergraduate students and provided additional topics with deficiency that were not listed on the survey.

2.3 DATA ANALYSIS AND FINDINGS

A total of 28 surveys (43%) were completed and returned to the study team. Returned surveys were coded into a data file and analyzed. Table 1 provides a breakdown of responding employers by state and organization type.

Table 1. Employer Survey Respondent Breakdown

Location	Type of Organization				Total Respondents
	State	Municipality	MPO	Consultant	
Arkansas	1	1	--	1	**3**
Louisiana	--	--	--	4	**4**
New Mexico	--	--	1	2	**3**
Oklahoma	1	--	--	2	**3**
Texas	3	3	3	7	**16**
Total Respondents	**5**	**4**	**4**	**16**	**28**

As noted in Table 1, responses were received from every state and from both public and private organizations. Furthermore, over 50% of the respondents were from organizations within Texas. The variety of respondents, while not statistically balanced, provided insight into the educational needs of transportation employers in the region.

Of the 28 employers that responded to the survey, 23 (82%) hire undergraduate engineering students into entry-level positions within their organization. Of those 23 employers, 20 exclusively hire students with a degree in Civil Engineering (CE), 2 hire students with either CE or planning degrees, and 1 exclusively hires students with planning degrees. The universities from which the organizations hire graduates varied depending on the state and the agency. Some respondents provided no preferences for universities. The following sections provide details on the survey responses regarding expected knowledge for new hires.

2.3.1 Expected Knowledge

For all of the transportation topics listed on the survey, the majority of responding employers expects new graduates to have a minimum of brief background knowledge of the topic. In some cases, a significant number (though not a majority) of respondents expect thorough knowledge of a topic. Figure 1 illustrates the responses received regarding expected knowledge. As illustrated in the figure, those topics of which a considerable number (over 1/3)

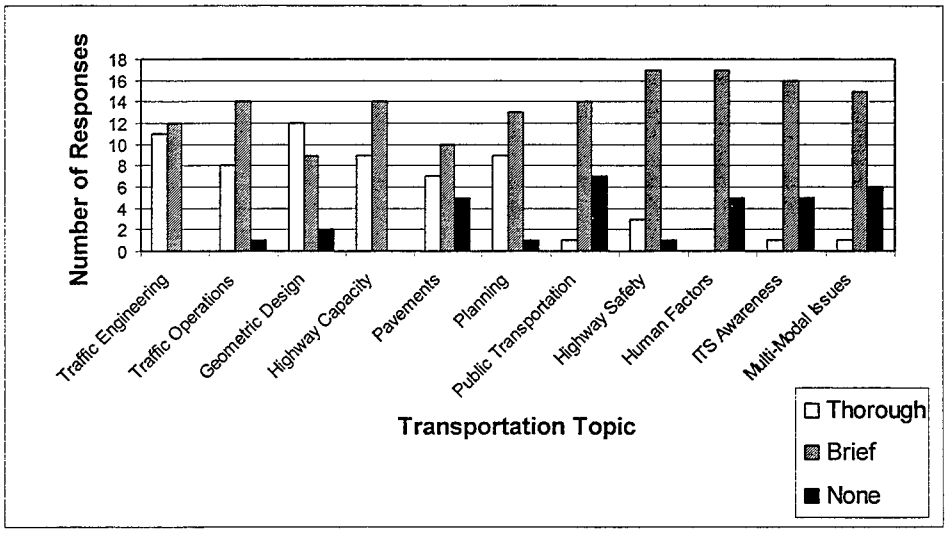

Figure 1. Employer Expected Knowledge of Transportation Topics

of employers expect thorough knowledge were geometric design (12), traffic engineering (11), highway capacity (9), transportation planning (9), and traffic operations (8). These findings are commensurate with the basic functions of the transportation professional in most entry-level positions. Those topics which received several responses indicating no expected knowledge included public transportation (7), multi-modal issues (6), pavements (5), human factors (5), and ITS awareness (5).

Respondents were asked to identify the top three transportation topics that were most critical when hiring undergraduates. These topics were to be selected from the list of topics the respondent noted as expecting "thorough" knowledge with the ability to solve applicable problems. Figure 2 illustrates the responses for those topics. These results correspond with the findings presented in Figure 1: topics that employers indicated as expecting thorough knowledge are more critical, and those that several indicated as expecting no knowledge are less critical in the hiring process.

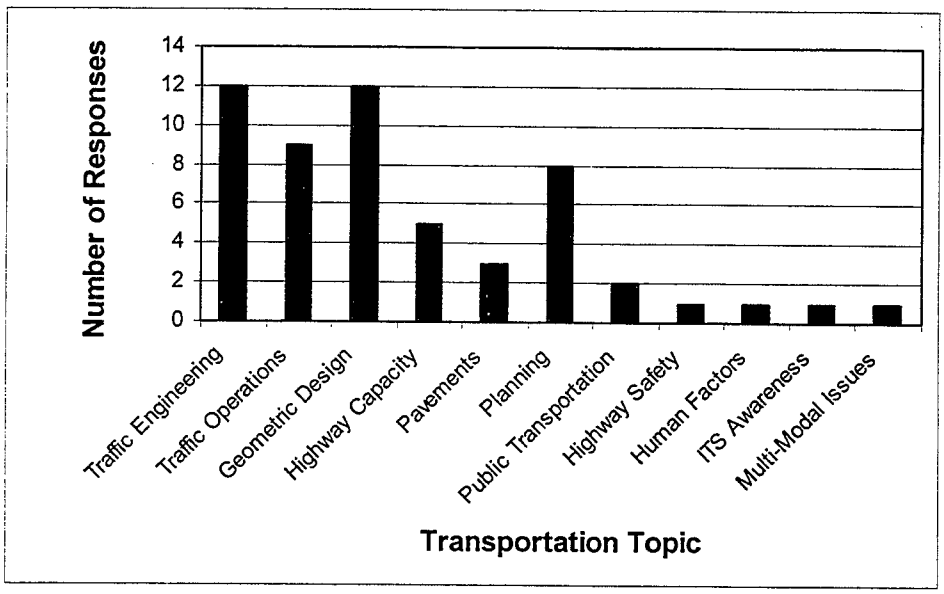

Figure 2. Thorough Knowledge of Topic Critical for Hiring

Respondents also listed additional transportation topics that were not provided in the survey. These topics were those in which undergraduates are expected to have some level of knowledge. Topics provided by respondents included traditional engineering knowledge and knowledge in other disciplines. For instance, general civil engineering topics included

surveying, air quality, environmental knowledge, hydraulics, and structural/bridge design. Specific transportation topics noted were right-of-way concepts, travel forecasting, travel demand management, and the public process. Software and computer skills included geographical information systems (GIS), computer aided design (CAD), transportation design software, and modeling software. Finally, other general topics in which respondents desired some knowledge were statistics, technical writing, interpersonal skills, tort liability, electronics technology, and communications engineering. While many of these topics can be addressed in transportation-related courses, many are skills required of all engineers, not just transportation professionals. Moreover, they indicate the diversity and complexity of the transportation infrastructure and the skills needed to manage it in the future.

2.3.2 Knowledge Deficiency

Once respondents identified expected knowledge levels for the listed topics, they provided information regarding knowledge deficiency they find with entry-level employees. At least ten respondents found some knowledge deficiency (either major or minor) in each of the transportation topics. Figure 3 provides a summary of the deficiency results. As shown in

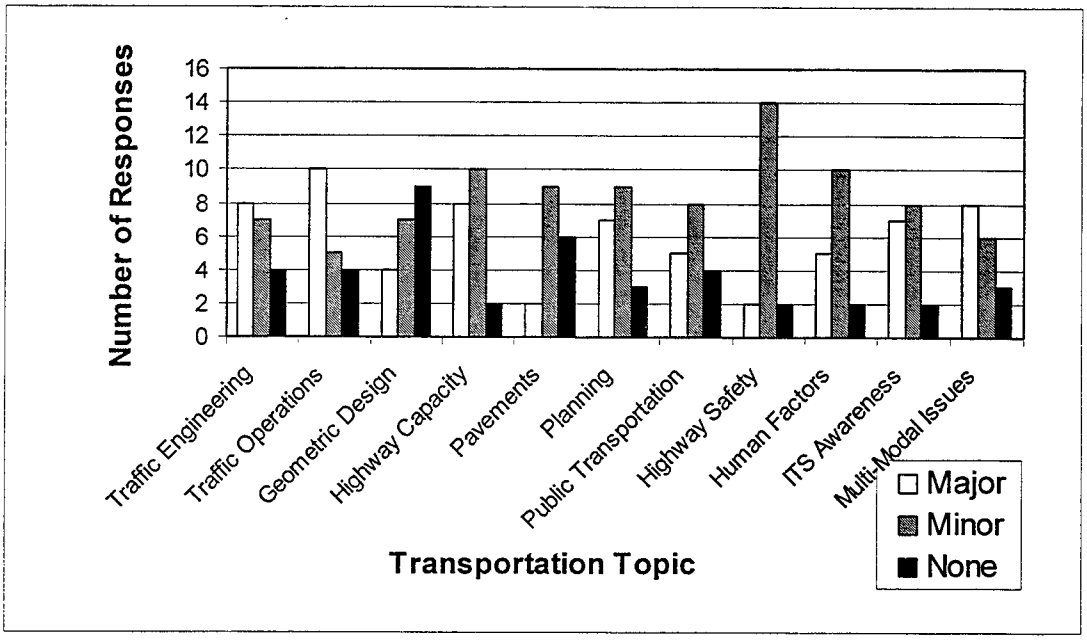

Figure 3. Level of Knowledge Deficiency

Figure 3, those topics receiving the most responses (over 25%) for major knowledge deficiencies were traffic operations (10), traffic engineering (8), highway capacity (8), transportation planning (7), and ITS awareness (7). The topic receiving the most responses for no knowledge deficiency was geometric design (9). Based on these findings, employers believe that knowledge deficiencies exist in critical areas with respect to transportation knowledge. The four most critical topics that perhaps need further attention at the universities include traffic engineering, traffic operations, highway capacity, and transportation planning.

Respondents also listed any additional transportation topics not provided in the deficiency section in which undergraduate students lack appropriate knowledge. Those listed in the responses were similar to those listed under expected knowledge. However, several of the topics mentioned are not directly related to transportation engineering. They include technical writing, personnel management, budgeting, finance, communications, and project management. Based on these responses, entry-level employees have complex roles that require KSAs they might not gain through traditional engineering programs. Hence, an opportunity exists to enhance their KSAs through non-traditional methods or university alliances to meet the needs of transportation employers.

3. CURRENT EDUCATION RESOURCES

The SWUTC region includes a diversity of universities with various strengths and expertise levels in engineering fields. Since these universities are the primary education resource for future transportation professionals, it is critical to determine the resources they provide with respect to transportation education and ways in which these resources might be enhanced to meet the education needs of the profession. Thus, the second task in assessing a regional transportation education alliance was to identify the transportation education resources provided by universities in the region.

3.1. SURVEY METHODOLOGY

A questionnaire survey was used to examine the transportation education resources at universities throughout the SWUTC region. Its focus was to assess the general transportation course offered to undergraduate students in a civil engineering program. A total of 22 surveys were mailed to four-year universities with civil engineering programs in Arkansas, Louisiana, New Mexico, Oklahoma, and Texas. The survey was sent to the civil engineering department head or a contact faculty member with a cover letter explaining the purpose of the research study and the objectives of the survey. A copy of the cover letter and survey sent to universities is included in Appendix B.

3.2. TOPICS INVESTIGATED

The information sought from the questionnaire included whether a university program offered a general transportation course to undergraduate students that provides an overview of the field. If such a course is offered, the respondent was asked to indicate whether the course is mandatory for all students within the department and to provide the course number, title, and description as listed in the university catalog.

The second section of the survey investigated the extent to which eleven transportation topics are covered in the general course. Respondents classified topic coverage as thorough (multiple lectures providing extensive coverage of topic, including problems, quizzes, laboratory exercises, etc.), brief overview (single lecture providing a general overview of the topic), or not covered (no lectures given on the topic). The transportation topics listed, which were identical to those addressed in the employer survey, were traffic engineering, traffic operations, geometric design, highway capacity, pavement, transportation planning, public transportation, highway safety, human factors, ITS awareness, and multi-modal issues.

If a topic was identified as "Not Covered", the respondent was asked to note the primary reason for its not being covered during the semester. Options included: (A) faculty interest and/or knowledge, (B) limited time available for subject matter, (C) lack of appropriate lecture material, and (D) other. Respondents also identified which of the topic areas not covered in the course should be added to the curriculum.

The third section of the survey solicited the opinion of the faculty regarding course delivery material. In short, if materials were made available for faculty use in the classroom, the survey asked the respondent to select a preferred material format for each of the transportation topics not covered in their course. The material formats provided were hard copies of lecture notes, presentation slides with outline, video clips, work problems, laboratory exercises, and other materials.

3.3. DATA ANALYSIS AND FINDINGS

A total of 15 surveys (68%) were completed and returned to the study team. Returned surveys were coded into a data file and analyzed. Table 2 provides a breakdown of responding universities by state. As noted in Table 2, responses were received from every state, with over 50% being from within Texas. The variety of respondents, while not statistically balanced, provided insight into the educational resources at universities across the region. The results of the university survey, when compared with those from the employer survey, provide information on areas where an alliance can work to close the gap between education resources and needs of employers.

Table 2. University Survey Respondent Breakdown

State	No. of Respondents
Arkansas	2
Louisiana	2
New Mexico	2
Oklahoma	1
Texas	8
Total Respondents	**15**

Of the 15 universities that responded to the survey, all of them offer a general transportation course to undergraduate students within their department that provides them with an overview of the field. Of those 15 universities, 7 require the course for all students in their department, and all courses are taught within the college of engineering. The following sections provide details on the survey responses regarding transportation topic coverage and preferred material format.

3.3.1 Transportation Topic Coverage

Figure 4 outlines the level of instruction each topic receives at the respondent universities. For the transportation topics listed on the survey, the majority of responding universities (over 70%) provide a minimum of brief background knowledge of each transportation topic with the exception of two: ITS awareness and multi-modal issues. Three topics are taught at every university either thoroughly or briefly, these being traffic engineering, traffic operations, and geometric design. Those topics receiving the most "thorough" instruction (over 45%) and the number of universities that teach this knowledge level were traffic engineering (8), geometric design (8), pavements (7), and transportation planning (7). The remaining topics receive a combination of thorough, brief, or no educational attention among the universities. Some topics were noted as receiving no attention, the most overwhelmingly so were ITS awareness and multi-modal issues. For both of these topics, over 50% of respondents do not cover the topic at all in their course. Other topics that are not taught at some universities include highway capacity, pavements, transportation planning, public transportation, highway safety, and human factors.

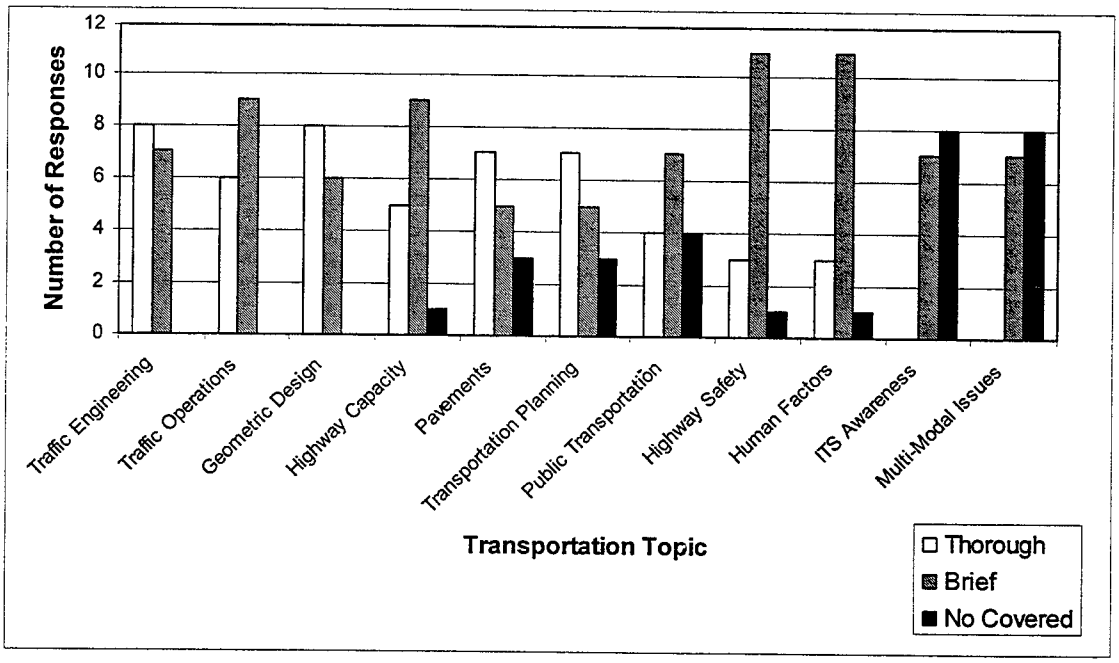

Figure 4. Transportation Topic Coverage at Universities

Respondents were asked to identify the primary reason for not covering a topic in the general transportation course. Figure 5 illustrates the responses received. As shown in the

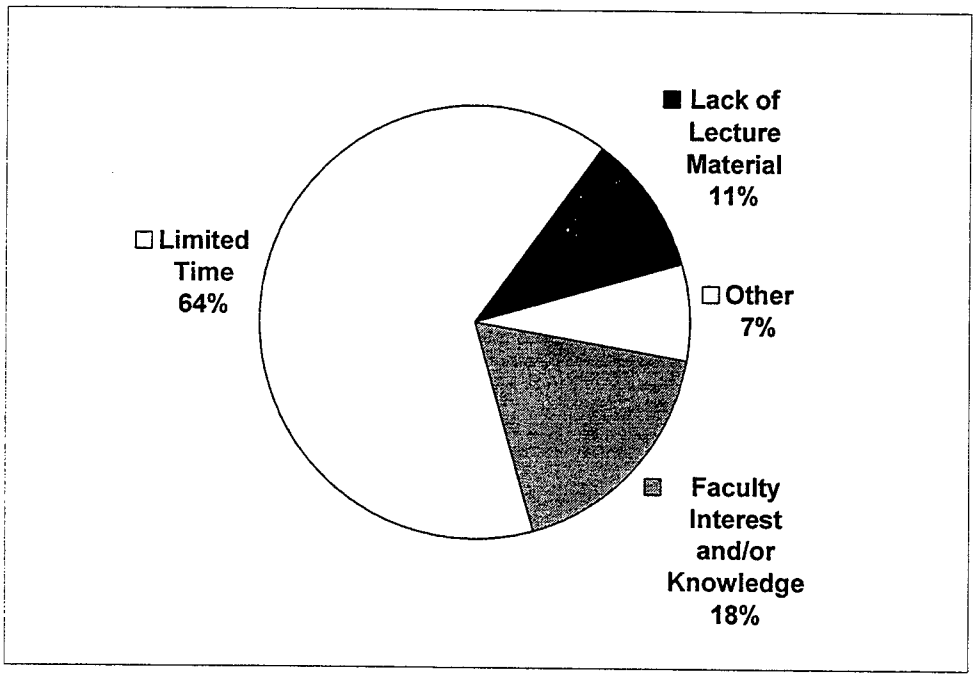

Figure 5. Primary Reason for Not Covering Topic

figure, most faculty have limited time to cover all topics in depth in an introductory course, most likely because of the large number of topics that must be covered. Furthermore, if faculty interest and/or knowledge in a course are limited or if teaching materials do not exist, then the topic might not be taught. Thus, while time is still limited, providing faculty with teaching materials that are easy to incorporate into a course syllabus may eliminate some barriers to certain topics being taught in the classroom.

Finally, respondents identified which of those topics that were not covered in their general transportation course should be added to the curriculum. Those topics faculty believed should be added, in order of importance, were ITS awareness, transportation planning, multi-modal issues, and human factors. Three remaining topics mentioned as less important were highway safety, highway capacity, and public transportation.

3.3.2 Preferred Material Format

The success of incorporating new educational material into a course relies heavily on the functionality and appropriateness of material itself. Faculty must be willing to use the material. Thus, respondents identified their preferences in resource material for use in the classroom. Figure 6 summarizes the material preferences of responding faculty members. As shown in the figure, the preferred material formats are lecture notes, presentation slides, and video clips.

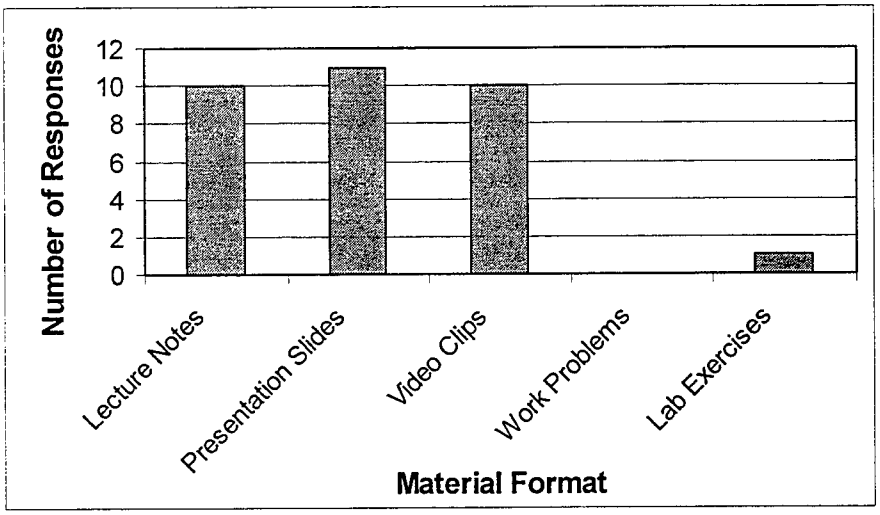

Figure 6. Resource Material Format Preferences

4. DELIVERY MECHANISMS

For transportation knowledge to be successfully disseminated to university students to enhance their KSAs, information must be delivered in a manner that is efficient and appropriate. Technology transfer, which is the method by which information and knowledge are disseminated to those who can benefit from it, consists of three critical elements: outreach, training, and education. (*1*) Education is the element of greatest use and concern in the university environment. With respect to students, education is the provision of both tools and background theory to apply those tools in the uncertain and/or changing future.

In the technology transfer arena, the general consensus is that effective communication is best accomplished through multiple channels or methods. (*2*) A wide variety of delivery methods exist, both electronic and traditional, all of which can be used by the academic community for dissemination of knowledge to students. Table 3 provides a list of those methods that readily lend themselves to use in the classroom and also identifies them as conventional or progressive in format.

Table 3. Delivery Mechanisms for Educational Technology Transfer

Delivery Mechanisms	Type of Mechanism	
	Conventional	Progressive
Fact Sheet, Circular, Newsletter	X	
Electronic Bulletin Board		X
Electronic Mail List Server		X
Electronic Newsgroup		X
Instructional Video	X	
Self-Guided Tutorial	X	
Manual	X	
Reference Guide	X	
Computer Program	X	
Book	X	
Digital Library		X
Electronic Clearinghouse		X
Technical Journal/Article	X	
Workshop	X	
Course	X	
Distance Learning		X

In many cases, the traditional classroom lecture is the easiest and most efficient way to deliver information to students. However, with the prevalence of computer technology at universities and students having easy access to the Internet, faculty can also utilize more progressive and non-traditional dissemination methods as a substitute for or to enhance lectures. Furthermore, the Internet can be a useful tool in designing problems and laboratory exercises for transportation students as a multitude of sites are devoted to all facets of the transportation industry. Moreover, transportation organizations and agencies across the country use many of these delivery mechanisms for dissemination of information to its target audiences. Students may often find information from these sources useful, and easy access to these materials can enhance their educational experience. In short, using a variety of these delivery mechanisms can work toward ensuring students graduating from universities and entering the transportation profession are well equipped with the KSAs to perform their jobs effectively.

5. FINDINGS AND RECOMMENDATIONS

The tasks completed during the course of this project provide insight into the educational needs in the transportation profession in the region. In short, transportation employers place a high priority on specific knowledge that is not necessarily being provided at all universities in a general transportation course. At some universities, this is the only transportation-related course some students take before entering the transportation work force. Thus, it is in the best interest of the profession that the KSAs of graduating students be as comprehensive as possible, especially if they receive limited exposure to transportation topics in their program. The following sections provide recommendations for action items regarding educational needs and potential delivery mechanisms for information dissemination, including methods for fostering collaboration between universities

5.1 EDUCATION ALLIANCE ACTION ITEMS

Based on the survey results from both employers and universities, action should be taken to bridge the gap between educational resources and knowledge needs. By comparing the knowledge needs expected of employers and the current educational resources at universities, each transportation topic requires some type of attention or action based on a level of criticality. The following sections prioritize actions with respect to transportation and other topics and provide suggestions on accomplishing those actions.

5.1.1 Transportation Topics

Table 4 provides a breakdown of the priority level of the topics with respect to creating an education alliance to address the needs of the profession. Primarily, transportation employers responding to the survey identified four topics as critical to hiring new graduates: traffic engineering, traffic operations, highway capacity, and transportation planning. They also indicated that some new employees had some level of knowledge deficiency in each of these topics. All of the responding universities cover traffic engineering and traffic operations in their

general course, either at a thorough or brief level, while not all teach highway capacity and transportation planning. Based on these findings, these topics are listed as a high priority, indicating that universities should address them first when working to bridge the education gap. The objective should be to ensure that these four topics are covered at a thorough level in a general transportation course to increase the primary KSAs of the students.

Table 4. Priority Level for Transportation Topics

Transportation Topic	Priority Level		
	High	Moderate	Low
Traffic Engineering	X		
Traffic Operations	X		
Geometric Design			X
Highway Capacity	X		
Pavements		X	
Transportation Planning	X		
Public Transportation		X	
Highway Safety		X	
Human Factors			X
ITS Awareness		X	
Multi-Modal Issues		X	

Five topics are identified as having a moderate priority level in the alliance effort: pavements, public transportation, highway safety, ITS awareness, and multi-modal issues. In each of these topics, the majority of employers expect only a brief knowledge level of graduates, but most indicate that a minor level of knowledge deficiency exists. While some universities address these topics at a thorough or brief level, each topic receives no coverage at one or more universities. Thus, a moderate priority level indicates that universities should work to ensure that these topics are covered at least briefly in the general transportation course.

Finally, geometric design and human factors are at a low priority level. For example, most employers expect graduates to have a thorough knowledge of geometric design, and most indicate that they observe minor to no knowledge deficiency in these topics. Furthermore, all of the respondent universities cover geometric design at either a thorough or brief level. Thus, this topic is a low priority as most of the universities are meeting these educational needs. Universities should ensure that the knowledge level is maintained and increased where

necessary. With respect to human factors, most employers expect a brief knowledge level or none at all and only experience a minor knowledge deficiency. Moreover, human factors is covered at thorough and brief levels at some universities and receives no coverage at others. In both of these cases, the universities should work to ensure that the topics receive a brief coverage at a minimum to meet the knowledge expectations of the employers.

5.1.2 Other Topics

As noted previously, employers believe that transportation professionals need various KSAs to perform their jobs, several of which might not be obtained through a traditional undergraduate program. These skills include project management, personnel management, budgeting, finance, technical writing, and communications. Thus, universities should strive to expose students to these topics either through departmental courses or outside the department through other avenues such as elective courses and continuing education. Such exposure can broaden the students' KSAs and ease their entry into the transportation work force.

5.1.3 Action Items

Universities and employers can take various actions to bridge the education gap based on the topics addressed in this report. First, universities with expertise in the areas identified can develop educational material that maximizes the knowledge gained by the student. They can utilize various formats to deliver that knowledge and work to ensure that material is available to all universities within the region and the nation. Second, a regional task force comprised of representatives from the professional and academic communities can work to identify expected KSAs and devise plans for meeting those expectations. Some of this work has already begun at the national level through the efforts of the U.S. Department of Transportation Professional Capacity Building Program, under the direction of Tom Humphrey. This regional task force can build upon the needs assessment currently underway by the PCB program to ensure the specific needs of the regional are included. Members of the task force can also participate in the Forum on Transportation Education and Training, the first of which will be held in January 1999. This forum is an opportunity for academic institutions, government agencies, industry partners, and

professional organizations to identify the forces affecting transportation and its educational needs and formulate broad guidelines for curriculum development based on these needs. Finally, the universities and employers in the region can create an alliance that has as its primary goal to address the educational needs of the region on a continuing basis. This alliance can collaborate on educational initiatives and work toward establishing a clearinghouse of educational and informational resources for the transportation profession. This clearinghouse would serve as a central location where faculty, students, and professionals can access information critical to developing and enhancing KSAs. The alliance can also ensure that the aforementioned actions become part of the fabric of the profession as a necessary component.

5.2 DELIVERY MECHANISMS

It is difficult to prioritize delivery mechanisms as they relate to the various transportation topics identified in this report. Each mechanism serves a specific purpose and is intertwined with the topic and the desired KSA level of the university students. It is recommended that the delivery mechanisms be determined on a case by case basis as each topic area is addressed. However, a general recommendation is to maximize the utilization of electronic media, such as the Internet, electronic list servers, newsgroups, bulletin boards, digital libraries, and electronic clearinghouses. These methods can deliver information to a broad audience and are an efficient use of resources. With minor effort, many of these methods can be utilized by university faculty to disseminate information to both students at a "home" university or to others across the country.

5.3 FINAL REMARKS

The results presented in this report begin to develop a framework for creating an alliance between universities in a region to meet the educational needs of the profession. While the focus was on the SWUTC region, the guidelines and action items are applicable across nation. By creating alliances and working to accomplish the actions set forth in this document, universities across the country can broaden student exposure to the transportation profession, encourage students to seek transportation as a viable career choice, enhance transportation education at the

undergraduate level, and encourage students to pursue graduate education in transportation. Finally, it is important to recognize that the alliance concept works to meet the goals and objectives of the national PCB program, especially as they related to educating the future professionals that will design, build, operate, manage, and maintain the transportation infrastructure of the 21st century.

REFERENCES

1. Seymour, E., Herrick, G.C., Vaughn, K., Kuhn, B., and Hedley, J. *Intelligent Transportation Systems: A Framework for Standards Technology Transfer.* Texas Transportation Institute, College Station, TX, and Viggen Corporation, Dallas, TX, 1998.
2. *Transportation Technology Transfer: A Primer on the State of the Practice.* Transportation Research Circular No. 488, Transportation Research Board, National Research Council, Washington, DC, 1998.

APPENDICES

APPENDIX A: EMPLOYER SURVEY

TEXAS TRANSPORTATION INSTITUTE

Center for Professional Capacity Building

Telephone: (512) 467-0946
Fax: (512) 467-8971
E-Mail: B-Kuhn@tamu.edu

5 February 1998

[Contact]
[Address]

Dear :

The Texas Transportation Institute's Center for Professional Capacity Building is working on a Southwest University Transportation Center (SWUTC) project to assess undergraduate transportation education in the region. Our intent is to leverage existing transportation education programs and work cooperatively to expand the educational knowledge at all of the universities in Arkansas, Louisiana, New Mexico, Oklahoma, and Texas. Our ultimate goal is to ensure that the region's universities match the needs of employers with qualified students and to attract students into the transportation engineering profession.

As a transportation employer, you have a vested interest in the students emerging from the region's undergraduate engineering programs. Attached is a survey aimed at assessing the level of transportation-related knowledge you expect of undergraduate students you hire in the region. Please take a few moments to fill out the enclosed survey and return it to me in the enclosed, self-addressed stamped envelope. If you feel that you are not the most appropriate person to complete this survey, please forward it to the appropriate individual and return your comments to me no later than **Monday, 16 March 1998**.

I appreciate your cooperation in this endeavor, and I look forward to hearing from you. Should you have any questions regarding the survey or this project, please do not hesitate to contact me. Thank you for your time and attention.

Sincerely,

Beverly Thompson Kuhn, Ph.D., P.E.
Center Director

Enclosures (2)

The Texas A&M University System • 7715 Chevy Chase Drive, Suite 4.160 • Austin, TX 78752

SURVEY OF DESIRED TRANSPORTATION UNDERGRADUATE KNOWLEDGE

1. **Name of Company / Agency** _____
2. **Does your Company / Agency hire undergraduate engineering students into transportation-related entry-level positions?** __Yes __ No **(If "No," please skip to Question 11, page 3.)**
3. **If "Yes," from which academic department do MOST of these students graduate? (Please list only one department).** _____
4. **Please list the universities in the region (Arkansas, Louisiana, New Mexico, Oklahoma, & Texas) from which you hire these students. (Please list all that apply and place them in order of preference from highest to lowest. If you need additional room, please list on the back of this page.)**

   (1) _____ (4) _____ (7) _____

   (2) _____ (5) _____ (8) _____

   (3) _____ (6) _____ (9) _____
5. **Please complete the following checklist to describe the level of KNOWLEDGE you expect these undergraduates to have in the following transportation topics. Expected knowledge level for each topic may be ranked in three ways:**

Thorough	Extensive knowledge of topic expected with ability to solve applicable problems.
Brief Background	General overview of topic expected.
None	Little or no knowledge expected for entry-level position.

	Thorough	Brief Background	None
Traffic Engineering	☐	☐	☐
Traffic Operations	☐	☐	☐
Geometric Design	☐	☐	☐
Highway Capacity	☐	☐	☐
Pavement	☐	☐	☐
Transportation Planning	☐	☐	☐
Public Transportation	☐	☐	☐
Highway Safety	☐	☐	☐
Human Factors	☐	☐	☐
ITS Awareness	☐	☐	☐
Multi-Modal Issues	☐	☐	☐

(Continued on Page 2)

SURVEY OF DESIRED TRANSPORTATION UNDERGRADUATE KNOWLEDGE

6. **Of the topics listed in Question 5 as "Thorough" in expected knowledge, list the top 3 you feel are the most critical when hiring undergraduate students.**

   (1) _____

   (2) _____

   (3) _____

7. **Please list any additional transportation topics not provided in Question 5 that are expected of undergraduate students and indicate the level of knowledge you expect them to have for each.**

   (1) _____

   (2) _____

   (3) _____

8. **Please complete the following checklist to describe the extent to which undergraduate students you hire have a knowledge DEFICIENCY in the following transportation topics with respect to the level of knowledge expected of them. Lack of knowledge for each topic may be ranked in three ways:**

Major	Recruit knowledge of topic is well below the expected level.
Minor	Recruit knowledge of topic is slightly below the expected level.
None	Acceptable knowledge in topic is found in recruits.

	Major	**Minor**	**None**
Traffic Engineering	☐	☐	☐
Traffic Operations	☐	☐	☐
Geometric Design	☐	☐	☐
Highway Capacity	☐	☐	☐
Pavement	☐	☐	☐
Transportation Planning	☐	☐	☐
Public Transportation	☐	☐	☐
Highway Safety	☐	☐	☐
Human Factors	☐	☐	☐
ITS Awareness	☐	☐	☐
Multi-Modal Issues	☐	☐	☐

(Continued on Page 3)

SURVEY OF DESIRED TRANSPORTATION UNDERGRADUATE KNOWLEDGE

9.Of the topics listed in Question 8 as "Major" in knowledge deficiency, list the top 3 you feel are the most critical when hiring undergraduate students.

(1) _____

(2) _____

(3) _____

10. Please list any additional transportation topics not provided in Question 8 in which undergraduate students lack appropriate knowledge and indicate the level of knowledge deficiency.

(1) _____

(2) _____

(3) _____

11. Name of Survey Respondent _____

Title _____

Address _____ **Phone** ____ - ____ - _____ (ext. __)

_____ **Fax** ____ - ____ - _____

_____ **E-Mail** _____

On the back of this questionnaire, please provide any additional comments or suggestions. All information provided on this survey will remain strictly confidential. Thank you for your time and participation. Please use the enclosed self-addressed stamped envelope to return to:

Beverly Thompson Kuhn, Ph.D., PE
Texas Transportation Institute
7715 Chevy Chase Dr. Suite 4.160
Austin, TX 78752

Phone: (512) 467-0946
Fax: (512) 467-8971
E-Mail: B-Kuhn@tamu.edu

APPENDIX B: UNIVERSITY SURVEY

TEXAS TRANSPORTATION INSTITUTE

Center for Professional Capacity Building

Telephone: (512) 467-0946
Fax: (512) 467-8971
E-Mail: B-Kuhn@tamu.edu

30 January 1998

[Contact]
[Address]

Dear :

The Texas Transportation Institute's Center for Professional Capacity Building is working on a Southwest University Transportation Center (SWUTC) project to assess undergraduate transportation education in the region. Our intent is to leverage the existing transportation education programs and work cooperatively to expand the educational knowledge at all of the universities in Arkansas, Louisiana, New Mexico, Oklahoma, and Texas. Our ultimate goal is to look for opportunities for the region's universities to assist each other in attracting students into the transportation engineering profession.

I have reviewed the undergraduate engineering program at and am interested in - , which is a general transportation course offered to undergraduate students in your department. Attached is a survey aimed at assessing this course and the transportation topics covered by instructing faculty. Please take a few moments to fill out the enclosed survey and return it to me in the enclosed, self-addressed stamped envelope. If you are not the faculty coordinator for this course or if you feel that you are not the most appropriate person to complete this survey, please forward it to the appropriate individual and return your comments to me no later than **Monday, 2 March 1998**.

I appreciate your cooperation in this endeavor, and I look forward to hearing from you. Should you have any questions regarding the survey or this project, please do not hesitate to contact me. Thank you for your time and attention.

Sincerely,

Beverly Thompson Kuhn, Ph.D., P.E.
Center Director

Enclosures (2)

The Texas A&M University System • 7715 Chevy Chase Drive, Suite 4.160 • Austin, TX 78752

SURVEY OF TRANSPORTATION UNDERGRADUATE COURSES AND CURRICULUM

1. **Name of University** _____
2. **Does your university offer a general transportation course to undergraduate students that provides them with an overview of the field?** __Yes __ No **(If "No," please skip to Question 14, page 3.)**
3. **If "Yes," is this course mandatory for all undergraduates in your department?** __Yes __ No
4. **In what college is this course offered?**_____
5. **In what academic department is this course offered?**_____
6. **Transportation Course Number** _____
7. **Transportation Course Title** _____
8. **Course description as listed in the university catalog** _____

_____

_____

9. **Please complete the following checklist to describe to what extent the following transportation topics are covered in the course listed above. Topics may be ranked in three ways:**

Thoroughly	Multiple lectures providing extensive coverage of topic, including problems, quizzes, laboratory exercises, etc.
Brief Overview	Single lecture providing a general overview of the topic.
Not Covered	No lectures given on topic

	Thoroughly	Brief Overview	Not Covered
Traffic Engineering	☐	☐	☐
Traffic Operations	☐	☐	☐
Geometric Design	☐	☐	☐
Highway Capacity	☐	☐	☐
Pavement	☐	☐	☐
Transportation	☐	☐	☐
Planning	☐	☐	☐
Public	☐	☐	☐
Transportation	☐	☐	☐
Highway Safety	☐	☐	☐
Human Factors	☐	☐	☐
ITS Awareness	☐	☐	☐
Multi-Modal Issues			

(Continued on Page 2)

10. For each topic listed in Question 9 as "Not Covered," what is the PRIMARY reason for not covering it during the semester? Please select only one of the reasons listed below.

A - Faculty Interest and/or Knowledge

B - Limited Time Available for Subject Matter

C - Lack of Appropriate Lecture Material

D - Other (please describe in the space provided)

Traffic Engineering _____

Traffic Operations _____

Geometric Design _____

Highway Capacity _____

Pavement _____

Transportation Planning _____

Public Transportation _____

Highway Safety _____

Human Factors _____

ITS Awareness _____

Multi-Modal Issues _____

11. Of the topics listed in Question 9 as "Not Covered" in the transportation course, list the top 3 you feel should be added to the curriculum.

(1) _____

(2) _____

(3) _____

(Continued on Page 3)

SURVEY OF TRANSPORTATION UNDERGRADUATE COURSES AND CURRICULUM

If materials were to be made available for faculty use in the classroom, what material format would be most useful in discussing those topics listed as "Not Covered?" Please select only one from the following.

A - Hard Copies of Lecture Notes
B - Powerpoint Slides With Outline
C - Video Clips
D - Work Problems
E - Laboratory Exercises
F - Other (please describe in space provided)

Traffic Engineering _____
Traffic Operations _____
Geometric Design _____
Highway Capacity _____
Pavement _____
Transportation Planning _____
Public Transportation _____
Highway Safety _____
Human Factors _____
ITS Awareness _____
Multi-Modal Issues _____

13. Faculty Coordinator for Course _____

12. Name of Respondent (if different from Question 13)

Address _____
_____
_____

Phone ___.___.____(ext.____)
Fax ___.___.____
E-Mail _____

On the back of this questionnaire, please provide any additional comments or suggestions. Thank you for your time and participation. Please use the enclosed self-addressed stamped envelope to return to:

Beverly Thompson Kuhn, Ph.D., PE
Texas Transportation Institute
7715 Chevy Chase Dr. Suite 4.160
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Phone: (512) 467-0946
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Southwest Region University Transportation Center

Assessment of a Regional Transportation Education Alliance to Improve Mobility

PB99-110900

SWUTC/98/167103-1

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16. Abstract

The emphasis in surface transportation is shifting from a construction-based paradigm to a more operations based approach to mobility. This increased emphasis on transportation system operation and management requires a skill set not available in traditionally trained students. A need exists to improve undergraduate education experiences to foster new skills and to also create interest among students to pursue advanced degrees in transportation. Currently, most university programs have minimal expertise in transportation and course material is often limited or nonexistent. An opportunity exists to take advantage of expertise at universities for the benefit of the entire transportation program. This study presents results from an investigation of a number of issues related to undergraduate education and provides an approach to improving undergraduate transportation education through appropriate alliances of universities to encourage more students to pursue graduate education. Results include an assessment of current education needs in the Southwest University Transportation Center region. The report also looks at educational resources in transportation education at universities in the region and outlines potential delivery mechanisms for needed curriculum. It also provides recommendations on fostering continued collaboration between universities to enhance education and encourage students to seek transportation as a viable career choice.

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ASSESSMENT OF A REGIONAL TRANSPORTATION EDUCATION ALLIANCE TO IMPROVE MOBILITY

Final Report

By

Beverly T. Kuhn, Ph.D., P.E.
Director, Center for Professional Capacity Building

Prepared for

Southwest Region University Transportation Center
Texas Transportation Institute
The Texas A&M University System
College Station, Texas 77843-3135

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Study No. SWUTC/98/167103-1

August 1998

ABSTRACT

The next generation of transportation professionals will come from current and future groups of undergraduate and graduate students in our universities. Thus, it is critical that universities take a proactive role in educating and preparing these future transportation professionals to work effectively and efficiently in the 21st century. The emphasis in surface transportation is shifting from a construction-based paradigm to a more operations based approach to mobility. This increased emphasis on transportation system operation and management requires a skill set not available in traditionally trained students. A need exists to improve undergraduate education experiences to foster new skills and to also create interest among students to pursue advanced degrees in transportation. Currently, most university programs have minimal expertise in transportation. Course material is often limited or non-existent. An opportunity exists to take advantage of expertise at universities, such as Texas A&M University, for the benefit of the entire transportation education program. This study presents results from an investigation of a number of issues related to undergraduate education and provides an approach to improving undergraduate transportation education through appropriate alliances of universities to encourage more students to pursue graduate education. Results include an assessment of current education needs in the Southwest University Transportation Center region (Arkansas, Louisiana, New Mexico, Oklahoma, and Texas). The report also looks at educational resources in transportation education at universities in these states. Finally, based on the results of the needs and resource assessments, the report outlines potential delivery mechanisms for needed curriculum and provides recommendations on fostering continued collaboration between universities to enhance education and encourage students to seek transportation as a viable career choice.

ACKNOWLEDGEMENTS

This publication was developed as part of the University Transportation Centers Program, which is funded 50% with general revenue funds from the State of Texas. The author would like to thank the following individuals, without whose assistance this undertaking would not have been possible: Tom Urbanik and Beth Neilson of Texas Transportation Institute, College Station, and Tina Collier, Ginger Daniels, and Frank Pakuszewski of Texas Transportation Institute, Austin.

The study team wishes to acknowledge the cooperation and input of the various universities, state agencies, local agencies, and private consultants who responded to the study surveys. Their input was critical to the success of this project and their assistance was appreciated.

DISCLAIMER

The contents of this report reflect the views of the author, who is responsible for the facts and the accuracy of the information presented herein. This document is disseminated under the sponsorship of the Department of Transportation, University Transportation Centers Program, in the interest of information exchange. Mention of trade names or commercial products does not constitute endorsement or recommendation for use.

EXECUTIVE SUMMARY

The next generation of transportation professionals will come from current and future groups of undergraduate and graduate students in our universities. Thus, it is critical that universities take a proactive role in educating and preparing these future transportation professionals to work effectively and efficiently in the 21st century. The emphasis in surface transportation is shifting from a construction-based paradigm to a more operations based approach to mobility. A need exists to improve undergraduate education experiences to foster new skills and to also create interest among students to pursue advanced degrees in transportation.

Currently, many university programs across the country have minimal expertise in transportation. In these programs, course material is often limited or non-existent. Furthermore, faculty members who are already overburdened do not have the time to develop additional transportation-related materials for use in their classes. Thus, an opportunity exists to take advantage of expertise available at some universities for the benefit of the entire transportation education program. The objective of this study was to determine ways in which this expertise can be packaged and disseminated to those universities that have a need for it. While the focus of the study was the Southwest University Transportation Center (SWUTC) region, the results of the study are applicable nationwide.

A questionnaire survey was used to examine the educational needs of the various types of employers that hire transportation professionals. Its focus was to assess the level of transportation-related knowledge the employer expects of undergraduates hired into entry-level positions within the organization. The information sought from the questionnaire included whether or not the employer hires undergraduate engineering students into transportation-related entry-level positions, and the academic department and university they prefer for prospective hires. Respondents classified desired knowledge in eleven transportation topics as thorough, brief background, or none. The topics listed were traffic engineering, traffic operations, geometric design, highway capacity, pavements, transportation planning, public transportation, highway safety, human factors, ITS awareness, and multi-modal issues. They identified three of these topic areas that were most critical when hiring undergraduates and provided additional

transportation topics of importance that were not listed in the survey. Respondents also identified knowledge deficiency in these topics as major, minor, or none. The employer respondent then listed which topics with "major" knowledge deficiency were the most critical when hiring undergraduate students and provided additional topics with deficiency that were not listed on the survey.

Responses were received from every state in the region and from both public and private organizations. For all of the transportation topics, the majority of responding employers expects new graduate students to have a minimum level of brief background knowledge. In some cases, a significant number (though not a majority) of respondents expect thorough knowledge of the topic. The most critical topics necessary for hiring were traffic engineering, traffic operations, geometric design, transportation planning, and highway capacity. At least ten respondents found some knowledge deficiency (either major or minor) in each of the transportation topics, the most prevalent being traffic operations, traffic engineering, and highway capacity.

A questionnaire survey was also used to examine the transportation education resources at universities in the SWUTC region. Its focus was to assess the general transportation course offered to undergraduate students in a civil engineering program. The information sought from the questionnaire included whether a university program offered a general transportation course to undergraduate students and whether the course is mandatory for all students within the department. Respondents classified transportation topic coverage as thorough, brief overview, or not covered. The topics were identical to those used in the employer survey. Respondents were asked to note the primary reason for not covering a topic and identify which topic areas not covered should be added to the curriculum. Faculty were also asked to identify a preferred material format if materials were made available for use in the classroom.

Responses were received from each state in the region, all of which offer a general transportation course. Of those responding nearly half require the course for all undergraduates. The majority of responding universities (over 70%) provide a minimum of brief background knowledge of each transportation topic except ITS awareness and multi-modal issues. Three topics are taught at every respondent university: traffic engineering, traffic operations, and geometric design. Topics receiving the most "thorough" instruction were traffic engineering, geometric design, pavements, and transportation planning. Over 50% of respondents do not cover ITS awareness or multi-modal issues in their course. Most faculty have limited time to

cover all topics in depth in an introductory course, which was the primary reason for not covering a topic. Those topics faculty believed should be added to the curriculum were ITS awareness, transportation planning, multi-modal issues, and human factors. Preferred formats for course material were lecture notes, presentation slides, and video clips.

The report recommends that four transportation topics receive high priority for action by an education alliance: traffic engineering, traffic operations, highway capacity, and transportation planning. Moderate priority topics include pavements, public transportation, highway safety, ITS awareness, and multi-modal issues. Low priority topics are geometric design and human factors. Universities and employers can take various actions to bridge the education gap based on the topics addressed in this report. First, universities with expertise in the areas identified can develop educational material that maximizes the knowledge gained by the student. They can utilize various formats to deliver that knowledge and work to ensure that material is available to all universities within the region and the nation. Second, a regional task force comprised of representatives from the professional and academic communities can work to identify expected KSAs and devise plans for meeting those expectations. Some of this work has already begun at the national level through the efforts of the U.S. Department of Transportation Professional Capacity Building (PCB) Program, under the direction of Tom Humphrey. This regional task force can build upon the needs assessment currently underway by the PCB program to ensure the specific needs of the regional are included. Members of the task force can also participate in the Forum on Transportation Education and Training, the first of which will be held in January 1999. This forum is an opportunity for academic institutions, government agencies, industry partners, and professional organizations to identify the forces affecting transportation and its educational needs and formulate broad guidelines for curriculum development based on these needs. Finally, the universities and employers in the region can create an alliance that has as its primary goal to address the educational needs of the region on a continuing basis. This alliance can collaborate on educational initiatives and work toward establishing a clearinghouse of educational and informational resources for the transportation profession. This clearinghouse would serve as a central location where faculty, students, and professionals can access information critical to developing and enhancing KSAs. The alliance can also ensure that the aforementioned actions become part of the fabric of the profession as a necessary component.

A variety of delivery mechanisms exist for disseminating information to students, many of which utilize electronic media and the Internet. It is difficult to prioritize delivery mechanisms as they relate to the various transportation topics identified in this report. Each mechanism serves a specific purpose and is intertwined with the topic and the desired KSA level of the university students. It is recommended that the delivery mechanisms be determined on a case by case basis as each topic area is addressed. However, a general recommendation is to maximize the utilization of electronic media, such as the Internet, electronic list servers, newsgroups, bulletin boards, digital libraries, and electronic clearinghouses. These methods can deliver information to a broad audience and are an efficient use of resources. With minor effort, many of these methods can be utilized by university faculty to disseminate information to both students at a "home" university or to others across the country.

The results presented in this report begin to develop a framework for creating an alliance between universities in a region to meet the educational needs of the profession. While the focus was on the SWUTC region, the guidelines and action items are applicable across the nation. By creating alliances and working to accomplish the actions set forth in this document, universities across the country can broaden student exposure to the transportation profession, encourage students to seek transportation as a viable career choice, enhance transportation education at the undergraduate level, and encourage students to pursue graduate education in transportation. Finally, it is important to recognize that the alliance concept works to meet the goals and objectives of the national PCB program, especially as they relate to educating the future professionals that will design, build, operate, manage, and maintain the transportation infrastructure of the 21st century.

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1. INTRODUCTION

The next generation of transportation professionals will come from current and future groups of undergraduate and graduate students in our universities. Thus, it is critical that universities take a proactive role in educating and preparing these future transportation professionals to work effectively and efficiently in the 21st century. The emphasis in surface transportation is shifting from a construction-based paradigm to a more operations based approach to mobility. This increased emphasis on transportation system operation and management requires a skill set not available in traditionally trained students. A need exists to improve undergraduate education experiences to foster new skills and to also create interest among students to pursue advanced degrees in transportation.

1.1 BACKGROUND

Currently, many university programs across the country have minimal expertise in transportation. In these programs, course material is often limited or non-existent. Furthermore, faculty members who are already overburdened do not have the time to develop additional transportation-related materials for use in their classes. Thus, an opportunity exists to take advantage of expertise available at some universities, including Texas A&M University, for the benefit of the entire transportation education program. The objective of this study was to determine ways in which this expertise can be packaged and disseminated to those universities that have a need for it. While the focus of the study was regional, the results of the study are applicable nationwide.

1.2 PURPOSE

The purpose of this study was to investigate a number of issues related to education and determine an approach to improve undergraduate transportation education through appropriate alliances of universities and to encourage more students to pursue graduate education. The study was conducted by Texas Transportation Institute (TTI) staff and involved the following major

tasks: an assessment of current education needs in the Southwest University Transportation Center region (Arkansas, Louisiana, New Mexico, Oklahoma, and Texas); an assessment of educational resources in transportation education at universities in these states; a review and assessment of potential delivery mechanisms for needed curriculum; and development of recommendations for fostering continued collaboration between universities to enhance education and encourage students to seek transportation as a viable career choice.

2. CURRENT EDUCATION NEEDS

The Southwest University Transportation Center (SWUTC) region includes a diversity of transportation needs. Each state has a transportation infrastructure unique to its urban and rural geographical makeup. Furthermore, this infrastructure is constantly expanding and improving to meet the needs of the motoring public. Thus, each state has unique needs with respect to the knowledge, skills, and abilities (KSAs) its transportation professionals require to perform their role in maintaining that infrastructure. The first task in developing a means of forging an education alliance was to assess the education needs as seen from the perspective of the various types of agencies, organizations, and firms that employ transportation professionals.

2.1 SURVEY METHDOLOGY

A questionnaire survey was used to examine the educational needs of the various types of employers that hire transportation professionals. Its focus was to assess the level of transportation-related knowledge the employer expects of undergraduates hired into entry-level positions within the organization. A total of 65 surveys were mailed to state, city, and county governments, metropolitan planning organizations, and private sector employers in Arkansas, Louisiana, New Mexico, Oklahoma, and Texas. The survey was sent to a senior-level staff member or contact with a cover letter explaining the purpose of the research study and the objectives of the survey. A copy of the cover letter and survey sent to transportation employers is included in Appendix A.

2.2 TOPICS INVESTIGATED

The information sought from the questionnaire included whether or not the employer hires undergraduate engineering students into transportation-related entry-level positions. If they hire such individuals, the employer was asked to indicate the academic department from which most of these individuals graduate and preferred universities for prospective hires.

The second section of the survey investigated the level of knowledge an employer expects undergraduates to have in various transportation topics. Respondents classified desired knowledge in eleven transportation topics as thorough (extensive knowledge of topic expected with ability to solve applicable problems), brief background (general overview of topic expected), or none (little or no knowledge expected for entry-level position). The transportation topics listed were traffic engineering, traffic operations, geometric design, highway capacity, pavements, transportation planning, public transportation, highway safety, human factors, ITS awareness, and multi-modal issues. Respondents also identified three of these topic areas that were most critical when hiring undergraduates and provided additional transportation topics of importance that were not listed in the survey.

The third section of the survey solicited the opinion of the employer regarding current knowledge deficiency in the same eleven transportation topics. Respondents identified knowledge deficiency as major (recruit knowledge of topic is well below the expected level), minor (recruit knowledge of topic is slightly below the expected level), or none (acceptable knowledge of topic is found in recruits). The employer respondent then listed which topics with "major" knowledge deficiency were the most critical when hiring undergraduate students and provided additional topics with deficiency that were not listed on the survey.

2.3 DATA ANALYSIS AND FINDINGS

A total of 28 surveys (43%) were completed and returned to the study team. Returned surveys were coded into a data file and analyzed. Table 1 provides a breakdown of responding employers by state and organization type.

Table 1. Employer Survey Respondent Breakdown

Location	Type of Organization				Total Respondents
	State	Municipality	MPO	Consultant	
Arkansas	1	1	--	1	**3**
Louisiana	--	--	--	4	**4**
New Mexico	--	--	1	2	**3**
Oklahoma	1	--	--	2	**3**
Texas	3	3	3	7	**16**
Total Respondents	**5**	**4**	**4**	**16**	**28**

As noted in Table 1, responses were received from every state and from both public and private organizations. Furthermore, over 50% of the respondents were from organizations within Texas. The variety of respondents, while not statistically balanced, provided insight into the educational needs of transportation employers in the region.

Of the 28 employers that responded to the survey, 23 (82%) hire undergraduate engineering students into entry-level positions within their organization. Of those 23 employers, 20 exclusively hire students with a degree in Civil Engineering (CE), 2 hire students with either CE or planning degrees, and 1 exclusively hires students with planning degrees. The universities from which the organizations hire graduates varied depending on the state and the agency. Some respondents provided no preferences for universities. The following sections provide details on the survey responses regarding expected knowledge for new hires.

2.3.1 Expected Knowledge

For all of the transportation topics listed on the survey, the majority of responding employers expects new graduates to have a minimum of brief background knowledge of the topic. In some cases, a significant number (though not a majority) of respondents expect thorough knowledge of a topic. Figure 1 illustrates the responses received regarding expected knowledge. As illustrated in the figure, those topics of which a considerable number (over 1/3)

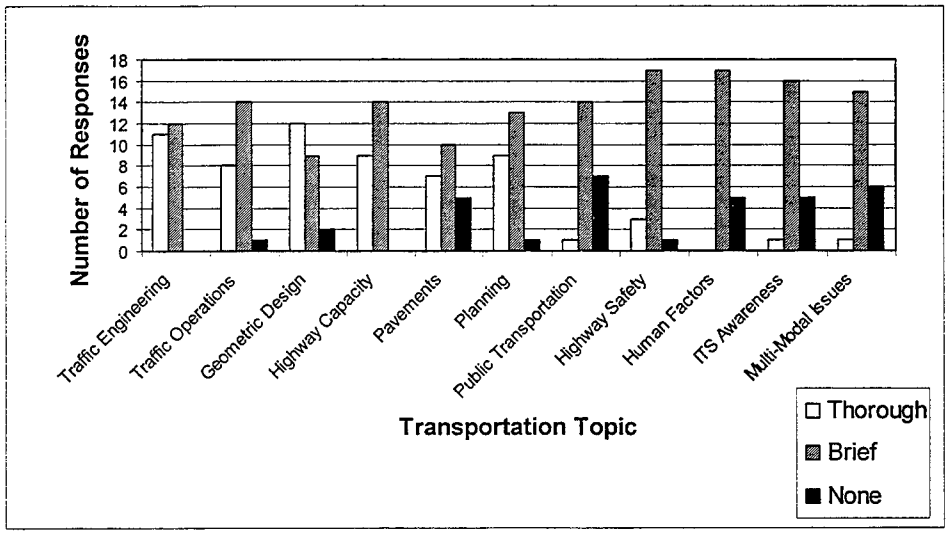

Figure 1. Employer Expected Knowledge of Transportation Topics

of employers expect thorough knowledge were geometric design (12), traffic engineering (11), highway capacity (9), transportation planning (9), and traffic operations (8). These findings are commensurate with the basic functions of the transportation professional in most entry-level positions. Those topics which received several responses indicating no expected knowledge included public transportation (7), multi-modal issues (6), pavements (5), human factors (5), and ITS awareness (5).

Respondents were asked to identify the top three transportation topics that were most critical when hiring undergraduates. These topics were to be selected from the list of topics the respondent noted as expecting "thorough" knowledge with the ability to solve applicable problems. Figure 2 illustrates the responses for those topics. These results correspond with the findings presented in Figure 1: topics that employers indicated as expecting thorough knowledge are more critical, and those that several indicated as expecting no knowledge are less critical in the hiring process.

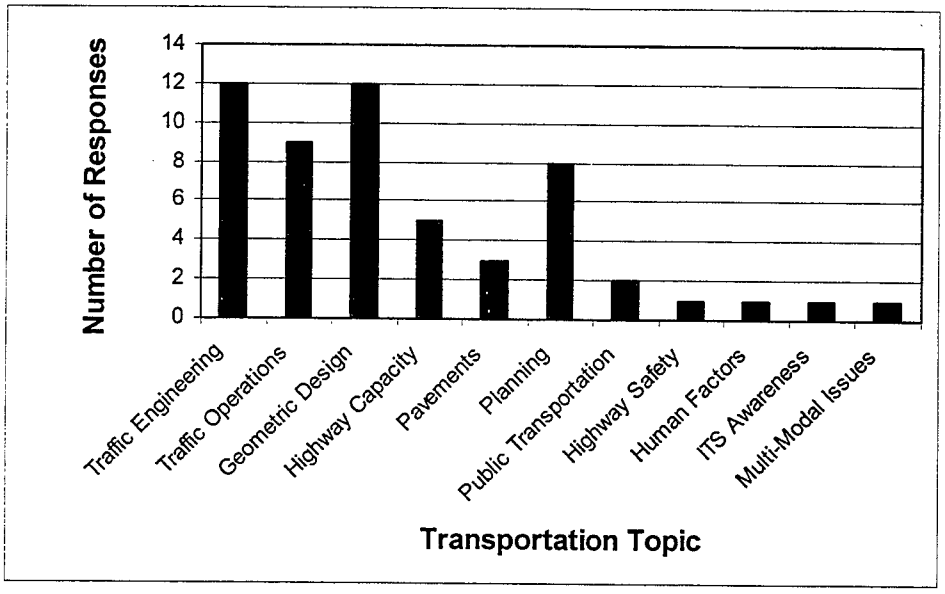

Figure 2. Thorough Knowledge of Topic Critical for Hiring

Respondents also listed additional transportation topics that were not provided in the survey. These topics were those in which undergraduates are expected to have some level of knowledge. Topics provided by respondents included traditional engineering knowledge and knowledge in other disciplines. For instance, general civil engineering topics included

surveying, air quality, environmental knowledge, hydraulics, and structural/bridge design. Specific transportation topics noted were right-of-way concepts, travel forecasting, travel demand management, and the public process. Software and computer skills included geographical information systems (GIS), computer aided design (CAD), transportation design software, and modeling software. Finally, other general topics in which respondents desired some knowledge were statistics, technical writing, interpersonal skills, tort liability, electronics technology, and communications engineering. While many of these topics can be addressed in transportation-related courses, many are skills required of all engineers, not just transportation professionals. Moreover, they indicate the diversity and complexity of the transportation infrastructure and the skills needed to manage it in the future.

2.3.2 Knowledge Deficiency

Once respondents identified expected knowledge levels for the listed topics, they provided information regarding knowledge deficiency they find with entry-level employees. At least ten respondents found some knowledge deficiency (either major or minor) in each of the transportation topics. Figure 3 provides a summary of the deficiency results. As shown in

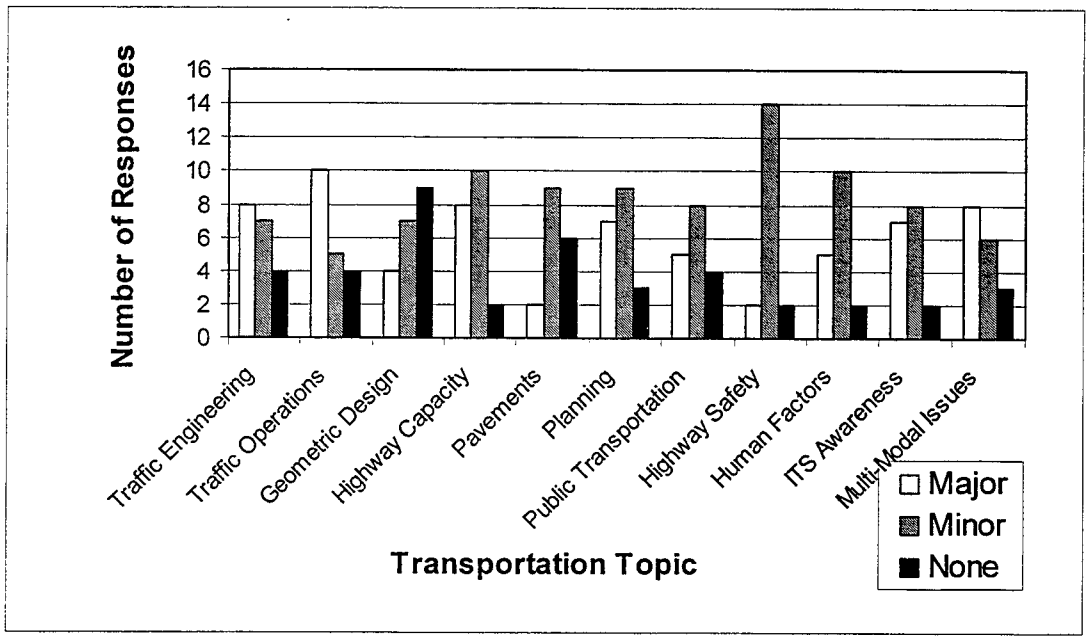

Figure 3. Level of Knowledge Deficiency

Figure 3, those topics receiving the most responses (over 25%) for major knowledge deficiencies were traffic operations (10), traffic engineering (8), highway capacity (8), transportation planning (7), and ITS awareness (7). The topic receiving the most responses for no knowledge deficiency was geometric design (9). Based on these findings, employers believe that knowledge deficiencies exist in critical areas with respect to transportation knowledge. The four most critical topics that perhaps need further attention at the universities include traffic engineering, traffic operations, highway capacity, and transportation planning.

Respondents also listed any additional transportation topics not provided in the deficiency section in which undergraduate students lack appropriate knowledge. Those listed in the responses were similar to those listed under expected knowledge. However, several of the topics mentioned are not directly related to transportation engineering. They include technical writing, personnel management, budgeting, finance, communications, and project management. Based on these responses, entry-level employees have complex roles that require KSAs they might not gain through traditional engineering programs. Hence, an opportunity exists to enhance their KSAs through non-traditional methods or university alliances to meet the needs of transportation employers.

3. CURRENT EDUCATION RESOURCES

The SWUTC region includes a diversity of universities with various strengths and expertise levels in engineering fields. Since these universities are the primary education resource for future transportation professionals, it is critical to determine the resources they provide with respect to transportation education and ways in which these resources might be enhanced to meet the education needs of the profession. Thus, the second task in assessing a regional transportation education alliance was to identify the transportation education resources provided by universities in the region.

3.1. SURVEY METHODOLOGY

A questionnaire survey was used to examine the transportation education resources at universities throughout the SWUTC region. Its focus was to assess the general transportation course offered to undergraduate students in a civil engineering program. A total of 22 surveys were mailed to four-year universities with civil engineering programs in Arkansas, Louisiana, New Mexico, Oklahoma, and Texas. The survey was sent to the civil engineering department head or a contact faculty member with a cover letter explaining the purpose of the research study and the objectives of the survey. A copy of the cover letter and survey sent to universities is included in Appendix B.

3.2. TOPICS INVESTIGATED

The information sought from the questionnaire included whether a university program offered a general transportation course to undergraduate students that provides an overview of the field. If such a course is offered, the respondent was asked to indicate whether the course is mandatory for all students within the department and to provide the course number, title, and description as listed in the university catalog.

The second section of the survey investigated the extent to which eleven transportation topics are covered in the general course. Respondents classified topic coverage as thorough (multiple lectures providing extensive coverage of topic, including problems, quizzes, laboratory exercises, etc.), brief overview (single lecture providing a general overview of the topic), or not covered (no lectures given on the topic). The transportation topics listed, which were identical to those addressed in the employer survey, were traffic engineering, traffic operations, geometric design, highway capacity, pavement, transportation planning, public transportation, highway safety, human factors, ITS awareness, and multi-modal issues.

If a topic was identified as "Not Covered", the respondent was asked to note the primary reason for its not being covered during the semester. Options included: (A) faculty interest and/or knowledge, (B) limited time available for subject matter, (C) lack of appropriate lecture material, and (D) other. Respondents also identified which of the topic areas not covered in the course should be added to the curriculum.

The third section of the survey solicited the opinion of the faculty regarding course delivery material. In short, if materials were made available for faculty use in the classroom, the survey asked the respondent to select a preferred material format for each of the transportation topics not covered in their course. The material formats provided were hard copies of lecture notes, presentation slides with outline, video clips, work problems, laboratory exercises, and other materials.

3.3. DATA ANALYSIS AND FINDINGS

A total of 15 surveys (68%) were completed and returned to the study team. Returned surveys were coded into a data file and analyzed. Table 2 provides a breakdown of responding universities by state. As noted in Table 2, responses were received from every state, with over 50% being from within Texas. The variety of respondents, while not statistically balanced, provided insight into the educational resources at universities across the region. The results of the university survey, when compared with those from the employer survey, provide information on areas where an alliance can work to close the gap between education resources and needs of employers.

Table 2. University Survey Respondent Breakdown

State	No. of Respondents
Arkansas	2
Louisiana	2
New Mexico	2
Oklahoma	1
Texas	8
Total Respondents	**15**

Of the 15 universities that responded to the survey, all of them offer a general transportation course to undergraduate students within their department that provides them with an overview of the field. Of those 15 universities, 7 require the course for all students in their department, and all courses are taught within the college of engineering. The following sections provide details on the survey responses regarding transportation topic coverage and preferred material format.

3.3.1 Transportation Topic Coverage

Figure 4 outlines the level of instruction each topic receives at the respondent universities. For the transportation topics listed on the survey, the majority of responding universities (over 70%) provide a minimum of brief background knowledge of each transportation topic with the exception of two: ITS awareness and multi-modal issues. Three topics are taught at every university either thoroughly or briefly, these being traffic engineering, traffic operations, and geometric design. Those topics receiving the most "thorough" instruction (over 45%) and the number of universities that teach this knowledge level were traffic engineering (8), geometric design (8), pavements (7), and transportation planning (7). The remaining topics receive a combination of thorough, brief, or no educational attention among the universities. Some topics were noted as receiving no attention, the most overwhelmingly so were ITS awareness and multi-modal issues. For both of these topics, over 50% of respondents do not cover the topic at all in their course. Other topics that are not taught at some universities include highway capacity, pavements, transportation planning, public transportation, highway safety, and human factors.

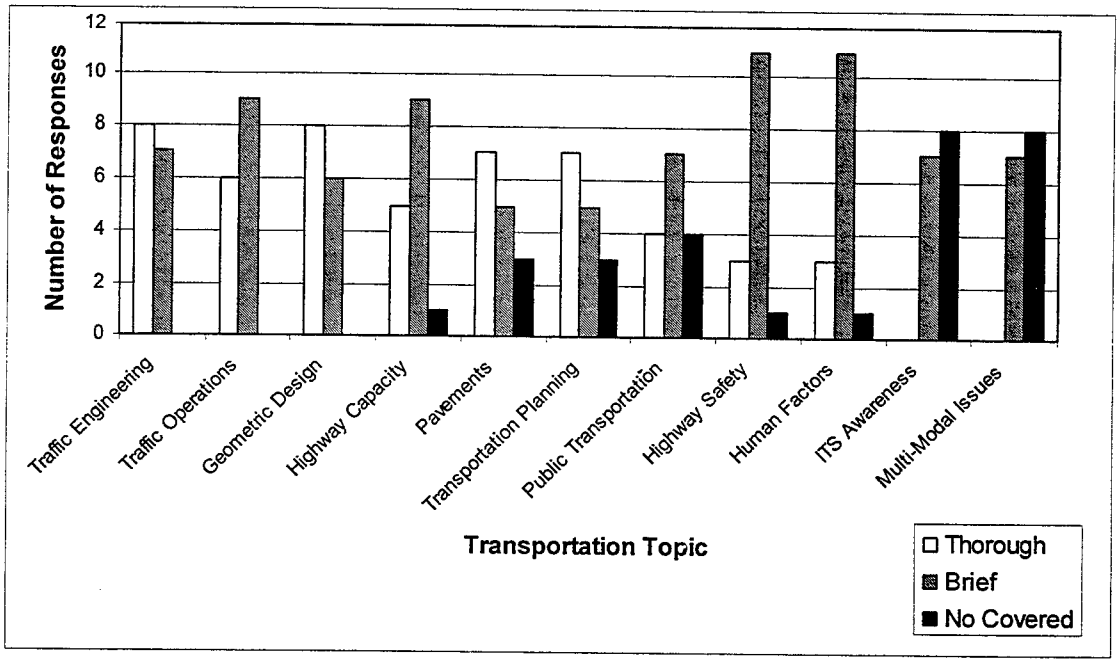

Figure 4. Transportation Topic Coverage at Universities

Respondents were asked to identify the primary reason for not covering a topic in the general transportation course. Figure 5 illustrates the responses received. As shown in the

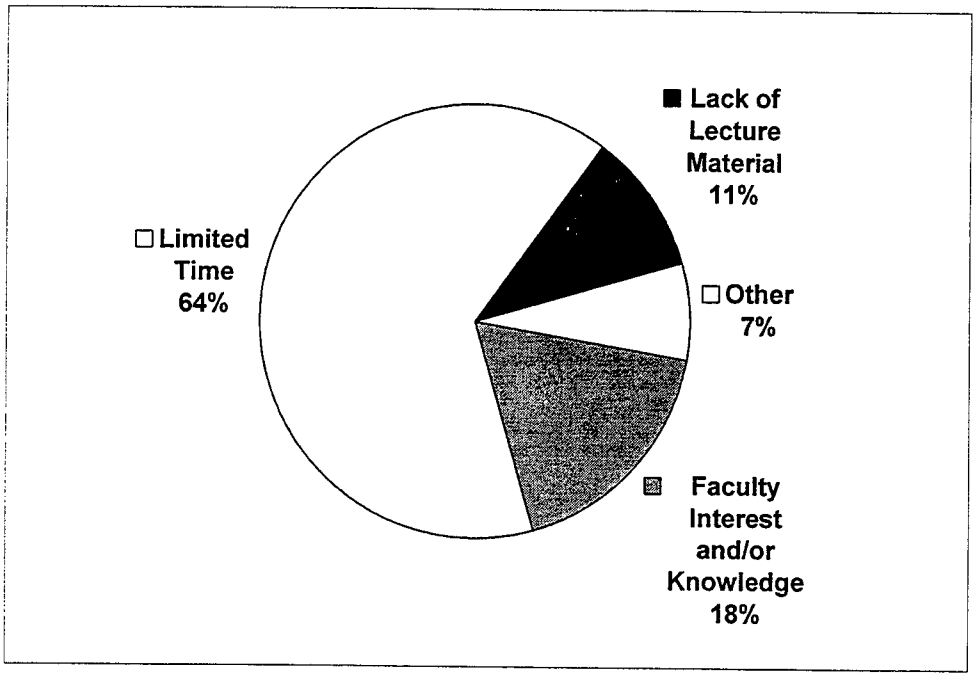

Figure 5. Primary Reason for Not Covering Topic

figure, most faculty have limited time to cover all topics in depth in an introductory course, most likely because of the large number of topics that must be covered. Furthermore, if faculty interest and/or knowledge in a course are limited or if teaching materials do not exist, then the topic might not be taught. Thus, while time is still limited, providing faculty with teaching materials that are easy to incorporate into a course syllabus may eliminate some barriers to certain topics being taught in the classroom.

Finally, respondents identified which of those topics that were not covered in their general transportation course should be added to the curriculum. Those topics faculty believed should be added, in order of importance, were ITS awareness, transportation planning, multi-modal issues, and human factors. Three remaining topics mentioned as less important were highway safety, highway capacity, and public transportation.

3.3.2 Preferred Material Format

The success of incorporating new educational material into a course relies heavily on the functionality and appropriateness of material itself. Faculty must be willing to use the material. Thus, respondents identified their preferences in resource material for use in the classroom. Figure 6 summarizes the material preferences of responding faculty members. As shown in the figure, the preferred material formats are lecture notes, presentation slides, and video clips.

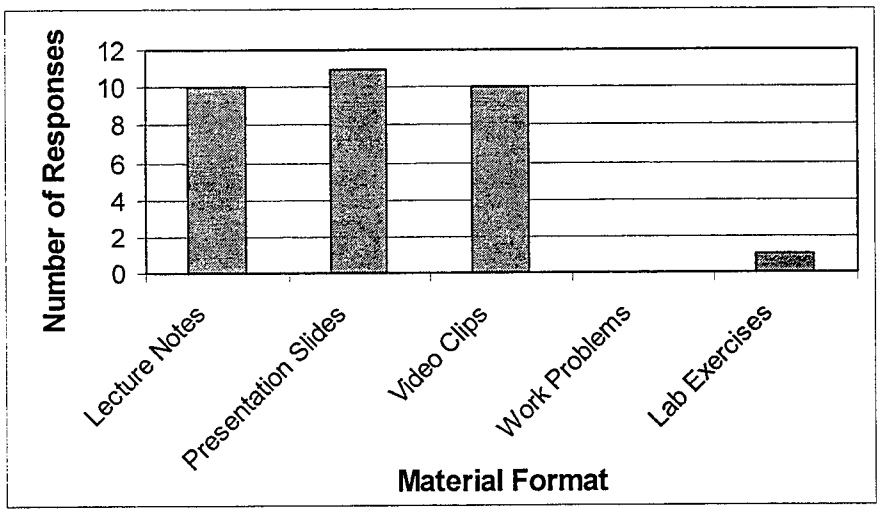

Figure 6. Resource Material Format Preferences

4. DELIVERY MECHANISMS

For transportation knowledge to be successfully disseminated to university students to enhance their KSAs, information must be delivered in a manner that is efficient and appropriate. Technology transfer, which is the method by which information and knowledge are disseminated to those who can benefit from it, consists of three critical elements: outreach, training, and education. (*1*) Education is the element of greatest use and concern in the university environment. With respect to students, education is the provision of both tools and background theory to apply those tools in the uncertain and/or changing future.

In the technology transfer arena, the general consensus is that effective communication is best accomplished through multiple channels or methods. (*2*) A wide variety of delivery methods exist, both electronic and traditional, all of which can be used by the academic community for dissemination of knowledge to students. Table 3 provides a list of those methods that readily lend themselves to use in the classroom and also identifies them as conventional or progressive in format.

Table 3. Delivery Mechanisms for Educational Technology Transfer

Delivery Mechanisms	Type of Mechanism	
	Conventional	Progressive
Fact Sheet, Circular, Newsletter	X	
Electronic Bulletin Board		X
Electronic Mail List Server		X
Electronic Newsgroup		X
Instructional Video	X	
Self-Guided Tutorial	X	
Manual	X	
Reference Guide	X	
Computer Program	X	
Book	X	
Digital Library		X
Electronic Clearinghouse		X
Technical Journal/Article	X	
Workshop	X	
Course	X	
Distance Learning		X

In many cases, the traditional classroom lecture is the easiest and most efficient way to deliver information to students. However, with the prevalence of computer technology at universities and students having easy access to the Internet, faculty can also utilize more progressive and non-traditional dissemination methods as a substitute for or to enhance lectures. Furthermore, the Internet can be a useful tool in designing problems and laboratory exercises for transportation students as a multitude of sites are devoted to all facets of the transportation industry. Moreover, transportation organizations and agencies across the country use many of these delivery mechanisms for dissemination of information to its target audiences. Students may often find information from these sources useful, and easy access to these materials can enhance their educational experience. In short, using a variety of these delivery mechanisms can work toward ensuring students graduating from universities and entering the transportation profession are well equipped with the KSAs to perform their jobs effectively.

5. FINDINGS AND RECOMMENDATIONS

The tasks completed during the course of this project provide insight into the educational needs in the transportation profession in the region. In short, transportation employers place a high priority on specific knowledge that is not necessarily being provided at all universities in a general transportation course. At some universities, this is the only transportation-related course some students take before entering the transportation work force. Thus, it is in the best interest of the profession that the KSAs of graduating students be as comprehensive as possible, especially if they receive limited exposure to transportation topics in their program. The following sections provide recommendations for action items regarding educational needs and potential delivery mechanisms for information dissemination, including methods for fostering collaboration between universities

5.1 EDUCATION ALLIANCE ACTION ITEMS

Based on the survey results from both employers and universities, action should be taken to bridge the gap between educational resources and knowledge needs. By comparing the knowledge needs expected of employers and the current educational resources at universities, each transportation topic requires some type of attention or action based on a level of criticality. The following sections prioritize actions with respect to transportation and other topics and provide suggestions on accomplishing those actions.

5.1.1 Transportation Topics

Table 4 provides a breakdown of the priority level of the topics with respect to creating an education alliance to address the needs of the profession. Primarily, transportation employers responding to the survey identified four topics as critical to hiring new graduates: traffic engineering, traffic operations, highway capacity, and transportation planning. They also indicated that some new employees had some level of knowledge deficiency in each of these topics. All of the responding universities cover traffic engineering and traffic operations in their

general course, either at a thorough or brief level, while not all teach highway capacity and transportation planning. Based on these findings, these topics are listed as a high priority, indicating that universities should address them first when working to bridge the education gap. The objective should be to ensure that these four topics are covered at a thorough level in a general transportation course to increase the primary KSAs of the students.

Table 4. Priority Level for Transportation Topics

Transportation Topic	Priority Level		
	High	Moderate	Low
Traffic Engineering	X		
Traffic Operations	X		
Geometric Design			X
Highway Capacity	X		
Pavements		X	
Transportation Planning	X		
Public Transportation		X	
Highway Safety		X	
Human Factors			X
ITS Awareness		X	
Multi-Modal Issues		X	

Five topics are identified as having a moderate priority level in the alliance effort: pavements, public transportation, highway safety, ITS awareness, and multi-modal issues. In each of these topics, the majority of employers expect only a brief knowledge level of graduates, but most indicate that a minor level of knowledge deficiency exists. While some universities address these topics at a thorough or brief level, each topic receives no coverage at one or more universities. Thus, a moderate priority level indicates that universities should work to ensure that these topics are covered at least briefly in the general transportation course.

Finally, geometric design and human factors are at a low priority level. For example, most employers expect graduates to have a thorough knowledge of geometric design, and most indicate that they observe minor to no knowledge deficiency in these topics. Furthermore, all of the respondent universities cover geometric design at either a thorough or brief level. Thus, this topic is a low priority as most of the universities are meeting these educational needs. Universities should ensure that the knowledge level is maintained and increased where

necessary. With respect to human factors, most employers expect a brief knowledge level or none at all and only experience a minor knowledge deficiency. Moreover, human factors is covered at thorough and brief levels at some universities and receives no coverage at others. In both of these cases, the universities should work to ensure that the topics receive a brief coverage at a minimum to meet the knowledge expectations of the employers.

5.1.2 Other Topics

As noted previously, employers believe that transportation professionals need various KSAs to perform their jobs, several of which might not be obtained through a traditional undergraduate program. These skills include project management, personnel management, budgeting, finance, technical writing, and communications. Thus, universities should strive to expose students to these topics either through departmental courses or outside the department through other avenues such as elective courses and continuing education. Such exposure can broaden the students' KSAs and ease their entry into the transportation work force.

5.1.3 Action Items

Universities and employers can take various actions to bridge the education gap based on the topics addressed in this report. First, universities with expertise in the areas identified can develop educational material that maximizes the knowledge gained by the student. They can utilize various formats to deliver that knowledge and work to ensure that material is available to all universities within the region and the nation. Second, a regional task force comprised of representatives from the professional and academic communities can work to identify expected KSAs and devise plans for meeting those expectations. Some of this work has already begun at the national level through the efforts of the U.S. Department of Transportation Professional Capacity Building Program, under the direction of Tom Humphrey. This regional task force can build upon the needs assessment currently underway by the PCB program to ensure the specific needs of the regional are included. Members of the task force can also participate in the Forum on Transportation Education and Training, the first of which will be held in January 1999. This forum is an opportunity for academic institutions, government agencies, industry partners, and

professional organizations to identify the forces affecting transportation and its educational needs and formulate broad guidelines for curriculum development based on these needs. Finally, the universities and employers in the region can create an alliance that has as its primary goal to address the educational needs of the region on a continuing basis. This alliance can collaborate on educational initiatives and work toward establishing a clearinghouse of educational and informational resources for the transportation profession. This clearinghouse would serve as a central location where faculty, students, and professionals can access information critical to developing and enhancing KSAs. The alliance can also ensure that the aforementioned actions become part of the fabric of the profession as a necessary component.

5.2 DELIVERY MECHANISMS

It is difficult to prioritize delivery mechanisms as they relate to the various transportation topics identified in this report. Each mechanism serves a specific purpose and is intertwined with the topic and the desired KSA level of the university students. It is recommended that the delivery mechanisms be determined on a case by case basis as each topic area is addressed. However, a general recommendation is to maximize the utilization of electronic media, such as the Internet, electronic list servers, newsgroups, bulletin boards, digital libraries, and electronic clearinghouses. These methods can deliver information to a broad audience and are an efficient use of resources. With minor effort, many of these methods can be utilized by university faculty to disseminate information to both students at a "home" university or to others across the country.

5.3 FINAL REMARKS

The results presented in this report begin to develop a framework for creating an alliance between universities in a region to meet the educational needs of the profession. While the focus was on the SWUTC region, the guidelines and action items are applicable across nation. By creating alliances and working to accomplish the actions set forth in this document, universities across the country can broaden student exposure to the transportation profession, encourage students to seek transportation as a viable career choice, enhance transportation education at the

undergraduate level, and encourage students to pursue graduate education in transportation. Finally, it is important to recognize that the alliance concept works to meet the goals and objectives of the national PCB program, especially as they related to educating the future professionals that will design, build, operate, manage, and maintain the transportation infrastructure of the 21st century.

REFERENCES

1. Seymour, E., Herrick, G.C., Vaughn, K., Kuhn, B., and Hedley, J. *Intelligent Transportation Systems: A Framework for Standards Technology Transfer.* Texas Transportation Institute, College Station, TX, and Viggen Corporation, Dallas, TX, 1998.
2. *Transportation Technology Transfer: A Primer on the State of the Practice.* Transportation Research Circular No. 488, Transportation Research Board, National Research Council, Washington, DC, 1998.

APPENDICES

APPENDIX A: EMPLOYER SURVEY

TEXAS TRANSPORTATION INSTITUTE

Center for Professional Capacity Building

Telephone: (512) 467-0946
Fax: (512) 467-8971
E-Mail: B-Kuhn@tamu.edu

5 February 1998

[Contact]
[Address]

Dear :

The Texas Transportation Institute's Center for Professional Capacity Building is working on a Southwest University Transportation Center (SWUTC) project to assess undergraduate transportation education in the region. Our intent is to leverage existing transportation education programs and work cooperatively to expand the educational knowledge at all of the universities in Arkansas, Louisiana, New Mexico, Oklahoma, and Texas. Our ultimate goal is to ensure that the region's universities match the needs of employers with qualified students and to attract students into the transportation engineering profession.

As a transportation employer, you have a vested interest in the students emerging from the region's undergraduate engineering programs. Attached is a survey aimed at assessing the level of transportation-related knowledge you expect of undergraduate students you hire in the region. Please take a few moments to fill out the enclosed survey and return it to me in the enclosed, self-addressed stamped envelope. If you feel that you are not the most appropriate person to complete this survey, please forward it to the appropriate individual and return your comments to me no later than **Monday, 16 March 1998**.

I appreciate your cooperation in this endeavor, and I look forward to hearing from you. Should you have any questions regarding the survey or this project, please do not hesitate to contact me. Thank you for your time and attention.

Sincerely,

Beverly Thompson Kuhn, Ph.D., P.E.
Center Director

Enclosures (2)

The Texas A&M University System • 7715 Chevy Chase Drive, Suite 4.160 • Austin, TX 78752

SURVEY OF DESIRED TRANSPORTATION UNDERGRADUATE KNOWLEDGE

1. **Name of Company / Agency** _____
2. **Does your Company / Agency hire undergraduate engineering students into transportation-related entry-level positions?** __Yes __ No **(If "No," please skip to Question 11, page 3.)**
3. **If "Yes," from which academic department do MOST of these students graduate? (Please list only one department).** _____
4. **Please list the universities in the region (Arkansas, Louisiana, New Mexico, Oklahoma, & Texas) from which you hire these students. (Please list all that apply and place them in order of preference from highest to lowest. If you need additional room, please list on the back of this page.)**

   (1) _____ **(4)** _____ **(7)** _____

   (2) _____ **(5)** _____ **(8)** _____

   (3) _____ **(6)** _____ **(9)** _____
5. **Please complete the following checklist to describe the level of KNOWLEDGE you expect these undergraduates to have in the following transportation topics. Expected knowledge level for each topic may be ranked in three ways:**

Thorough	Extensive knowledge of topic expected with ability to solve applicable problems.
Brief Background	General overview of topic expected.
None	Little or no knowledge expected for entry-level position.

	Thorough	**Brief Background**	**None**
Traffic Engineering	☐	☐	☐
Traffic Operations	☐	☐	☐
Geometric Design	☐	☐	☐
Highway Capacity	☐	☐	☐
Pavement	☐	☐	☐
Transportation Planning	☐	☐	☐
Public Transportation	☐	☐	☐
Highway Safety	☐	☐	☐
Human Factors	☐	☐	☐
ITS Awareness	☐	☐	☐
Multi-Modal Issues	☐	☐	☐

(Continued on Page 2)

SURVEY OF DESIRED TRANSPORTATION UNDERGRADUATE KNOWLEDGE

6. **Of the topics listed in Question 5 as "Thorough" in expected knowledge, list the top 3 you feel are the most critical when hiring undergraduate students.**

   (1) _____

   (2) _____

   (3) _____

7. **Please list any additional transportation topics not provided in Question 5 that are expected of undergraduate students and indicate the level of knowledge you expect them to have for each.**

   (1) _____

   (2) _____

   (3) _____

8. **Please complete the following checklist to describe the extent to which undergraduate students you hire have a knowledge DEFICIENCY in the following transportation topics with respect to the level of knowledge expected of them. Lack of knowledge for each topic may be ranked in three ways:**

Major	Recruit knowledge of topic is well below the expected level.
Minor	Recruit knowledge of topic is slightly below the expected level.
None	Acceptable knowledge in topic is found in recruits.

	Major	**Minor**	**None**
Traffic Engineering	☐	☐	☐
Traffic Operations	☐	☐	☐
Geometric Design	☐	☐	☐
Highway Capacity	☐	☐	☐
Pavement	☐	☐	☐
Transportation Planning	☐	☐	☐
Public Transportation	☐	☐	☐
Highway Safety	☐	☐	☐
Human Factors	☐	☐	☐
ITS Awareness	☐	☐	☐
Multi-Modal Issues	☐	☐	☐

(Continued on Page 3)

SURVEY OF DESIRED TRANSPORTATION UNDERGRADUATE KNOWLEDGE

9.Of the topics listed in Question 8 as "Major" in knowledge deficiency, list the top 3 you feel are the most critical when hiring undergraduate students.

(1) _____

(2) _____

(3) _____

10. Please list any additional transportation topics not provided in Question 8 in which undergraduate students lack appropriate knowledge and indicate the level of knowledge deficiency.

(1) _____

(2) _____

(3) _____

11. Name of Survey Respondent _____

Title _____

Address _____ **Phone** ____ - ____ - _____ (ext. __)

_____ **Fax** ____ - ____ - _____

_____ **E-Mail** _____

On the back of this questionnaire, please provide any additional comments or suggestions. All information provided on this survey will remain strictly confidential. Thank you for your time and participation. Please use the enclosed self-addressed stamped envelope to return to:

Beverly Thompson Kuhn, Ph.D., PE
Texas Transportation Institute
7715 Chevy Chase Dr. Suite 4.160
Austin, TX 78752

Phone: (512) 467-0946
Fax: (512) 467-8971
E-Mail: B-Kuhn@tamu.edu

APPENDIX B: UNIVERSITY SURVEY

TEXAS TRANSPORTATION INSTITUTE

Center for Professional Capacity Building

Telephone: (512) 467-0946
Fax: (512) 467-8971
E-Mail: B-Kuhn@tamu.edu

30 January 1998

[Contact]
[Address]

Dear :

The Texas Transportation Institute's Center for Professional Capacity Building is working on a Southwest University Transportation Center (SWUTC) project to assess undergraduate transportation education in the region. Our intent is to leverage the existing transportation education programs and work cooperatively to expand the educational knowledge at all of the universities in Arkansas, Louisiana, New Mexico, Oklahoma, and Texas. Our ultimate goal is to look for opportunities for the region's universities to assist each other in attracting students into the transportation engineering profession.

I have reviewed the undergraduate engineering program at and am interested in - , which is a general transportation course offered to undergraduate students in your department. Attached is a survey aimed at assessing this course and the transportation topics covered by instructing faculty. Please take a few moments to fill out the enclosed survey and return it to me in the enclosed, self-addressed stamped envelope. If you are not the faculty coordinator for this course or if you feel that you are not the most appropriate person to complete this survey, please forward it to the appropriate individual and return your comments to me no later than **Monday, 2 March 1998**.

I appreciate your cooperation in this endeavor, and I look forward to hearing from you. Should you have any questions regarding the survey or this project, please do not hesitate to contact me. Thank you for your time and attention.

Sincerely,

Beverly Thompson Kuhn, Ph.D., P.E.
Center Director

Enclosures (2)

The Texas A&M University System • 7715 Chevy Chase Drive, Suite 4.160 • Austin, TX 78752

SURVEY OF TRANSPORTATION UNDERGRADUATE COURSES AND CURRICULUM

1. **Name of University** _____
2. **Does your university offer a general transportation course to undergraduate students that provides them with an overview of the field?** __Yes __ No **(If "No," please skip to Question 14, page 3.)**
3. **If "Yes," is this course mandatory for all undergraduates in your department?** __Yes __ No
4. **In what college is this course offered?**_____
5. **In what academic department is this course offered?**_____
6. **Transportation Course Number** _____
7. **Transportation Course Title** _____
8. **Course description as listed in the university catalog** _____

_____

_____

9. **Please complete the following checklist to describe to what extent the following transportation topics are covered in the course listed above. Topics may be ranked in three ways:**

Thoroughly Multiple lectures providing extensive coverage of topic, including problems, quizzes, laboratory exercises, etc.

Brief Overview Single lecture providing a general overview of the topic.

Not Covered No lectures given on topic

	Thoroughly	Brief Overview	Not Covered
Traffic Engineering	☐	☐	☐
Traffic Operations	☐	☐	☐
Geometric Design	☐	☐	☐
Highway Capacity	☐	☐	☐
Pavement	☐	☐	☐
Transportation	☐	☐	☐
Planning	☐	☐	☐
Public	☐	☐	☐
Transportation	☐	☐	☐
Highway Safety	☐	☐	☐
Human Factors	☐	☐	☐
ITS Awareness	☐	☐	☐
Multi-Modal Issues			

(Continued on Page 2)

10. For each topic listed in Question 9 as "Not Covered," what is the PRIMARY reason for not covering it during the semester? Please select only one of the reasons listed below.

A - Faculty Interest and/or Knowledge

B - Limited Time Available for Subject Matter

C - Lack of Appropriate Lecture Material

D - Other (please describe in the space provided)

Traffic Engineering _____

Traffic Operations _____

Geometric Design _____

Highway Capacity _____

Pavement _____

Transportation Planning _____

Public Transportation _____

Highway Safety _____

Human Factors _____

ITS Awareness _____

Multi-Modal Issues _____

11. Of the topics listed in Question 9 as "Not Covered" in the transportation course, list the top 3 you feel should be added to the curriculum.

(1) _____

(2) _____

(3) _____

(Continued on Page 3)

SURVEY OF TRANSPORTATION UNDERGRADUATE COURSES AND CURRICULUM

If materials were to be made available for faculty use in the classroom, what material format would be most useful in discussing those topics listed as "Not Covered?" Please select only one from the following.

A - Hard Copies of Lecture Notes
B - Powerpoint Slides With Outline
C - Video Clips
D - Work Problems
E - Laboratory Exercises
F - Other (please describe in space provided)

Traffic Engineering _____
Traffic Operations _____
Geometric Design _____
Highway Capacity _____
Pavement _____
Transportation Planning _____
Public Transportation _____
Highway Safety _____
Human Factors _____
ITS Awareness _____
Multi-Modal Issues _____

13. Faculty Coordinator for Course _____

12. Name of Respondent (if different from Question 13)

Address _____
_____
_____

Phone ___.___.____(ext.____)
Fax ___.___.____
E-Mail _____

On the back of this questionnaire, please provide any additional comments or suggestions. Thank you for your time and participation. Please use the enclosed self-addressed stamped envelope to return to:

Beverly Thompson Kuhn, Ph.D., PE
Texas Transportation Institute
7715 Chevy Chase Dr. Suite 4.160
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