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**Forum on Transportation  
Education and Training**

*Responding to the  
Changing Needs of the Profession*

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**FORUM ON TRANSPORTATION  
EDUCATION AND TRAINING**  
**Responding to the Changing Needs of the Profession**

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Beverly Kuhn, Texas A&M University  
Ria Melendez, ITS America  
Chip White, University of Michigan  
Valeri Plotnikov, Virginia Tech

## EXECUTIVE SUMMARY

The First Annual Forum on Transportation Education and Training was held in Washington, D.C., on January 10, 1999, and was attended by more than 125 individuals. The Forum consisted of a plenary session and several breakout groups. The major goals of the Forum were to identify the changing needs of the transportation profession and, in light of these changing needs, to consider the following ideas on curriculum development:

1. The development of transportation curricula is influenced by the diverse and rapidly changing educational and training needs of the transportation profession.
2. The needs are diverse because they span multiple segments of the transportation community, including, but not limited to, entry-level professionals, experienced mid-career professionals, paraprofessionals and technicians, policymakers, and the general public.
3. The many disciplines involved in the transportation profession contribute to the diversity of educational and training needs. These disciplines include engineering, computer science, urban planning, economics, management, law, and other specialty areas.
4. These needs have changed over the last 10 years and are expected to continue to change as the transportation profession enters the next millennium. Thus, curricula need to be re-evaluated on a continuing basis in order to meet these changing needs.
5. Rapid changes in education and training needs are associated with advancements in information, computer, communication, and sensor technology, as well with the continued concern for the environment, economic development, and overall mobility and accessibility.
6. Curricula should be designed to meet the educational and training (E & T) needs and desires of each segment of the community. Graduate degree curricula (e.g., M.S. programs) should be designed to prepare entry-level professionals to enter the field of transportation as transportation planners, engineers, computer scientists, economists, and managers, and where appropriate undergraduate seniors should be encouraged to enroll in selected courses of such curricula. Other graduate curricula (e.g., certificate programs) should be developed to offer mid-level professionals and others an opportunity to pursue education and training in selected areas of concentration, such as transportation systems engineering, intermodal transportation planning, infrastructure management, and intelligent transportation systems. Where possible, these M.S. and certificate programs should be developed in an integrated manner so that they might be pursued simultaneously or sequentially. Courses should also be developed and offered to respond to the needs of policymakers and the general public. Such courses may be

part of graduate curricula or may be offered through continuing education programs or technology transfer centers on a credit or non-credit basis. Policymakers and the general public could also benefit from the dissemination of information regarding transportation issues, problems, and solutions via a variety of media (e.g., World Wide Web, television).

7. The E & T needs of the transportation community comprise knowledge, skills, and abilities from an array of subject or topic areas. In the broadest sense and at the risk of oversimplifying, these subject areas may be grouped into one of two categories; that is, they are either technical or non-technical. A few examples of these topic areas are transportation engineering, transportation policy, systems engineering, urban planning, computer science, economics, telecommunications, management, law, and interpersonal communications.
8. Graduate degree curricula should be clearly focused and should recognize the interdisciplinary nature of transportation. One possible graduate curriculum might focus on transportation systems engineering, while another might have a broader focus on computer science, operations research and systems engineering, management and logistics, or urban planning. Graduate curricula should include a set of required core courses that provide depth and cover the fundamental knowledge, concepts, and principles associated with the focus area. A set of elective courses within and outside the focus area should be offered to provide breadth and additional depth and to prepare the students for the interdisciplinary environment in which transportation professionals must often work. Special effort should be made to articulate the objectives of each course in terms of its intent to a) address either depth or breadth of a subject, b) cover the fundamental knowledge and concepts related to the subject, and c) teach skills and abilities.
9. The delivery of curricula and courses should include, where appropriate and possible, alternative delivery methods, including traditional lecture, lecture with video conference link in synchronous or asynchronous mode, web sites in conjunction with lectures, and self-administered web-based courses.
10. There is no ideal approach to administering degree or non-degree programs. Administrative approaches might take several forms, depending on program goals and local conditions and needs. Undergraduate- and some graduate-level curricula might be administered by a single academic department, while other curricula might be an interdepartmental responsibility; these administrative units might periodically seek formal and informal input from industry and government representatives. In addition, some degree programs may be administered at the college or university level. Non-degree programs and curricula might be a joint effort between academic departments and non-academic units such as a university's continuing education office, a transportation technology transfer (T2) center, or a professional association.

## **FORUM ON TRANSPORTATION EDUCATION AND TRAINING: RESPONDING TO THE CHANGING NEEDS OF THE PROFESSION**

### **Program Summary**

The Forum program opened with a welcome by Administrator Kelley Coyner of the U.S. Department of Transportation Research and Special Programs Administration (RSPA) and opening remarks by Deputy Secretary Mortimer Downey of the U.S. DOT. Both focused their remarks on the importance of developing education and training programs in transportation that will provide the nation with a work force that is able to design, deploy, operate, and maintain the innovative transportation technologies of the future. Dr. Thomas Dingus, Professor of Industrial and Systems Engineering at Virginia Tech, then introduced the plenary session moderator, Dr. Chelsea White, Professor of Industrial and Operations Engineering at the University of Michigan. Dr. White stated the major objectives of the Forum and introduced the five plenary speakers.

Three plenary speakers addressed the question, What factors affect transportation and changing educational needs? The speakers, whose remarks are summarized in this Circular, were

Mr. John Mason, Vice President of SAIC and Mayor of Fairfax City, Va.,  
Dr. Joseph Sussman, Professor of Civil and Environmental Engineering at MIT,  
and Mr. Frank Francois, Executive Director of AASHTO.

Two additional plenary speakers addressed the question: What actions are being taken to respond to the changing needs? The speakers, whose remarks are summarized in this Circular, were

Mr. Thomas Humphrey, U.S. DOT Coordinator for Professional Capacity  
Building, and  
Dr. John Collura, Professor of Civil and Environmental Engineering at Virginia  
Polytechnic Institute and State University.

The group then divided into three breakout sessions to consider the same five issues with respect to three different perspectives: 1) Undergraduate Programs, 2) Graduate Programs, and 3) Continuing/Post-Graduate Programs. The five issues addressed by each were:

1. What could/should universities do at this level to respond to the changing needs in the transportation profession?
2. How and when might these offerings be delivered?
3. To what extent should universities collaborate with industry, government, professional associations, and other groups in the design and delivery of such offerings?

4: What factors affect transportation and the changing educational needs of the profession at this level?

5: What knowledge, skills, abilities, and core competencies might be addressed in programs at this level?

Each of the breakout groups' discussions is summarized below.

The Forum concluded with remarks by Ms. Elaine Joost, Chairman of the TRB Committee on Transportation Education and Training, who stated that the Committee is pledged to follow up on the results of the First Annual Forum on Transportation Education and Training.

**Ms. Kelley S. Coyner, RSPA Administrator, U.S. DOT**

Ms. Kelley Coyner, Administrator of the Research and Special Programs (RSPA) of the U.S. DOT, welcomed the workshop attendees. She pointed out that the need for a full-day workshop, rather than a two-hour session, to discuss transportation education and training reinforces the increasing importance of these facets of transportation in the U.S. today and in the future. She encouraged the attendees to think about the value of transportation education they received and the benefits it afforded them and their communities. She also asked the attendees to focus on how to make transportation education more valuable to current as well as prospective students and to ensure that transportation educators generate and share knowledge necessary to provide the best transportation systems possible to communities across the country. Finally, Ms. Coyner acknowledged the sponsors of the workshop and introduced U.S. DOT Deputy Secretary Mr. Mortimer Downey.

**Mr. Mortimer L. Downey, Deputy Secretary, U.S. DOT**

Deputy Secretary Downey first noted that he was impressed with the turnout of more than 100 attendees and reinforced the notion that transportation education and training becomes more important in transportation decision making on the verge of the twenty-first century. He acknowledged the efforts of several organizations working in this area and specifically mentioned contributions of TRB, ITS America, University of Michigan, Texas A&M, Virginia Tech, and University of Minnesota. He also thanked Dr. John Collura personally for taking the lead in organizing the Forum.

Deputy Secretary Downey indicated that in order to define transportation E&T needs and to articulate strategic goals the transportation community has to understand the nature of the transportation system in the 21st century. The U.S. DOT has already proceeded in this effort by focusing on the provision of greater transportation efficiency, mobility, and safety; the promotion of economic growth and national security; and the protection of the environment. Deputy Secretary Downey also mentioned that in addition

to these broad goals, the U.S. DOT has developed a set of specific and verifiable objectives. In order to achieve these goals, the transportation community needs to progress in four key areas of transportation—better vehicles, better facilities, better management, and the increasing application of technology and information systems.

Deputy Secretary Downey stressed that people working in this environment must understand new technologies, innovative economic and financial concepts, and inter-organizational principles, among many other issues. He further suggested that the transportation industry needs a body of knowledge to support its operations and management similar to the one that supports current business operations. That body of knowledge should involve a combination of systems engineering, traffic engineering, economics, political science, and other subjects.

Deputy Secretary Downey asked the audience to consider two of DOT's strategic goals—safety and national security. The U.S. DOT has defined success in the area of safety as the absolute reduction of transportation-related fatalities, injuries, and property damage. However, achieving this goal is going to be a tremendous challenge in a world with greater congestion, high pressure from economic competition, an aging population, and increasing demand for travel. In order to meet this challenge, the transportation professional would have to understand operator performance, technology and information systems, community relations, public awareness campaigns, and business trends. The transportation community must ensure that the national transportation system is secure, reliable, and available for emergency and defense mobility. In this context, greater consideration should be given to the growing vulnerability of information-based systems. Overall, the situation requires a transportation environment that would attract high-quality, forward-looking people—those who can take on complex management, political, environmental, and financial challenges.

In conclusion, Deputy Secretary Downey urged the university leaders to keep up with the rapidly changing global transportation system and continue their striving for excellence in preparing transportation professionals.

**Dr. Thomas Dingus, Director of the Center for Transportation Research, Virginia Polytechnic Institute and State University**

Dr. Thomas Dingus began his remarks by expressing surprise and satisfaction with an impressive turnout and linked this fact with the greater role that education and training play in transportation today. He noted that education needs not only to keep up but also to catch up with the changing landscape of transportation. In his view, keeping up means forging an effective tie between research and education by moving new concepts and ideas from the research lab into the curriculum in the most efficient ways possible. He also stressed the need to re-evaluate traditional transportation curriculum and make necessary changes so that transportation education is in line with transportation state of the art. In order to meet these needs, he continued that transportation educators should attempt to develop consensus on curriculum development guidelines and, perhaps, on a common base of information that a future transportation professional would need to know. Finally, Dr. Dingus expressed his belief that the Forum provided the venue to ensure that the right group of people began these tasks.

**Dr. Chelsea White, Professor, University of Michigan**

Dr. Chelsea White, the plenary session moderator, addressed the audience by stating his belief that a safe, efficient, and environmentally friendly transportation system is a function of a skilled labor and knowledge force, properly focused research and development (R&D) process, capital investment from private and public sectors, and supporting policy. Universities, he continued, can contribute to the development of such a system by preparing knowledgeable and skilled transportation professionals, accumulating and disseminating new knowledge and technology, and providing information to policymakers to support rational planning and policy formation. To accommodate the most productive environment possible at the Forum, its organizers divided the program into a two-part plenary session and three concurrent breakout sessions. The plenary session was designed to focus on the provision of baseline information regarding the exogenous forces that impact the transportation system of the future.

Dr. White explained that in the first part of the plenary session three distinguished speakers from academia, the private sector, and the public sector would give their perspectives on the factors affecting transportation education and training. The second part of the plenary session would provide attendees with a recently completed assessment of the current and future transportation professional needs and an inventory of academic efforts to address these needs. In conclusion, Dr. White expressed the hope that the plenary session would provide rich material for the three breakout sessions and that the Forum would lead to a report capturing the environmental scan, needs assessment, description of current university efforts to satisfy these needs, and guidelines for the future curriculum development. Finally, Dr. White introduced the first speaker, Mr. John Mason.

**Mr. John Mason, Vice President, SAIC and Mayor, City of Fairfax, Va.**

Mayor Mason began his speech by promising to share his vision of transportation education and training needs based primarily on his civic experiences and to provide the attendees with the perspective on this matter from the viewpoint of an elected official. As a member of the Washington Metropolitan Area Metropolitan Planning Organization (MPO) and the Northern Virginia Transportation Coordination Council, the Chair of the Policy Advisory Committee for the I-66 MIS, as well as mayor of the city of Fairfax, Mr. Mason invited the attendees to share his perspective on transportation issues. He asked each listener to assume, for a moment, the role of a newly elected official attending an MPO meeting for the first time. Following that, he addressed the Forum with an excerpt from a hypothetical MPO briefing, full of acronyms, transportation terminology, and references to special transportation legislature documents. He indicated that the point he wanted to make was that there was often lack of good communication between transportation professionals and elected officials. He stressed that transportation professionals should always think from the perspective of their clients. Even though the private sector, public sector, and academic community might have different immediate clients, in the end what they all try to satisfy is the American public, represented usually

by a fairly small subset of elected officials. Mr. Mason asked the attendees to think about the transportation E&T needs as they facilitate a greater service to transportation clients and shared his thoughts on these subjects:

- Transportation planning and decision making are no longer solely the provinces of transportation planners and engineers. Transportation professionals should be good speakers and listeners, able to communicate effectively with elected officials.
- Transportation professionals should use tools that are understandable and suitable for the environment in which they are dealing. Traditional transportation planning and analysis tools may not be adequate to deal with the intangibles and variables that drive decision making in the real world.
- A preferred engineering solution may not be the best solution from the viewpoint of a civic community and its leadership. The civic leadership is constantly fighting competing solutions. Therefore, in order to be successful, transportation planners and engineers should think multimodally.

In conclusion, Mayor Mason expressed the hope that multimodal and multidisciplinary aspects of transportation, as well as good interpersonal skills, are not overlooked during the assessment of the current and future transportation education and training needs.

#### **Dr. Joseph Sussman, Professor, MIT**

Dr. Joseph Sussman addressed the workshop attendees with the academic perspective on transportation education and training needs. He began his presentation by raising two questions: what would the “new transportation faculty” need to know to carry out the educational mission and what is the future of such a faculty member in academia? In order to answer these questions, Dr. Sussman invited the audience first to trace recent developments in the area of transportation, then to consider challenges in today’s academia, then to investigate the role of transportation faculty, and, finally, to project the future of the “new transportation faculty.”

Dr. Sussman noted that in the last 20 years the role of transportation has become both broader and deeper. Today transportation should be considered as a major ingredient of the global economy and international competition. The time frame of transportation planning, decision making, and development has also changed dramatically. Finally, the organizational scale of transportation, in terms of the relationship between transportation providers and their customers has undergone critical transformation, too. The field of transportation has also been influenced by changes in technology, organizational and institutional relationships, and environmental and social attitudes. Recent advances in computer, information, and communication technologies have had profound impacts on transportation systems. Similarly, the increased importance of “externalities” in the areas of environment, energy, societal equity, and

land use, as well as changing roles of public and private sectors, have reshaped the transportation domain.

In response to these and other changes in transportation, Dr. Sussman suggested that a new definition of the boundaries of the transportation field is needed, and pointed out that it should include technological, institutional, and system dimensions of transportation. Discussing the challenges in academia, Dr. Sussman pointed out that with the end of the Cold War the federal government support of research universities diminished, which led to the private sector's taking a greater role in funding research, education, and training. In addition, many universities have developed programs abroad, reflecting the place of the U.S. within the global economy. Dr. Sussman stressed that the change in the support base requires academia to be more relevant than before and to be more effective in helping to solve the problems that society faces.

The technology of teaching has also changed dramatically, continued Dr. Sussman. The use of the Internet and the growth of distance learning require new skills and approaches from educators. Given the fundamental change in the nature of financial support and advances in the technology of teaching, the modern research university should be a central player in the solution of major issues facing society. In these settings, the future for the new transportation faculty is to build on its strengths in integrating new disciplines into the transportation domain. Dr. Sussman suggested that transportation educators should discover new relevant disciplines and attract specialists in those disciplines to transportation studies. In closing, he reiterated that as a broader role for the new transportation faculty emerges, the traditional tasks—to integrate, innovate, and instruct—should not be overlooked.

**Mr. Francis Francois, Executive Director, American Association of State Highway and Transportation Officials (AASHTO)**

The third speaker of the plenary session, Mr. Frank Francois, presented a public sector perspective on transportation education and training needs. He urged transportation educators to focus on the needs of the primary employers of their graduate students—state departments of transportation (DOTs). Mr. Francois noted that the 52 state DOTs currently employ some 200,000 civil engineers, and these organizations will remain the major customer of transportation education institutions in the near and more distant future. Despite the fact that highways remain the primary concern for state DOTs, there is a clear tendency for DOTs to become more involved in dealing with issues related to public transit, railroads, small and large airports, and waterway transportation. In short, one of the major items on the transportation professional's agenda today is intermodalism. Another two top issues on the agenda include increasing concerns over air, water, and soil quality and safety.

To summarize these issues, Mr. Francois suggested that transportation professionals start thinking about their domain as a network of larger, more integrated, and more interdependent systems than what has been believed before. As most state DOTs are challenged with the issues outlined above, they are simultaneously faced with a number of serious organizational and management changes, including downsizing, emergence of larger and more complex programs, outsourcing, emphasis on performance

management, and interagency cooperation. As a result, concluded Mr. Francois, a transportation professional today needs to be computer literate, possess good communication and interpersonal skills, be knowledgeable in economics and other non-engineering disciplines, and, above all, demonstrate superior leadership skills.

### **Mr. Thomas Humphrey, Consultant to U.S. DOT**

Mr. Humphrey thanked the group for the opportunity to participate in the Forum and acknowledged the many organizations and people who have assisted him in his national PCB effort and his recent study to determine “what professionals need to know.”

Mr. Humphrey began by stating that we are embarking upon a new era in transportation education and noted the challenge that ASCE has issued to the academic community: today’s engineers must have skills not only in fundamental engineering, but also in computer applications, information technology, management, communications, and foreign languages. In addition, he stressed the need for engineers to understand the political, economic, and social implications of their proposed projects. Mr. Humphrey also emphasized that ASCE’s challenge did not single out the ITS community or just the transportation discipline. As he explained, ASCE’s challenge was directed at the entire civil engineering profession.

Mr. Humphrey’s remaining remarks focused on his recent study to obtain a better understanding of the fundamental knowledge, skills, and competencies required of those individuals currently involved in operating and managing multimodal transportation facilities in the U.S. Some 200 professionals in the country were interviewed as part of this study. The following includes major study findings:

- The top ten competencies required of current professionals participating in ITS deployment fall into the following areas: systems integration, organizational and institutional changes, technology options, systems analysis and design, managing contractors, financing, communications, ITS planning, coalition building, and data analysis and management.
- The fundamental knowledge areas for the professional of the future include transportation systems engineering, electrical engineering, computer sciences, telecommunications, business practices, interpersonal communications, creativity, and the ability to apply fundamental skills in a real world environment.
- Although the study focused on ITS deployment, it was recognized that that the fundamental knowledge and competencies are applicable to a wider audience engaged in surface transportation management and operation.
- A partnership involving the public and private sectors as well as the academic community will be essential to formulate and implement the curricula required to meet the fundamental educational and training needs of the transportation community. Such an effort must acknowledge the different roles of various

academic levels, including K–12; community, junior, and technical colleges; undergraduate and graduate programs, and continuing education activities, and must also consider innovative curricula delivery methods.

**Dr. John Collura, Professor, Virginia Polytechnic Institute and State University**

Dr. Collura expressed his appreciation for the opportunity to participate in the Forum and thanked the many faculty and staff involved in his nationwide study to examine the actions recently taken by the academic community to address the changing education and training needs of the transportation profession.

Dr. Collura began by indicating that there have been three categories of action taken by universities to respond to the changing needs of the profession: 1) conduct research on educational issues, 2) sponsor conferences and workshops (such as this Forum), and 3) develop new and modified curricula and courses.

In the area of research he cited the work regarding curriculum development by Steffel and Kuhn at the Texas Transportation Institute; Boile, Spasovic, and Pignataro at the New Jersey Institute of Technology; and Pignataro and Hoel in conjunction with TRB. In addition, he made reference to Sussman's paper titled "Educating the New Transportation Professional," in which Sussman argues that professionals need a "much broader and deeper education." Dr. Collura also indicated that National Science Foundation (NSF) is funding an ongoing ITS research/curriculum project being conducted jointly by Virginia Tech and the University of Massachusetts at Amherst.

In the last several years, according to Dr. Collura, university faculty in collaboration with CUTC, TRB, ITE, ITS America, and the I-95 Coalition have held conferences and workshops to review educational issues and to exchange information about curricula and other matters. While some conferences and workshops were general in scope, others focused on more specific themes, such as integrating ITS into education and training, designing intermodal transportation and logistics programs at the graduate level, and coordinating undergraduate and graduate programs.

Drawing from a nationwide study conducted by the Virginia Tech Center for Transportation Research (CTR) in cooperation with the U.S. DOT PCB Program, Dr. Collura reviewed the major curricula actions of more than 70 universities in the U.S. to integrate ITS concepts and applications into their undergraduate and graduate curricula and non-degree programs. These actions included 1) the development of new full-semester academic courses focusing exclusively on ITS (25), 2) the modification of existing full-semester academic-year courses incorporating selected ITS concepts (33), and 3) the development of non-degree short courses and workshops on ITS-related topics (15). (The numbers in parentheses denote the number of universities which have developed or modified at least one such course, as of October 1998.) In general, these courses are being offered by both public and private institutions dispersed throughout the major regions of the U.S. For further details on these courses in terms of the university location, instructor name and address, email, content/description, skill level, target audience, and availability, Dr. Collura recommended that individuals consult the Virginia Tech CTR web site: <http://www.ctr.vt.edu/>

In closing, Dr. Collura summarized the major actions of universities to respond to the current and future education and training needs of the profession. These actions include conducting research and publishing articles; organizing and sponsoring conferences and workshops; developing new curricula and revamping old curricula; adding new full-semester ITS courses and modifying existing full-semester courses; establishing new and expanding existing laboratories; and developing non-degree ITS-related short courses and workshops. He also noted that while many of these actions were prompted in part by the ITS movement, others resulted from trying to be more sensitive to logistics concerns, freight movement issues and matters pertaining to environmental matters. Finally, Dr. Collura recommended that the university community consider adopting a comprehensive, continuing, and cooperative (3C) process within which to carry out its actions. For example, he proposed that curriculum development be continuing in that the curricula should be re-examined periodically to be sensitive to the changes in needs and the dynamic environment in which transportation professionals operate; that curriculum development be cooperative in that faculty should seek input from industry, government, and selected professional associations and societies; and that curriculum development be comprehensive in that curriculum changes should be a consequence of the diverse set of societal issues and concerns related to the transportation sector; and, where appropriate, that curriculum development should consider the interdisciplinary nature of the profession.

#### **Dr. Lester Hoel, Professor, University of Virginia**

Dr. Hoel started by noting that the conference was a major success not only in terms of attendance, but also in terms of high-quality presentations and active participation of many attendees. He reminded the audience that the focus of the conference was twofold—to understand the forces that shape the future of transportation and that influence on transportation education and to develop guidelines for transportation curriculum development. Then Dr. Hoel pointed out the clearly visible links between the goals of transportation community as outlined by Deputy Secretary Downey, the challenges and current state of affairs in transportation education and training as summarized by the five plenary speakers, and the task of trying to formulate curriculum guidelines in the breakout sessions.

He continued by stating that the first three plenary speakers provided the Forum with very good and useful perspectives on the challenges and changes that are under way in the world of transportation. John Mason, Joe Sussman, and Frank Francois shared their visions as an elected official, a university educator, and an executive of a professional association, respectively. Dr. Hoel added that the other two plenary speakers, Tom Humphrey and John Collura, had provided a cogent and comprehensive overview of the current status of needs and curriculum development. Dr. Hoel then asked the attendees to focus their attention on the breakout session summaries directed at developing curriculum guidelines. These summaries are provided below.

## **Ria Melendez, ITS America - GROUP #1: Undergraduate Education Programs**

The group began by addressing general definitional issues. For example, it was agreed that defining transportation is getting more and more difficult. With the introduction of new technologies, the traditional definition of “transportation” has mutated from passenger and freight movement to a less definite and concrete term that also encompasses issues such as communications, logistics, and engineering.

The members of this breakout group consisted mainly of university representatives from different sizes and types of academic institutions. Representatives came from a broad range of disciplines, including civil engineering, electric engineering, business, communications, and management. The broad representation provided a variety of opinions and views and challenged the group's reaching a consensus on some topics.

The members chose this breakout session for a variety of reasons, ranging from the need to update a 20-year-old curriculum to the interest in better understanding the changes in transportation and their impacts on university programs and curricula development.

While the thought of arriving at a consensus was viewed by the group as a daunting task, the group agreed that universities need to “re-create” themselves and begin to consider the possibility and merits of establishing a multidisciplinary undergraduate program. It was also agreed that common “transportation” threads exist throughout many disciplines. It was also noted that a transportation-related program without a multidisciplinary orientation might pose problems in that it may be too focused or narrow in light of the fact that technology and other factors change so rapidly and have a dramatic impact on transportation.

Another discussion topic centered on the students themselves. For example, when students enter a university program, they do not necessarily know what field they want to pursue – and if they do it is rarely the “transportation engineering” field. It was recognized that universities should create programs that meet the students’ expectations and provide them with a knowledge base that correctly matches what they need to know.

The group then focused on the questions proposed by the Forum organizers, a summary of which is provided below.

*#1: What could/should universities do at the undergraduate level to respond to the changing needs in the transportation profession?*

Universities should address the following questions and determine what works best for their particular set of circumstances.

- a) Is it better to have consistency or diversity?
- b) Should programs be integrated? Is specialization better for the students?
- c) When addressing curriculum reform as it relates to the Accreditation Board for Engineering and Technology (ABET) 2000 – to whom is the curriculum aimed?
  - Is it the undergraduate engineering student who will expect the employer to train him or her in what he or she needs to know about transportation and ITS?

- Should it be directed to the student who pursues a graduate engineering degree?
- Is it directed toward the student who has followed a multi-engineering path – (e.g. E.E., and C.E.)?
- Should the focus be on giving the student a multi-faceted program in management, policy and technology?
- When creating a new curriculum to address the changing needs of the transportation professional, how might the course content be directed to fit one of the categories above?

*#2: How and when might these undergraduate offerings be delivered?*

Discussion on delivery methods indicated that traditional classroom for the undergraduate is the accepted and expected method. Common transportation threads should be highlighted in programs. Supplying videos about transportation among disciplines would be helpful to show the importance and impact of transportation on everyone's life. Discussed later is the concept of including internships, collaboration among different groups and organizations, and employment as excellent learning tools. There was little or no discussion about distance education learning. This does not mean that the universities are not pursuing this type of delivery; it was just not touched upon.

*#3: To what extent should universities collaborate with industry, government, professional associations, and other groups in the design and delivery of such offerings?*

Collaboration with industry, government, business, associations, and others is an important learning tool for the student and provides a basis for a comprehensive understanding of what transportation is all about. It adds to the student's experience and is invaluable. Programs that bring in private sector participants four or five times a semester would help the students learn about the "real world." The real-life experience makes a bigger impact on the students' learning than classroom instruction alone. This cannot be a one-way approach. Students must also go into the business world. Whether this includes an internship, a co-op, or part-time employment, it provides the student with firsthand professional experience, builds resumés, provides tuition assistance, and helps foster professional relationships that may be useful after graduation.

*#4 & #5: What factors affect transportation and the changing educational needs of the profession at the undergraduate level? What knowledge, skills, abilities, and core competencies might be addressed in undergraduate programs?*

The line that separates communications and transportation is becoming grayer. Transportation only encompasses roads and bridges but also draws from an entire spectrum of fields, including information and data management, electrical engineering, structural engineering, civil engineering, communication systems, and business practices.

It is important for a student to have the "traditional" engineering skills, but the student needs more than that. When the student enters the business world, whether in the public or private sector, he or she often needs to "sell" transportation projects to

stakeholders. This leads to the need for education in "soft skills" including presentation and communication skills, teaming, computer capability, negotiation skills, and ethics.

Summary: In the past, undergraduate education and curricula were often intended to provide the knowledge and skill development required for an entire career, with perhaps a few minor adjustments along the way. However, this is no longer the case in the transportation profession; because of the rapid changes taking place in technology and other factors, the educational needs of the transportation professional are also changing, and as a consequence, the group agreed that undergraduate curricula should be directed at preparing students for "life-long" learning.

### **Steven Hay, University of Minnesota - GROUP 2: Graduate Programs**

This group directed its discussion at the outset toward the questions provided by the Forum organizers. A summary is provided below.

*#1: What factors affect transportation and the changing educational needs of the profession?*

The development of Intelligent Transportation Systems (ITS) and other transportation-related technologies and systems has changed the educational needs of transportation professionals. The introduction of advanced computing, as well as electronic and sensing technologies, often requires new knowledge, skills, and abilities. There is a need to convince the transportation profession that it has an educational responsibility.

The marketplace is another factor that was identified by the group. What is the market willing to pay for transportation professionals? How does the transportation profession compete for the best students with other, higher-paying technical and engineering fields?

*#2: What knowledge, skills, abilities, and core competencies might be addressed at the graduate level?*

Group 2 talked about the need for graduate students to focus on the customer side of transportation. Graduate students need to understand the needs of the customer for transportation services, regardless of whether those services are for passenger or freight movement. There is a need to emphasize service to the customer that is associated with the need for performance measures and evaluation criteria. Group 2 also discussed the need for education in the area of ethics and professional responsibility as well as logistics and supply chain management.

Much of the discussion in Group 2 centered on the need to emphasize the non-technical/engineering aspects of transportation education. Transportation professionals need basic knowledge in broad areas such as business, management, public policy, social sciences, and communication. This issue seems to have particular relevance at the graduate level since many graduate students are engaged in highly specific and very technical programs. The group cautioned, however, that "one size does not fit all," and

students need some latitude and flexibility to choose how much and what emphasis to place in the non-technical areas.

With the increasing set of knowledge, skills, and abilities that seem to be required for transportation professionals, the issue was raised that perhaps we need to stop teaching some things to allow more time for other types of courses. The group did not reach any conclusions about what kinds of courses might be appropriately eliminated. The group did discuss, however, the idea that “everybody doesn’t need everything.” It would not be possible for all graduate students to have the same degree of breadth and scope of their education. Students need to take responsibility to synthesize their own educational experience.

*#3: What might universities do at the graduate level to respond to these changing needs?*

Transportation education at the graduate level needs to be interdepartmental and multidisciplinary. There is a need for faculty to look beyond their own discipline and to embrace and collaborate with colleagues from elsewhere within the university for the benefit of the graduate students. There may be a need to educate faculty beyond their disciplines and to emphasize the importance of collaboration with other departments and disciplines. There was some discussion about the possibility of providing incentives to encourage collaboration.

The group also discussed the relative importance of teaching and research by the faculty. It was agreed that faculty should be engaged in both teaching and research activities and that faculty need to be able to translate and synthesize cutting-edge research and bring it to the classroom.

There was considerable discussion about the need to provide “real-world” experience for graduate students. The group discussed several ideas on how this real-world experience could be brought to students. Traditionally, internships or class projects have provided this type of experience for students, and the group concurred that these types of activities remain a very valuable educational experience for graduate students.

Additionally, the group talked about the concept of “team teaching” for graduate courses. The idea is that one or more practitioners would participate as guest lecturers in a course and would complement the faculty. The group also discussed the idea of having “real-world” transportation professionals serve as advisors to students in addition to their academic advisors.

The group did express concern that practitioners need to do more than tell “war stories” about their professional experience. To be successful, universities need to provide guidance and quality control for nonacademic instructors.

*#4: How might these graduate course offerings be delivered?*

There is a definite need for innovative methodologies for offering courses. There are many instances of small class size, which may be prohibitive for course offerings. Several ideas were discussed, including distance learning, shared courses, video and teleconferencing, and the use of the Internet. The group felt that the technical capabilities

exist to offer a variety of distance-learning offerings, but that there are significant institutional issues that need to be overcome.

*#5: To what extent should universities collaborate with industry, government, professional associations, and other groups in the design and delivery of such graduate courses?*

The group discussed the possibility of nonuniversity educational providers participating in graduate-level education. Private-sector educational providers can respond faster than universities to changing technologies and the changing needs of the profession. There may be opportunities for universities to collaborate and partner with private- and public-sector agencies to provide educational facilities such as laboratories as well as educational experiences.

### **Beverly Kuhn, Texas Transportation Institute - Group 3: Continuing / Post-Graduate Education**

To adequately address the changing needs in continuing and post-graduate education (CPGE), the providers of these programs and their anticipated customers must first be identified. While the focus of the Forum was on the university, the university is only one component of the continuing and post-graduate education system. Along with traditional four-year institutions, other providers of continuing / post-graduate education (CPGE) programs include, but are not limited to, junior and other two-year colleges, technical schools, community colleges, training organizations, and professional organizations. Thus, the recommendations and guidelines developed for the university apply to the entire network of CPGE providers.

Secondly, it is important to identify the customers of CPGE programs. Without such an exercise, the providers cannot hope to successfully accomplish the goal of enhancing the knowledge, skills, and abilities (KSAs) of the transportation workforce. The customers of CPGE programs have many faces. Most importantly, CPGE customers exist at the local, regional, national, and international levels of the transportation industry, both in the public and private sectors. They include, but are not limited to, employees in the transportation industry, those with college degrees, those without college degrees who require technical information, those who provide transportation services, professional users of the transportation system, and utility providers. The customer may be entry-level employees, mid-level managers, executives, individuals making career changes, elected and appointed officials, or the public at large. They also include academics and employers, professional societies and associations, law enforcement agencies, emergency service providers, and future transportation leaders. In short, potential customers of CPGE programs make up a diverse pool of individuals with diverse needs with respect to KSAs. Hence, it is clear that universities are only one part of a network of providers that must service these customers. It is virtually impossible for any one institution to accomplish the daunting task of CPGE alone. These diverse opportunities to provide CPGE programs will allow many groups and organizations to identify those areas that best match their missions and their capabilities for delivery.

A summary of the discussion in this breakout session related to the questions provided by the Forum organizers is provided below.

*#1: What could or should universities do at the CPGE level to respond to the changing needs in the transportation profession?*

The CPGE provider should undertake a comprehensive and ongoing assessment of the needs of the target audience. This assessment can include advisory groups and marketing strategies that identify emerging needs and trends in the transportation industry. Using input from the CPGE attendees as well as from employers, helps the provider understand what the customers expect, what they need, and what they do not need. This approach helps determine future needs and ensures that the provider is successful in developing a CPGE program that satisfies the needs of the diverse customer. It can ensure that the provider is more responsive to the customer and the rapidly changing industry, even at the regional and local level. Such responsiveness means retooling knowledge and information for today's market by applying academic knowledge to the practical world and vice versa. Timing is also important in technology transfer. The delivery of information needs to be relative and pertinent to an individual's specific needs at a point in time. In short, universities and other providers must respond proactively to the changing needs of the profession and tailor CPGE programs to meet the needs of the diverse pool of potential customers.

*#2: How and when might these CPGE offerings be delivered?*

The key to CPGE offerings is flexibility. Whether traditional or nontraditional delivery methods are used, CPGE programs must be flexible to meet the needs of the market. As discussed previously, the customer for CPGE programs is diverse, and providers need to use diverse means of disseminating information and resources. The goal is to successfully match the delivery method to both the customer and the topic so that information is disseminated efficiently and effectively. In the CPGE arena, conventional methods are not always the best option for a particular audience or topic. While the traditional workshop or short course increases interaction, it does not provide flexibility in delivery. CPGE offerings need to capitalize on non-traditional methods of dissemination to increase flexibility. Such formats as distance learning, newsletters, list servers, on-line bulletin boards, and chat rooms can provide just-in-time delivery of knowledge and give the audience flexibility in when and where it receives information. CPGE programs can also be developed in partnership with employers, either public or private sector, to encourage on-the-job training and to increase and retain knowledge within an organization. An additional benefit of such programs is the creation of a pool of trained instructors, which ensures that skilled and knowledgeable individuals are delivering information to the intended audience. Such programs also encourage transportation professionals to be proactive about their own professional development.

*#3: To what extent should universities collaborate with industry, government, professional associations, and other groups in the design and delivery of such CPGE offerings?*

Universities should exercise any opportunity to collaborate with industry, government, professional organizations, and other groups to design CPGE programs. Such collaborations offer the opportunity to assess the needs of the audience and provide programs that meet those needs. New networks and partnerships can be formed, both between academic institutions and the public and private sector, and between academic institutions themselves, capitalizing on the strengths of all partners to form a synergistic program. Such collaborations can result in diverse dividends for all involved. Benefits include the blending of academic research results with practical applications to meet the needs of the customer, the swifter implementation of results, and a direct channel for feedback from the customer. Such feedback broadens the areas monitored and results in program modification and improvement, enhancing the responsiveness of the CPGE provider. Experience has shown that institutional barriers associated with partnerships can be overcome with cooperation and commitment by all partners. Teaming a faculty member with a practitioner can also enhance synergy and interaction by facilitating the sharing of ideas and experiences, thereby merging existing information sources with new ones to ensure that efforts are not duplicated.

*#4: What factors affect transportation and the changing educational needs of the profession at the CPGE level?*

Various factors affect the educational needs of the transportation profession at the CPGE level. Today, the Transportation Equity Act for the 21st Century (TEA-21) window is small. Institutions must capitalize on the increase in funding while making a commitment to CPGE efforts. Most organizations have small budgets dedicated to training and CPGE. If the KSAs of transportation professionals must improve to meet the changing industry, then all employers must increase commitments in this arena. Conversely, if the need for CPGE programs is as great as anticipated, it should become obvious as entities demonstrate an increased willingness to financially support such training and education on a continuing basis. Establishing knowledge officers responsible for improving and retaining knowledge within the organizational structure is a first step toward this commitment.

Another factor affecting educational needs is the increased diversity in interest groups and their goals. For example, transportation mobility and efficiency and the environment share the same platform and often compete in today's economy. The transportation professional must understand the impacts of these competing interests and learn to balance them, thereby increasing the need for CPGE. Limited access to current instructional technology affects the ability of some customers to participate in certain CPGE programs, thereby emphasizing the need for flexibility. Also, there needs to be a willingness to share technological information across political and organizational boundaries, realizing that information and knowledge benefit the entire industry at all levels. With such a diverse audience for CPGE programs, attendees should be pre-qualified for specific topics to ensure that information is disseminated to the appropriate target audience.

*#5: What knowledge, skills, abilities, and core competencies might be addressed in CPGE programs?*

As discussed previously, the audience for CPGE programs is diverse. As such, the KSAs required by this audience are tailored to the needs of the customer. Responding to this constituency requires the provider to realize that one size does not fit all. Primarily, the transportation professional should have a breadth of knowledge across the industry and a depth of knowledge in one or more technical areas. If a KSA need exists within an organization, support for CPGE programs is critical to successfully meet those needs. It is critical that the transportation industry and its employers support both types of knowledge and the pursuance of them. Alternatively, if an institution or organization plans to outsource certain divisions, the organization must determine what KSAs are required of outsource personnel, both now and in the future. Thus, CPGE programs can work to meet those requirements to ensure that the needs of the customer are met, whether internal or external. Furthermore, the transportation profession should ensure that value-added aspects of CPGE programs are realized so that a return on investment is achieved at all levels. Related knowledge and literature should be included in programs and the needs of the customer (i.e., the KSAs of the professional) should be met with speed, efficiency, and flexibility.

Summary: An explicit need for CPGE programs and the delivery of knowledge exists in the transportation profession. Unfortunately, such programs are woefully underfunded at all levels, while the need for them is increasing across the profession. Hence, the future success of the profession requires a commitment to professional development at all levels, even at the individual level where the professional is personally motivated to participate in lifelong learning. Quality and value are cornerstones of any CPGE program and must be incorporated, along with feedback and input processes to ensure continuous improvement. It is important to remember who the CPGE customer is and to respond to his needs quickly and appropriately. A multimedia delivery approach under the test of appropriateness is the key. Such a strategy ensures the right topic is taught to the right audience at the right time with the right delivery format. Finally, there must be a measure of return in CPGE investment realized by the provider, the customer, and the industry as a whole.

## **CLOSURE AND NEXT STEPS**

### **Dr. Paul W. Shuldiner, Professor, University of Massachusetts**

Dr. Shuldiner acknowledged the efforts of the Forum organizers and sponsors and commented on the importance of identifying possible subsequent actions to the Forum. He then introduced Ms. Elaine Joost, who proposed several actions to take as a follow-up to this Forum.

**Ms. Elaine E. Joost, Chairman, TRB Committee A1A04, Transportation Education and Training**

Ms. Joost began by stating that the Forum was the first of what is intended to become an annual event sponsored by the TRB Committee on Transportation Education and Training. She went on to note that the standing-room-only crowd suggested that there was sufficient interest to sustain a continuing dialogue and forward movement toward ambitious goals.

She then went on to explain how the Committee on Transportation Education and Training would extend the work of the Forum. First of all, the Forum proceedings would be published as a TRB Circular. Then the Committee would develop a work-plan for the next two years. Having already committed to sponsoring an annual forum on transportation education and training, the Committee would use the results of this, the first one, to select the topic for the second, as well as to select the topic of any paper or conference sessions proposed for the next annual meeting of TRB.

One idea arose from a brief discussion of transportation ethics that took place during the breakout session on graduate programs. The participants in that session appeared to have no common understanding of the term. They did, however, appear to have a common belief that transportation practitioners have a duty to society that can override their duty to a client or employer. There is room for a stimulating exchange of ideas involving a system of agreed values that can expand on narrow legal definitions related to ethical and unethical behavior. Ms. Joost indicated that her Committee would consider sponsoring a paper or conference session to address these issues.

In conclusion, Ms. Joost expressed the hope that the first annual Forum on Transportation Education and Training would kick off a period of creativity and multidisciplinary exchange worthy of the energy and insights that the participants had shown throughout the day.

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