21st Century Workforce Development Summit

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WisDOT 0092-09-14, CFIRE 01-10
September 2009

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Technical Report Documentation Page

1. Report No. CFIRE 01-10/WisDOT 0092-09-14	2. Government Accession No.	3. Recipient's Catalog No. **CFDA 20.701**
4. Title and Subtitle **21st Century Workforce Development Summit**		5. Report Date 3ÅÐÔÅ Í ÂÅÔì ςππω 6. Performing Organization Code
7. Author/s Ernie Wittwer, Teresa Adams, Ph.D., Edwin Toledo-Duran		8. Performing Organization Report No. CFIRE 01-10
9. Performing Organization Name and Address National Center for Freight and Infrastructure Research and Education (CFIRE) University of Wisconsin-Madison 1415 Engineering Drive, 2205 EH Madison, WI 53706		10. Work Unit No. (TRAIS) 11. Contract or Grant No. WisDOT 0092-09-14
12. Sponsoring Organization Name and Address Wisconsin Department of Transportation 4802 Sheboygan Avenue Madison, WI 53707-7910		13. Type of Report and Period Covered **Final Report [6/30/08 – 6/30/09]** 14. Sponsoring Agency Code
15. Supplementary Notes **Project completed for the CFIRE with support from the Wisconsin Department of Transportation.**		
16. Abstract: The transportation workforce will be facing severe strains over the next decade as the baby boom generation begins to retire. These strains will be made worse by the relatively small numbers of workers entering the transportation workforce and the small number entering the technical fields that are the source of the workforce. At the same time the nature of the transportation industry is changing producing the need for new and broader skill sets. These issues were explored in a workshop. It was concluded that new skills will be required, To produce those skills and the number of workers required, new partnerships will also be needed. Agencies, private sector firms and educators will have to combine forces to make the training and development processes as effective as possible and to attract students to the sciences and to transportation in particular/		
17. Key Words: workforce, training, development	18. Distribution Statement **No restrictions. This report is available through the Transportation Research Information Services of the National Transportation Library.**	
19. Security Classification (of this report) **Unclassified**	20. Security Classification (of this page) **Unclassified**	21. No. Of Pages 55 / 22. Price **-0-**

Form DOT F 1700.7 (8-72) **Reproduction of form and completed page is authorized.**

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Executive Summary

Public sector transportation agencies and the consultants and contractors who help them carry out their missions will face a major challenge in finding qualified employees in coming years. The baby boom generation, those people born from the late 1940s through the early 1960s, is reaching retirement age. As a result, most agencies and many consultants may see a major exodus of experienced employees in the near future. As much as fifty percent of the existing public agency transportation workforce will reach retirement age within the next ten years. With fewer people getting into transportation-related fields, increasing competition for workers from other industries and difficulties in reaching women and minorities replacing those workers will be difficult.

As this major challenge of replacing retiring workers unfolds, the nature of the transportation industry is also changing. The skills held by the current generation of workers will have to be augmented if agencies are to be responsive to changing demands. Technical skills will need to be more robust and will have to be complemented by a range of soft skills, such as communications, management and leadership.

To explore these issues and to try to find actions to meet the workforce needs of the transportation industry, representatives of seven state departments of transportation, fifteen educational institutions and six consulting firms came together on December 8th and 9th in Madison, WI. The workshop was hosted by the National Center for Freight and Infrastructure Research and Education (CFIRE), which is located at the University of Wisconsin-Madison.

The group reached a number of conclusions:

- The nature of the transportation industry is changing and can be expected to continue to change dramatically into the future.

- These changes will require a broader set of skills in the transportation workforce. New materials, concerns and processes will demand broader technical skills. Demands for greater involvement and accountability will require increased communications skills, management skills and project management skills. The greater use of outsourcing will require greater interpersonal, negotiation, conflict resolution and measurement skills. A wider range of financing options and a greater concern with financial efficiency will demand a wider range of financial management skills.

- Educational institutions have made many changes to engineering and planning curriculums in response to impending changes, but many gaps still exist between the skills that will be needed and those that are processed by

current graduates.

- Changes in the composition of the workforce in terms of age, generation and ethnicity will require agencies to make efforts to become more attractive to these new types of employees.

- Effort will have to be made to encourage more students in the K-12 classes to take an interest in math and science, so they have the option of pursuing careers in the sciences in college.

- New partnerships between educational institutions, public agencies and private sector firms will be required to guide the workforce training process to make it more responsive and more efficient.

- Workplace training efforts will also have to be expanded, again through the type of partnerships outlined above.

These conclusions will require coordinated action from all of the participants in the transportation workforce development effort, educators, public and private sector practitioners and employers.

Introduction

Public sector transportation agencies and the consultants and contractors who help them carry out their missions will face a major challenge in finding qualified employees in coming years. The baby boom generation, those people born from the late 1940s through the early 1960s, is reaching retirement age. As a result, most agencies and many consultants may see a major exodus of experienced employees in the near future. As much as fifty percent of the existing public agency transportation workforce will reach retirement age within the next ten years. With fewer people are getting into transportation-related fields, increasing competition for workers from other industries and difficulties in reaching women and minorities replacing those workers will be difficult.

As this major challenge of replacing retiring workers unfolds, the nature of the transportation industry is also changing. The skills held by the current generation of workers will have to be augmented if agencies are to be responsive to changing demands. Technical skills will need to be more robust and will have to be complemented by a range of soft skills, such as communications, management and leadership.

Several programs had been implemented under the 2005 Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (SAFETEA-LU). The Surface Transportation Program, National Highway System, Bridge Program, Interstate Maintenance, and Congestion Mitigation and Air Quality are the five core programs. Some workforce development provisions in the legislation include the Garrett Morgan Program, which funds outreach to elementary school and secondary school students for transportation career awareness. Other programs include the Transportation Education Development Pilot Program, which establishes funding and pilot programs to develop training and education curriculums for surface transportation workers, and the Transportation Opportunities Scholarship Program, which includes the Eisenhower Fellowship Grants. Section 5204(e) of the legislation provides that core funds may be used for activities related to training, education and workforce development that can be used for training current workers, activities to encourage young people in transportation, internships, scholarships and cooperative education programs. In addition the role of universities was expanded with the creation of the University Transportation Centers program and funds available to develop training and education curriculums.

Representatives of educational institutions reported many efforts to expand their programs. Many involved graduate level programs. Some involved modifying how undergraduate programs are taught. [Appendix C]

Workforce issues will force agencies to become more concerned with the entire work life cycle, which is depicted in Figure 1. Historically, employers have been most concerned about the post-college portion of an employee's life. They assumed that the market would provide enough trained workers and that the employee would take charge of ensuring that skills were kept current in the later phases of their careers. This narrow focus may no longer be possible. Young people are not choosing careers in the technical fields in sufficient numbers to meet the needs of industry. In part they may not be choosing those fields because they have not taken enough math and science in middle and high schools to allow them the option of becoming an engineer or a scientist in college. Potential employers must concern themselves with the number of young people who are able to make the choice for math and science. In many cases, this can mean taking a role in the K-12 schools to help students understand the impact of the choices made even at this young age.

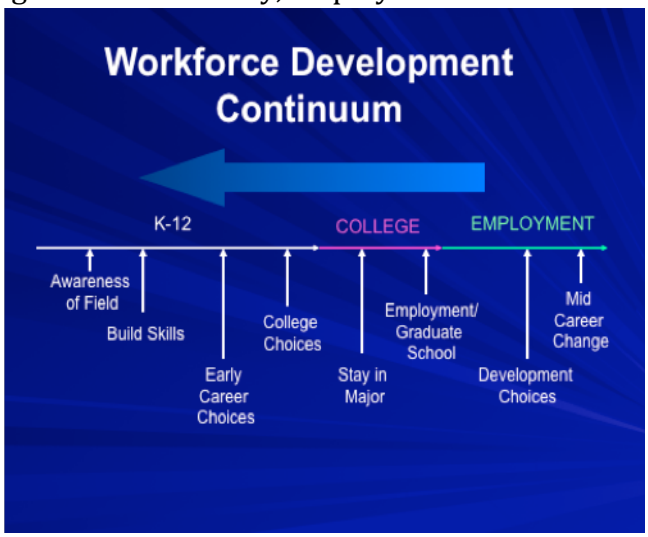


Figure 1 Workforce Development Continuum

The FHWA has established these strategic concepts to guide its efforts in workforce development, which were also considered sound guidance for the overall transportation industry: [Clark Martin]

- Develop broad-based transportation internship programs,
- Connect community colleges to transportation careers,
- Engage with retraining programs for downsized industries,
- Increase transportation participation in broad efforts to promote Science, Technology, Engineering, and Mathematics (STEM),
- Raise visibility and attractiveness of transportation careers,
- Make the transportation workplace an outstanding workplace environment.

These strategies capture the need to connect young people to potential transportation careers before they make their career choices. They also point to some creative ways of finding new employees and of making transportation an attractive career option. Finally, they deal with the need to reach students in K-12 to ensure that they are prepared to enter the science and math fields when they enter college.

The strategies not listed above that might be needed include:

- Finding ways to broaden the typical planning or engineering curriculum to allow students to gain some of the additional skills that will be needed.

- Pursuing ongoing training programs to help existing employees renew and expand their skills.
- Introducing greater flexibility into the workplace to make it attractive to older workers and to others who may have different work/life needs.

Methodology

Planning Committee

A planning committee made up of representatives of eight states, the FHWA and eight educational institutions was assembled. It met telephonically over the months of September, October and November 2008. The group finalized the agenda, the list of invitees and the list of speakers. The committee roster can be found in Appendix A.

Surveys

Prior to the workshop a survey was conducted with state authorities and universities to get an insight of the transportation needs and workforce issues. Seven state transportation agencies and fourteen universities successfully completed their respective surveys.

State Authorities

On transportation issues and needs, surveyed state authorities reported they foresee very significant changes such as greater emphasis on facilitating freight movements for economic competitiveness, multimodalism and building public support, as well for greater need to manage operations to reduce congestion. Significant changes in agency environments to attract and retain workers and creative financing are anticipated. These changes are expected to have an effect on the skills required in the workforce. Most of the authorities foresee that professionals will need stronger people skills; managers will have to be able to manage networks of activities and relate to other professional disciplines; and managers will have to relate positively to a wide array of public constituencies in order to solve problems.

Greater outsourcing has influenced the skills required in the surveyed agencies, ranging from the need for project managers with excellent communication, negotiation and technical skills to the movement from a specialized technical and professional engineering organization to a more generalist project and program management operation. Some of the surveyed agencies are hiring people from disciplines other than the traditional areas of planning and civil engineering for program purposes. This has led to the need to provide career paths for people in these new disciplines by broadening supervisory and management standards to make them eligible for senior jobs and by creating non-supervisory management professions.

Some of the challenges that surveyed agencies face are pay levels, ability to provide environments attractive to young or ethnic minority workers and the availability of qualified candidates. Benefit levels and ability to provide challenging work were not seen as major problems. Some innovative efforts taking place to recruit new workers are internships and co-op programs, pre-graduation hires, building relationships through career fairs, expanded scholarship programs and off-shore recruiting. Efforts such as expanded training, higher salaries, and work enrichment

have been used to retain workers. Surveyed agencies are attracting non-traditional workers mostly by rehiring retired workers and targeting recruitment and supervisory training to make the workplace more inviting to these employees.

Surveyed agencies reported that they are making efforts to develop skills in employees by in-house technical and supervisory/management training programs, mentoring programs and/or agency supporting for-credit programs. Educational institutions also have a role in meeting development needs mostly by offering courses for the agency followed by partnering in accessing and defining responses. Some institutions manage training programs or offer certificate programs. In order to encourage students to take an interest in transportation, math or science, surveyed agencies reported different activities ranging from speaking at schools, career and job fairs, to participating in the American Association of State Highway and Transportation Officials (AASHTO) Transportation and Civil Engineering Programs (TRAC).

Senior management and human resources professionals were reported to be the staff concerned with future workforce issues and charged with developing strategies to meet future needs.

The complete survey and survey responses can be found in Appendix B

Educational Institutions

Educational institutions were surveyed on challenges, enrollment, employment and program changes. Some of the serious challenges reported were the availability of qualified students, demand for broader training, and reluctance of students to continue in advanced degrees. The lack of interest in transportation careers and expanded course offerings were reported as challenges as well. To address these challenges, institutions have implemented changes in their planning programs such as offering graduate certificates, establishing dual-degree and interdisciplinary programs, controlling undergraduate enrollment, adopting entrance exams to identify deficiencies, and improving courses and financial aid opportunities. Civil engineering programs are also implementing ideas to meet challenges such as developing dual-degree programs with Urban and Regional Planning, finding creative methods to obtain student visas, and improving courses.

Surveyed institutions reported that compared to ten years ago they have about the same or more students, and they expect that in the next five years the number of students will remain about the same. The institutions that conduct post-graduation surveys reported that more than 25% of civil and planning bachelor-level graduates are employed in the transportation industry, and about 10% to 25% are employed in transportation agencies. The range of salaries at entry-level were reported to be more than $40,000 with a majority ranging between $40,000 and $50,000. The majority of institutions address the continuing educational needs of the transportation workforce by partnering with public and private sectors of the transportation industry. To meet those needs they have developed programs

ranging from interdisciplinary degrees and certificates, distance learning, extended hour and short courses tailored to transportation. About half of the surveyed institutions have implemented programs designed to encourage students at the K-12 levels to consider science and/or transportation related courses.

The complete survey and survey responses can be found in Appendix C.

Interviews

Telephone interviews were conducted to solicit information from state agency leaders with experience in dealing with workforce issues. Three were agency heads: Deb Miller, Rhonda Faught and Neil Petersen; from Kansas DOT, New Mexico DOT and the Maryland Highway Administration, respectively. Two were people involved in activities that represent the type of change that will impact the industry: Roberta Broeker, CFO of Missouri DOT; and Phil Russell, Assistant Executive Director for Innovative Projects of Texas DOT. The questions were designed to solicit views on areas of change and impacts of those changes.

All of the transportation leaders interviewed pointed to the need for transportation professionals with a broader array of skills. Desired skills include project management, general management, communications, finance, and interpersonal skills. All of these skills are needed in response to changes they have seen in the transportation industry over the past several years, change they expect to continue in the future. The interviews are summarized in Appendix D.

The workshop was designed to be fairly informal and interactive. Participation was by invitation. All participants received information on the surveys and interviews prior to the meeting. Three speakers provided basic information at the conference:

- Clark Martin, of FHWA, provided an overview of the transportation workforce, the current challenges facing transportation agencies to meet workforce needs and of the programs now in place at the federal level to help states in meeting those needs.
- Julius Rhodes, of Knowledge Bank, Inc., spoke about the changing demographics and ethnicity of the workforce and the challenges that those changes will bring.
- Teresa Adams, of the National Center for Freight and Infrastructure Research and Education, reviewed the changes that are taking place in the transportation industry and how those changes will impact the workforce of the 21st Century.

A panel of practitioners responded to the three presentations, providing their own views and experiences and beginning a discussion amongst the workshop participants. The panelists were:

- Roberta Broeker, of the Missouri Department of Transportation

- Leon Hank, of the Michigan Department of Transportation
- Van Walling, of Engineers and Scientists of Milwaukee
- Keith Hinkebein, of HNTB

A series of small groups then discussed the skills that would be needed as a result of the changes in the industry that the panel had discussed. The conclusions arrived at by the groups were reported and discussed.

These reports were followed by a panel of educators who spoke about the efforts that are now underway to address changing needs in professional education for the transportation industry. The panel was comprised of:

- Adjo Amekudzi, of Georgia Tech
- Tom Maze, of Iowa State
- Mark Vonderembse, of the University of Toledo
- Gen Giuliano, of the University of Southern California

Gaps between the needs and the efforts of the universities and possible institutional issues were the subject of small group discussions. After these were reported and discussed by the entire group, another series of small group discussions took place on the question of next steps: What should agencies, consultants and educators do to meet this need?

Workshop Presentation Summaries
Demographics
(Julius Rhodes/Clark Martin)

Our workforce is a subset of our overall population. Our birthrates were very high in the 1950's and 1960's. They have been declining since (See Figure 1). In the next decade, the group between the ages of 65 to 84 will increase 54% and will double by 2030; in contrast the group between 22-44 years will increase 4% and 10%, respectively. In the next ten years, the projected growth rate of employment will outpace growth of the participating labor force. Figure 2 is an overview of the generations and the impact that they have on today's workforce. The boomer generation was born at a time of high birth rates. As the boomers retire, people born in the 1970s and 80s, a time of relatively low birth rates, will replace them. This disparity in birth rates means that relatively fewer workers will be available in the future.

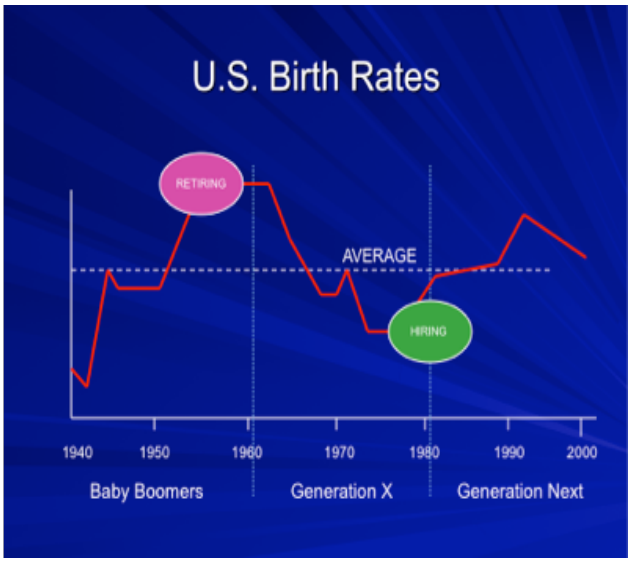


Figure 2 U.S. Birth Rates

Annual rates of labor force growth increased from 1.1% in 1950-1960 to 2.6% on 1970-1980. After 1980 the rate had been declining and it is expected that it will continue to decline reaching a 0.2% rate on 2015-2025 (See Figure 3). Participation of workers 55 and older will increase more than four times that of workers in the 25-54 category and the participation of workers aged 16-24 will decline because of decreasing birth rates.

At the same time, the nature of industry and the rate of change in industry, including the transportation industry, are sufficiently great that employers have to be more concerned about the ability of workers to maintain current skills. They might also be concerned about the ability of educational institutions to produce the professionals with the broad

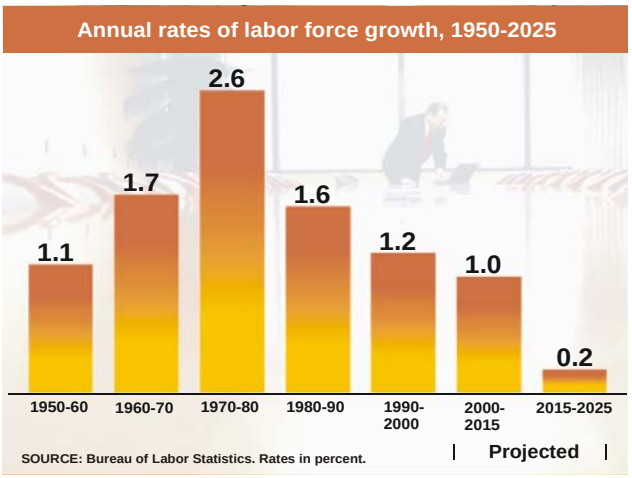


Figure 3 Labor Force Growth Rates

range of skills that might be required.

Older workers and those who are members of the generations that follow the boomers will probably have different wants and needs from their jobs. Workers who may be past normal retirement age may still want to continue working, but with reduced and more flexible hours. Members of generation X and Y will likely want jobs that respond more easily to the needs of family and non-work life (See Figure 4).

Baby Boomers	Gen X	Gen Y
Can use a cell phone, but don't know which way the camera points	Communicates with emails and is attached to a BlackBerry	IMs, thinks emails are old-fashioned
Overachievers for whom work is necessary and satisfying; achieved status and success, often at the sacrifice of a personal life	Hard workers, but unencumbered with status, free agents for whom employer loyalty is unimportant	Concerned about job security, money and status, but impatient with slow upward progress
Need little supervision and management; want more work-life balance, but struggle with it	Need supervision and frequent feedback; focus on work-life balance	Need supervision and immediate, personal feedback; need variety in work and require work-life balance

Figure 4 Generational Differences

Not only will the workforce will be older, it will also be more racially and ethnically diverse. In the next ten years, Caucasians will remain the largest participating race group but will have the slowest rate of growth. Participating Hispanic and Asian workers will grow six times that of Caucasians. Members of minority groups, who may have been under-represented in the transportation workforce, will have to be reached and made to feel welcome in the industry.

Changes in the Transportation Industry
(Teresa Adams)

Teresa Adams, CFIRE Director, outlined some of the changes that are taking place in the transportation industry. Technology is bringing about fundamental change in the materials and tools used in many aspects of the transportation industry. It is bringing changes in workforce and business processes as well. Changing public values and expectations and environmental concerns are altering the range of responsibilities placed on agencies and the processes used to meet those responsibilities. Changes are taking place in public sector transportation agencies in business functions, organizational culture, scope of concerns and emerging influences.

Engineering

In engineering fields such as construction materials, the industry has experienced a great deal of technical innovation (See Figure 5). For example, new pavement designs have led to the development of superpave, a durable rutting-resistant type of pavement. The use of geo-fabrics has increased for unstable soils and carbon-reinforced materials are showing promise for fast and low-cost structural repairs. In addition, plastic and plastic-like materials also show promise to replace some concrete and steel in structures which lead to reductions in time and cost. Construction techniques have changed; the need for rapid construction has brought prefabrication. Spatial information technologies have allowed construction equipment to be controlled by GPS reducing the need for surveying and speeding up the processes. New skills needed include intellectual curiosity, computer sophistication, stronger management skills and the ability to deal with economic and demographic information.

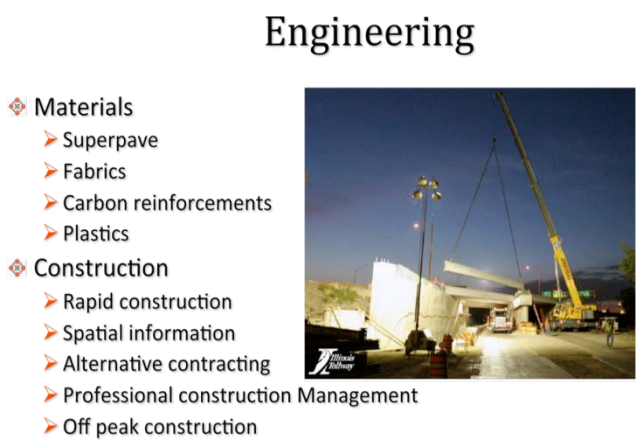


Figure 5 Changes in Engineering

Traffic

Congestion has grown significantly in recent years causing increases in delays (See Figure 6). This has inspired attempts to find solutions to the problem.

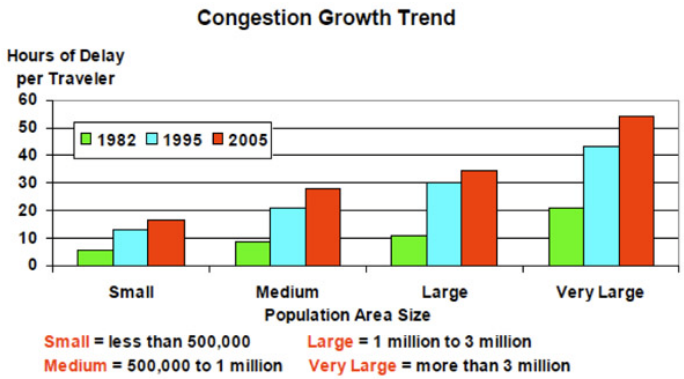


Figure 6 Hours of congestion delay

Traffic surveillance and management techniques are used to improve flow of traffic. In the future, greater interaction between the vehicle and the roadway can be expected to improve safety and reduce congestion. These changes require new skills such as approaching problems differently, electrical engineering, computer sciences, communication systems, human factors and creative traffic control.

Maintenance

It is estimated that in order to maintain current transportation systems all levels of government must invest $305 billion in 2015 and $430 million by 2030. On the other hand, in order to improve the transportation system to a level that benefits the nation's economic productivity, all levels of government must invest $368 million by 2015 and $561 million by 2030. It is expected that current revenue streams will fall short of these levels. *Maintain* means that pavement and bridge conditions and traffic levels of service will remain the same, on average and *improve* means that all additional spending on transportation systems will have a positive benefit/cost ratio and will improve economic productivity.

Maintenance innovations include the use of management systems that measure performance and public desire to improve levels of service. In winter maintenance, innovations with types of chemicals used had helped to reduce environmental damage while maintaining a high level of service. GPS-guided equipment will make blizzard operations safer. Agencies are challenged to improve management on right-of-way associated with highways by introducing indigenous plants, reducing mowing and chemicals and protecting habitats.

Planning and Design

In planning, spatial information systems have allowed the development of performance-based planning that had changed the structure of plans making them more service and outcome oriented. In addition, issues like environmental justice have also forced planners to develop new skills in analyzing demographic, economic and spatial data. In design, automation has eliminated much of the work of doing calculations and drafting and allowing more alternatives to be analyzed. Spatial information systems have allowed tridimensional designs, making them much more understandable in a transportation environment.

Financing

Reductions in public revenues forced greater use of alternative financing mechanisms. Recent federal rule changes have made tolling easier on federal aid routes and future changes are expected to make it still easier. In some cases, tolling has become a form of franchise or leasing agreements with private

Figure 7 Transportation Finance

companies. Variations on debt financing have also been introduced to speed projects and delay payments. Greater need of more efficient financial management has raised the bar for financial management (See Figure 7).

Economy

Figure 8 shows the relationship between investment in transportation and time, cost, reliability; productivity; and competitiveness. In freight this relationship is important since it can influence investment decisions. Investment in infrastructure has changed the face of the nation; it raises private rates of return. Transportation and logistics became more efficient in the United States over the past 16 years, as measured as a percent of Gross Domestic Product, but current trends are showing the opposite because of fuel cost and congestion which can hurt the nation's global competitiveness. The consideration of evolving global trade patterns, such as the emerging Asia-Suez Canal trade routes, is important to make accurate predictions on truck volumes and rail growth.

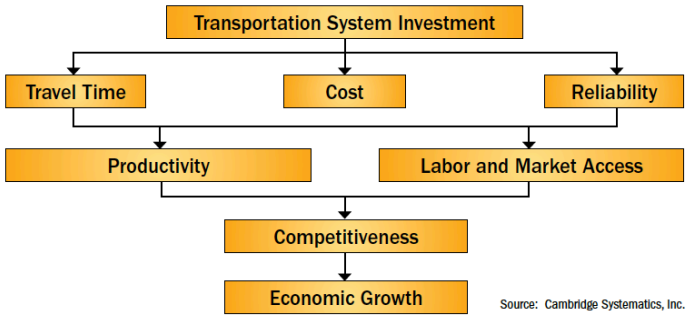


Figure 8 Transportation and the Economy

The growth of economically interdependent mega regions demonstrates the importance of a regional approach to planning and managing transportation and communications infrastructure. The ability to move products and information between them is critical. Multi-jurisdictional awareness and cooperation are critical for the success of a mega-region. The jurisdictions across the mega region share common cultures, economic base, workforce, expertise, infrastructure and natural resources. Success of the mega region is interdependent among the jurisdictions.

Environment

Regulations, cleaner fuel and engines are contributing to improve air quality. Addressing greenhouse gases that are causing global climate change is a major challenge; unfortunately there are no technological remedies. Transportation is one of the major producers of greenhouse

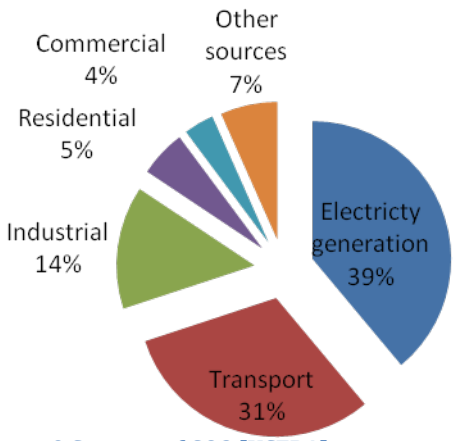
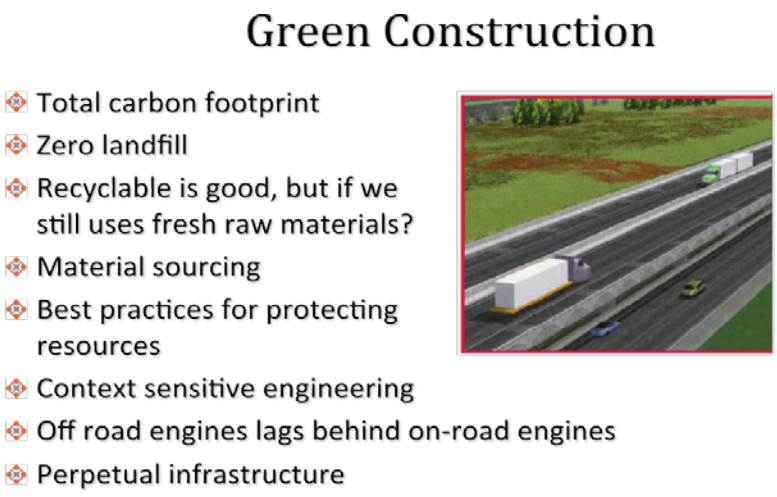


Figure 9 Sources of CO2 [USEPA]

gases; there are few initiatives to reduce the consumption of fossil fuels. System operational efficiencies such as open road tolling are an example of efforts on the issue. Lean logistics involves reducing shipment sizes with frequent deliveries. Green logistics consolidates shipments and reduces transportation by increasing inventory holdings. Alternative modes and alternative fuels are other initiatives considered to address the problem.

Another environmental concern of growing importance is the concept of *green construction*, which concerns itself with the carbon footprint of the construction operation, the impact on landfills, the use of recycled materials and the frequency of reconstruction needs (See Figure 10).



Accountability

The public and elected officials are increasingly asking the managers of all public agencies to make clear what actions are being taken with public funds and what policies guide those actions. The need for accountability and transparency has placed greater demands on the ability of transportation officials to measure and analyze performance and to communicate their findings to both external and internal stakeholders.

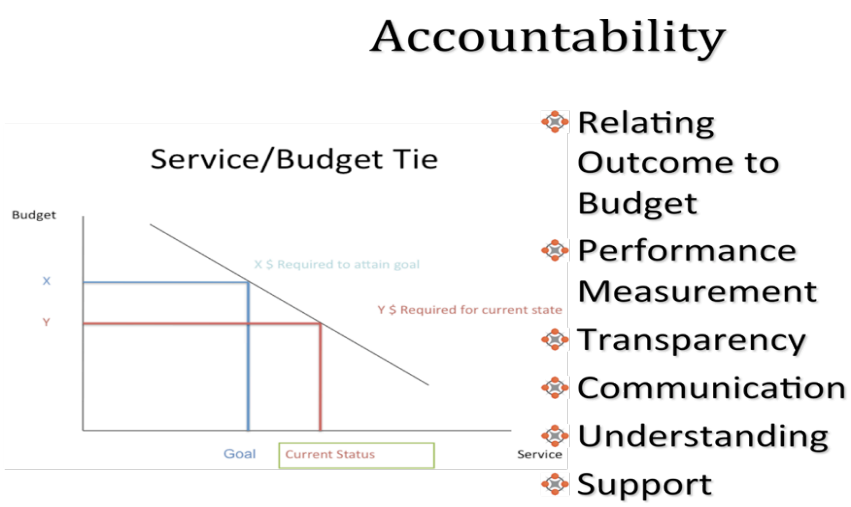


Figure 11 Agency Accountability

Panel and Breakout Discussions
Skills Required

A number of change areas in the industry will lead to the need for new skills. Panel discussions and break out groups identified a number of specific areas in which changes can be expected and how skills can be acquired and evaluated.

Accountability and Transparency

One such area was accountability and transparency, which has three critical skills: public communication and involvement, ethics and teamwork. The group reached several conclusions on these three skills. First, public communication and involvement skills should be acquired through general education, engineering communication classes and requiring more writing and speaking in engineering courses. Training of existing employees should be by the means of experience in the workplace, internal agency training, industry speakers, and media training. Performance should be measured by tracking improvement in engineering curriculum.

Second, ethics is not heavily emphasized in university curriculums. Ethical skills can be acquired, in addition to personal morals, through agency training programs, which might include role-playing and examples or case studies. Performance evaluation can be done based on the incidence of disciplinary actions and complaints of violations of ethics standards.

Finally, teamwork, which can deal with achieving common goals, dealing with problems and conflict resolution, can be acquired during high school athletics programs and college courses, which have already be changed in many cases to require team activities. Performance should be measured by peer reviews.

Finance

A second change area is finance. Some of the technical skills needed relate to funding, debt strategies, private equity, and accounting. Overarching skills such as consensus building, communication, project management and administration, and common sense are needed for future success. These skills can be acquired by experience, in cross-functional teams, training, mentoring, evaluating proposals from the private sector and researching what industry leaders are doing. The training and retraining process should be managed by linking strategic priorities to training, empowering staff to drive their career, indentifying core competencies, succession planning and talent management strategies. Measures can be developed to determine if the agency has acquired the appropriate skill sets such as operational measures of efficiency, high ratings by external reviewers, successful implementation of innovation and completion of training as a measurement of competencies.

Technology
A third area of change is technology. Like the previous areas, this also has some related skills for future success. To master this area, or at least to maintain needed skills, workers must be continuous learners and open to change. Examples of how this continuous learning could take place include integrating common software into class development, so that technology is learned incidentally to the primary leaning topic; integrating students into technology projects, so that learning is accomplished as projects are completed; and embracing a range of communication technologies, which both illustrate technologies and offer new ways of disseminating information. Learning how to manage based on results is another skill needed to deal with technology. It involves understanding results-based productivity, and mastering virtual environments in education and collaborative learning. Other consideration include:

- Devoting resources to technology
- Transitioning to technology by role studies and demonstrations
- Listening to technologically savvy people
- Learning from industry.

These skills can be acquired by working with industry or consultants, developing trust within establish boundaries and by not stifling creativity. The training and retraining process should be managed by constant exposure to technology, just in time training and learning by doing. Program evaluation and surveying customers are two of the measures used to evaluate if the agency had acquired the appropriate skill sets.

Sustainability and Smart Growth
A fourth area is the emerging concept of sustainability and smart growth. In sustainability, skills in materials, energy and interdisciplinary teams are critical. These skills can be acquired through university classes, in-house training, and mentoring. The training and retraining process can be managed by developing a matrix to determine levels of skills needed and what training is available. Performance evaluations tools include employee and customer satisfaction surveys and cultural assessments.

Economic Efficiency
A fifth area is economic efficiency, in which interpersonal relationships and technical skills are critical. Economic efficiency applied to the efficient movement of freight and people would require specific technical skills in economic theory, modeling, data analysis, logistic supply chain, financing, and community impact analysis, as well as an understanding of multimodalism. Interpersonal relationships will require knowledge in legislative processes and regulations, negotiation skills, marketing and how to deal with customers. University education, job training, professional development, short courses and seminars are routes to acquire these skills. The consensus was that most of the technical skills would come from the

universities by integrating them into undergraduate curriculums. Performance can be measured through customer and employee surveys and performance appraisals.

Lean and Green

A final change area that was discussed is lean and green, which deals with a wide range of environmental issues. Critical skills for this area are knowledge of environmental issues, ranging from green technologies to environmental economics; management; interpersonal relationships; the ability to speak with stakeholders and the general public; understanding public policy; project management; creativity; life cycle assessment; and critical thinking. These skills can be obtained from various levels of education and training and mentoring. Evaluation of skills in this area can be done similarly to how agencies review their green performance.

Educational Institutions' Efforts

A panel composed of a number of educators discussed their educational institutions efforts to refine curriculums to meet changing needs.

Georgia Institute of Technology has an institute of transportation that coordinates research and professional development for the state. It also has a University Transportation Center (UTC) that focuses on system productivity, economic development and finance. Prior to the 1980s, the university programs were focused on engineering operations, then in the 1980s and 1990s the emphasis was on planning, environment and policy, now the focus is on key issues such as climate change, mega regions, mega cities, sustainability through research and electives. The institute has a center for regional planning and quality growth as well. Graduate students need to take four core courses in statistics, transportation planning, traffic engineering and administration and policy analysis. Seminars, distance learning, co-op programs and internships are some activities held for training and outreach. Recently, they had developed the Transportation Engineers for the Future program where a company funds masters students for two years, and after graduation, they work for that company for same number of years.

Iowa State University has a UTC that deals with traffic, safety and management information systems. The center, along with the transportation programs of the university, is under an organization called the Institute for Transportation (InTrans). The university offers a Master of Science in Transportation where students take courses in three core fields: transportation engineering, community and regional planning, and transportation and logistics. Opportunities exist for joint programs as well. The undergraduate program is under pressure for students to complete their studies in four years. The enrollment is around 1,000 students, which makes it the 5th largest civil engineering program in the country. Co-op and internships are encouraged. The university developed the Highway Design Council, which, under the guidance of state agencies and regional consultants, evaluates how to make student experiences more compatible and consistent. This has led to changes in the software used in several of their courses. The UTC program in Iowa has helped graduate students to get financial support. The students are required to sign a contract that identifies the interdisciplinary classes they plan to take outside their program of specialization.

The University of Toledo in Ohio houses the Intermodal Transportation Institute, which has developed a set of relationships with other universities and other agencies. Their educational programs and approach to transportation are not driven by the university but rather by their partners in the region such as the local MPO, the ports authority, private carriers and shippers. The institute has designated a UTC, which deals with economic vitality, including alternate energy, infrastructure utilization, and supply chain management. The university offers programs in civil engineering, where all undergraduate students need to complete a mandatory co-op program of at least three semesters. On the graduate level, they offer programs in

fuel cell development as a part of their alternative energy efforts. Geography information systems and planning programs are available under arts and sciences. One of the UTC's efforts was creating a program in spatially integrated social sciences which is GIS-based and focused on transportation economic development. The business school has programs in supply chain and global supply chain management at both the undergraduate and graduate levels. A co-op requirement is under consideration for both of programs. They have added a supply chain management track to the Ph.D. program in manufacturing and technology management. The university has embarked on a process of reaching out to universities around the world for research and education to look at how educational programs and research is conducted in other countries to try and bring back the best practices from those universities.

METRANS is a joint partnership between the University of Southern California and the California State University at Long Beach. Their role as a research center is trying to influence what schools do in order to develop programs that are more relevant to what is seen in the transportation profession. Multidisciplinary degrees and new professional training have been developed in Long Beach. One of their recent interests is moving to a distance-learning environment for all their degree programs. Southern California is a research university that focuses on graduate programs. The center has created a transportation specialization composed of a core of electives available to all regular degree programs. A transportation certificate program is available for the master's degrees. Cal State,Long Beach is a teaching university that focuses on professional training. They have a masters program in global logistics. The university has a large civil engineering program that includes transportation, which is affiliated with a minority association that helps to fund students and do summer science programs to bring minorities to the civil engineering program. The professional training program at Long Beach started with a global logistics program, and currently has an extension services school that deals with the training programs. This professional development initiative has offered training workshops to agencies and elected officials.

To reach K-12 students, many educational institutions had implemented STEM (Science, Technology and Engineering and Math) programs to increase interest and attract qualified students to the fields of engineering, including transportation. During the summit, several representatives from educational institutions discussed efforts focused on K-12 students. Teachers are being trained to implement "Project Lead The Way" programs in their schools that are getting students interested in STEM areas.

California State University at Long Beach has implemented programs focused on minorities to encourage them to get interested in engineering. On Saturdays, CSU faculty members travel to high schools in need to provide instruction. Students who perform at a certain level are guaranteed entry into CSU's engineering program. The University of Southern California receives minority students from all age groups all summer long for two-week sessions providing instruction in the sciences, including

engineering. They also have a program aimed at students graduating from sixth grade in which students have a guaranteed scholarship for four years at the University of Southern California if they maintain their grades to qualify for entry. Mentors work with these students all the way through junior high and high school.

The University of Minnesota has implemented web-based programs to get high school students involved in tackling transportation problems. They have also worked with a curriculum developer to create transportation-related curriculums that could get incorporated into senior high and junior high school academics. In addition, they have partnered with a number of urban schools to bring students on campus for tours. Their K-12 efforts are growing thanks to their UTC funding.

Gaps between Required Skills and University Efforts

Group discussions following the panel discussions dealt with specific gaps seen between the skills required and the efforts of the universities.

Educators said that their programs emphasize communications. Some require a co-op experience. Others try to incorporate communications into their regular courses. They noted that it was difficult to dedicate enough time to the topic to develop student confidence. The gaps can be closed by mentoring, having speakers in classrooms, use of career services, requiring more writing in the curriculum, by encouraging co-op experiences and by encouraging students to take ownership of developing their communication skills. Training of existing professionals can be addressed by internal training at organizations, incorporating the topic into performance evaluations and encouraging participation in organizations like the Toastmasters club.

Educators also said that their programs have mandatory courses on project/program management and their capstone courses have management components. Some concerns expressed were the complexity of transportation challenges, which require management and strategic skills, and that management skills are required earlier for the new workforce. Demands for management training and basic management skills such as supervision, planning, scheduling, budgeting and planning are not currently being met. Including project management courses in transportation programs and requiring transportation capstone courses that integrate project management and public involvement are two ways that the gap can be closed. Another measure is offering seminar series, or luncheons, in which industry and agency leaders present and share real world experiences. American Association of State Highway and Transportation Officials-like leadership programs, State DOT management activities, university management programs, and management training orientations are ways to train existing professionals.

Conflict resolution was another area discussed. The group noted that there are not required courses in conflict resolution and as a result students have limited exposure to these skills in their formal educations. The gap can be closed by experiential opportunities in the field, potential performance bonuses, collaboration with other departments, and a genuine effort on the part of DOTs to embrace and practice these skills with mentors or other seasoned officials. This knowledge transfer is critical for organizational success.

Educators mentioned that ethics, another of the skills discussed, is not addressed in universities. Recommendations for closing this gap were bringing businesses and agencies into the classroom and bringing ethics courses to the engineering curriculum from business school. Ideally such courses would use transportation-specific case studies on ethics. Mandatory annual training and professional development may be needed to train existing professionals.

Next Steps

Five areas were defined as the next steps needed to address the workforce issues. They are professional development, partnering, recruiting and retention, research and change leadership.

1. On professional development, the group determined that creating a clearinghouse to leverage existing resources, and creating a matrix of needs, course offerings, expertise and resources are ways for the government agencies and private sector to work with universities and professional organizations to provide high quality and relevant non-credit continuing education. Some of the institutional issues that must be addressed to make arrangements work better are home state issues, standards, evaluations and competition.

   Funding and travel cutbacks are obstacles that must be overcome or minimized to make professional development better. Other issues that must be considered are distance learning, university networking for collaboration, and AASHTO's role for ongoing communication among state DOTs.

2. Another area of discussion was partnering. Some of the benefits that partnering arrangements between agencies, educational institutions and the private sector could bring about are better understanding of desired outcomes, less duplication of efforts, greater efficiency, better relationships, improved understanding of organizational constraints, and practical opportunities for students, faculty and practitioners to expand their experiences.

   Several obstacles to such partnerships range from time, funding and staff resource constraints, to access and communication. There are several models for this type of partnerships such as the FHWA Peer Exchange, the Partner of Innovative Efficiencies program, and university-level advisory boards. The group agreed that University Transportation Centers should have a role in establishing partnerships through Local Assistance Technical Programs and outreach education. To build partnerships, UTCs should work with AASHTO to identify data needs, develop design and research models for effective partnering, and to collect data related to student graduation.

3. On recruiting and retention, getting students interested in the science professions, then attracting those students to transportation, and then keeping new professionals in transportation are three related challenges. Strategies for attracting more qualified students to the fields of math and science in the K-12 setting include curriculum-based programs, the AASHTO TRAC program, extracurricular programs, career days, take your child to work days, classroom speakers, field trips, counseling/career services and project-based public information efforts. For attracting quality students into

transportation fields the effective strategies are internships and co-op programs. The public, private and educational sectors should take several actions to maximize impacts such as publicizing positive results, focusing on a long-term approach, and assessments to measure results to ensure effectiveness.

Primary obstacles to keeping professionals in transportation are geography (moving out in order to move up) and funding. To overcome them, actions such as continuing support for public funding of infrastructure investment, providing professional development opportunities and more progressive work environment practices should be considered. Other actions are hiring employees with broad-based skill sets, analyzing real job duties and matching those with appropriate job classifications, and non-compensation based incentives such as flexible schedules.

4. Research can help to identify current and future workforce needs and help to develop innovative approaches to meet those needs by surveying employers, measuring awareness of transportation careers at K-12, tracking demographical trends within agencies, indentifying curriculum changes, and determining if graduates have the necessary skills. Some specific questions that need to be explored are if current topics are being taught in undergraduate and graduate courses and if K-12 students are aware of transportation careers.

   Research should be in the form of longitudinal tracking. An example would be interviewing students and employers one year after graduation. Research results should be communicated in publications such as American Society of Civil Engineers (ASCE), AASHTO and National Highway Institute (NHI), in best practices documents and in workshops. Other issues in the research area are the timeliness of the data and how effective magnet K-12 schools are.

5. On changes in leadership, some of the organizational changes that are required to address workforce issues in the future include having a strategic decision process that includes all of the stakeholders in the transportation workforce, investing in workforce development, communicating effectively the missions of organizations, committing to working with partnerships, promoting the transportation profession and having senior leadership in workforce development.

   Developing a culture that encourages leadership, empowering staff, building a change management mentality throughout the organization and educating leaders are several efforts that should be made to better equip transportation leaders to lead change.

   Institutional issues that should be addressed to make dealing with change in

transportation easier are supporting leaders across the organization, creating an environment supportive of innovation, creating effective communication plans and emphasizing that leadership embraces the need of change. To help transportation professionals to adapt more easily to change, some efforts should be made to demonstrate that change and innovation help position the organizations for the future.

Implications for the Wisconsin Department of Transportation

The Wisconsin Department of Transportation (WisDOT) is experiencing many of the same workforce issues described in this document. Its workforce is aging. As the baby boom generation retires, much of the experience of the agency will leave. Twenty-two percent of the agency's 3,349 permanent employees will be eligible to retire within the next five years. The workforce in Wisconsin is changing in much the same way as the national workforce. The minority component of the working population will grow in absolute terms and as a percentage of the total workforce over the next decade. The generations that replace the boomers will require different support and compensation from their employers. They will want greater flexibility and more time for non-work activities. Wisconsin schools are not producing the numbers of graduates in engineering and the sciences as will be required in the workplace, and the availability of foreign students to supplement those American-born engineers and scientists will be more limited than it has been in the past. Finally, WisDOT is experiencing the same pressures for changed services and practices in transportation as the balance of the nation. A workforce that is technically competent in a fairly narrow discipline will not longer meet the needs of Wisconsin transportation users.

Wisconsin does have a number of tools and opportunities available to it to meet the impending challenges.

1. Wisconsin offers a quality of life that is attractive to future workers. The combination of the outdoor recreation assets of Wisconsin and its attractive urban centers should make it competitive with other employers. Moreover, the proximity to major urban centers in Chicago and the Twin Cities serves to complement the state's quality of life.

2. WisDOT has historically taken an active role in promoting science and math in the K-12 public schools. It has taken part in AASHTO's TRAC program and sponsored summer camps for young people who might otherwise not have had the opportunity to learn about the potential career opportunities in science, math and engineering. In Southeast Wisconsin a very active group, the Engineers and Scientist of Milwaukee, has taken a leadership role in promoting science and math in the public schools. WisDOT intends to increase its efforts in this area and work to strengthen partnerships that will promote careers in transportation-related fields to young people. WisDOT will be conducting its first annual Wisconsin Transportation Expo directed towards fostering interest in transportation among middle schoolers.

3. The UW-Madison offers a certificate program in Transportation Management and Policy (TMP). Graduates with this certificate have been encouraged to take a broader view of the skills needed in transportation. WisDOT has been a participant in the program, with many staff members taking part in class discussions and projects. WisDOT has not been particularly successful in

hiring TMP graduates. It might want to consider strengthening its relationship with the program by offering work experiences for these students beyond the traditional classroom arrangements.

4. WisDOT also has ongoing relationships with other parts of the UW-Madison and with UW-Milwaukee, Platteville and Superior and with Marquette University. It may want to review these relationships in light of the impending workforce challenges and consider strengthening its practices in offering internships and similar work experiences. The goal of this review should be to ensure that students who take part in these work experiences finish with a positive view of the agency and have a solid learning experience.

   Options WisDOT could use to a greater degree to make potential employees familiar with the agency are graduate student internship or project assistantship agreements with the UW system and other state institutions. For short term (semester long) appointments, WisDOT has some experience with departments that encourage or require internships, such as UW-Madison's Department of Urban and Regional Planning or the Transportation Management and Policy graduate certificate program. Alternatively, the department could satisfy longer term needs (one to three years) through project assistantship agreements, under which graduate students work part-time in WisDOT offices and bureaus while receiving support for their education. Students from the La Follette School of Public Affairs and Department of Urban and Regional Planning at University of Wisconsin have worked in Department bureaus including Planning and Economic Development (BPED) and Transit, Local Roads, Railroads, and Harbors (BTLR).

   These arrangements offer students valuable exposure to transportation planning and policy issues, as well to public sector decision-making environments. Moreover, students can bring their classroom experiences and outside research to support WisDOT work efforts, including long-range planning and American Reinvestment and Recovery Act (ARRA) management activities. One challenge associated with this strategy is the short term nature of the appointments; limited funding and other issues may prevent WisDOT from retaining student employees after contract expiration or graduation. In addition, it is difficult to secure funding for assistantships in the current climate of personnel reductions. Costs of tuition remission and associated benefits also present obstacles to expanding the programs beyond 1-2 students at a time.

5. Some of the state's vocational schools have also had solid relationships with WisDOT, largely in the training of civil engineering technicians. Again, a review of these relationships with a view toward meeting future workforce needs may be appropriate.

6. In light of the changing generational and ethnic makeup of the workforce, WisDOT may find it useful to evaluate itself as an employer in terms of its practices that may or may not be attractive to future workers. Does it offer the degree of flexibility that might be desired? Does it offer a work environment that new workers will find satisfying?

7. WisDOT has had a close relationship with the private sector on issues related to research, technical processes and standards. It may want to consider broadening those relationships to include workforce development and retention. Since private companies do much of the work of WisDOT, it shares an interest with those companies in developing the total transportation workforce.

8. Finally, direct compensation does matter. WisDOT will have to work to ensure that its total compensation package remains competitive with private companies and with other states.

Attention to these challenges may help WisDOT to be successful in the workforce challenges that it will face over the next decade.

Appendix A
Planning Committee

Teresa Adams, CFIRE

Jason Bittner, CFIRE

Jody Bohn, North Dakota State University

Lea Ann Curtis, Kansas Department of Transportation

Betty Deakin, UC Berkeley

Karen Glitman, University of Vermont

Leon Hank, Michigan Department of Transportation

Bob Johns, University of Minnesota

Tammy Kirschenbauer, Michigan Department of Transportation

Micki Knudsen, Missouri Department of Transportation

Rachel Livengood, Ohio Department of Transportation

Randy Machemel, University of Texas, Austin

Clark Martin, FHWA

Joetta Parker, Michigan Department of Transportation

Randy Sarver, Wisconsin Department of Transportation

Ronald.Scott, Missouri Department of Transportation

Denver Tolliver, North Dakota State University

Pam Tschida, Minnesota Department of Transportation

Dan Turner, University of Alabama

Melissa Tooley, Texas A&M University

Greg Waidley, CFIRE

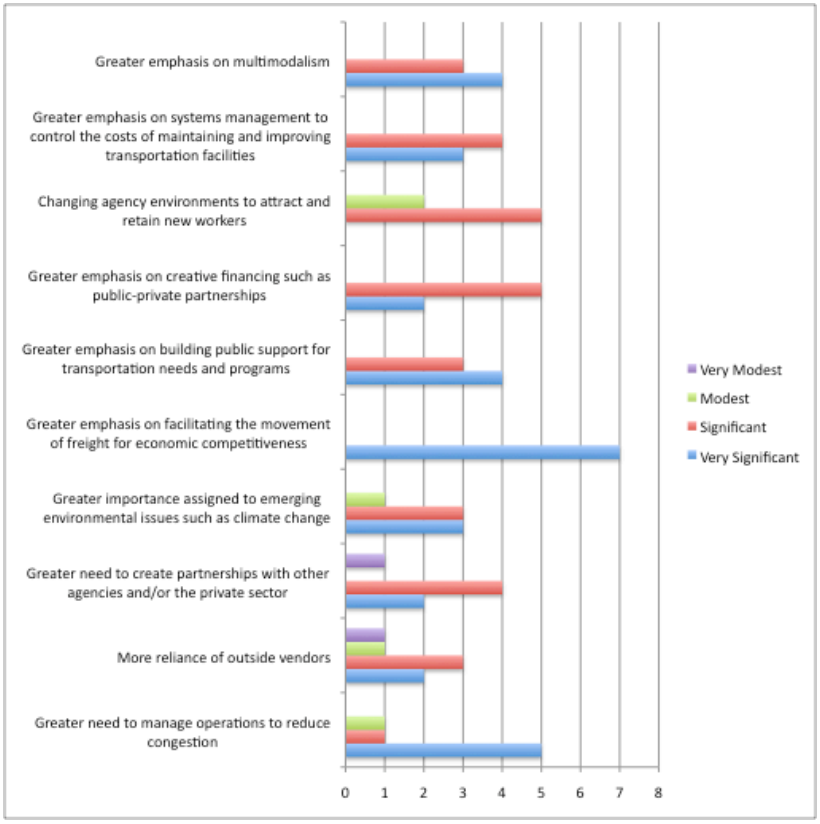
John Webber, Illinois Department of Transportation

Lee Wilkinson, Iowa Department of Transportation

Ernie Wittwer, CFIRE

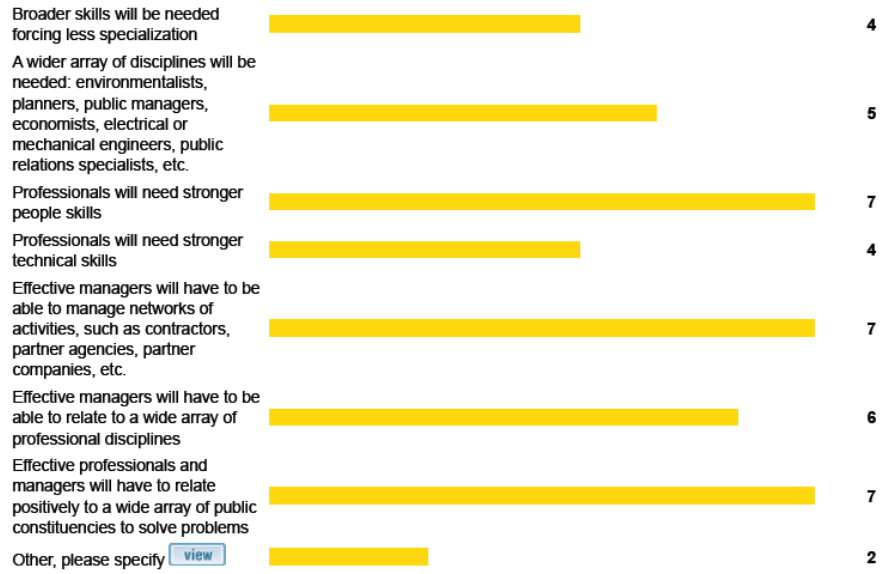
Appendix B
State Survey

1. Which state transportation agency do you represent? IA, IL, KS, MI, MO, OH, WI
2. What changes do you foresee in transportation needs and/or program operations over the next ten to twenty years?

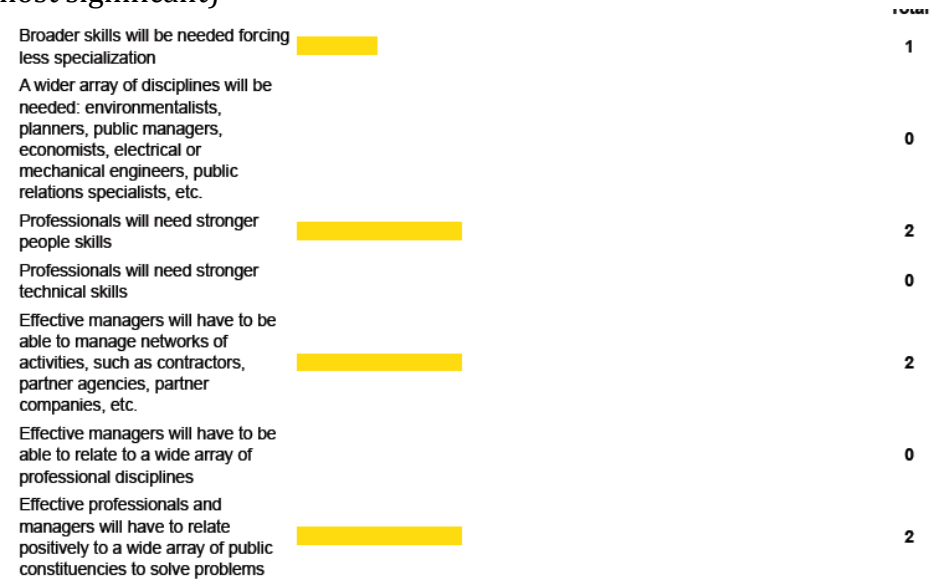


3. If you selected "Other" in question 2 as anything but "Very Modest Change", please describe in detail. No responses.

4. How will these changes affect the skills required in your workforce?



5. How will these changes affect the skills required in your workforce (pick the most significant)



6. How has greater outsourcing changed the skills required in your agency?
   - Our project managers must have excellent communication and negotiation skills. They must have the technical skills to ensure work is done correctly, and the communication skills to work with the contractors and consultants to get the work produced effectively and efficiently.
   - We're moving from a specialized technical and professional engineering organization to a more generalist, project or program management orientation that requires technical expertise with a broader ability to

adapt, learn on the fly, manage people more effectively, and handle multiple tasks or projects simultaneously.

- The Iowa DOT has hired outside consultants in the past. Recently there has been no significant changes in the skills needed because fo the use of consultants. However, there will be in the future resulting from more need in specialized areas [e.g. finance. planning, environmental (climate, clean-air) and increased regulatory/compliance).
- Greater use of design/build practices in Missouri has impacted the skill sets necessary to manage projects.
- There is more of an emphasis on contract management, which is a different role in overall project management. This results in a concern over the loss of technical skills/knowledge.
- We are not currently increasing our outsourcing. We are in fact trying to bring more work back inside. So, that forces us to focus on our EIT program to ensure that we are developing a continuous stream of new talent.
- We need more general skills as well as the ability to manage people and projects.

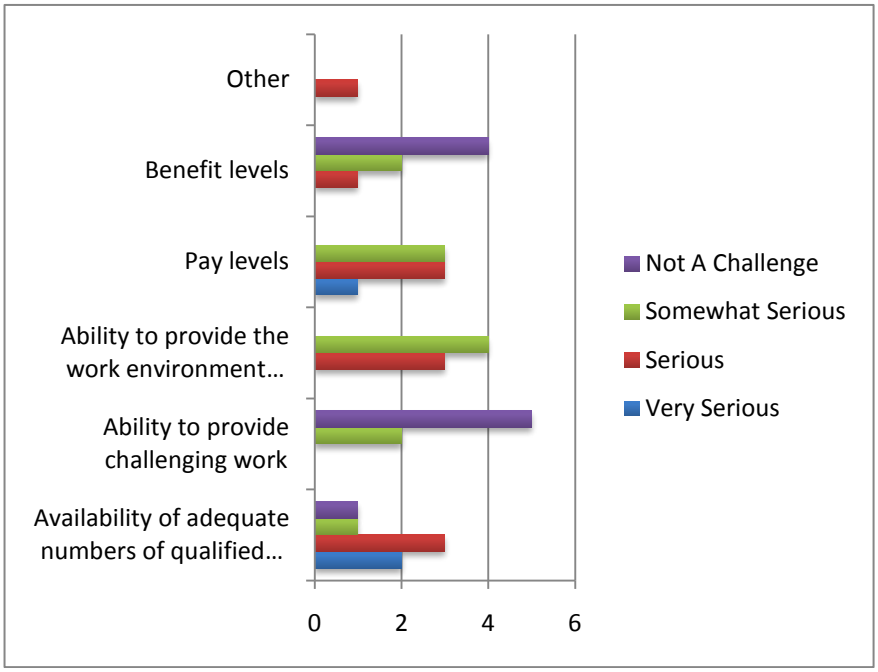
7. Has your agency hired people from disciplines other than the traditional areas of civil engineering, planning, IT, etc. for program purposes?
   Three positive responses; four negative

8. What steps has your agency taken to provide career paths for people from these new disciplines? (pick all that apply)

9. Has your agency hired electrical, mechanical or environmental engineers for program purposes?
   Five positive answers; two negative

10. What steps has your agency taken to provide career paths for people from these new disciplines? (pick all that apply)

11. What challenges does your agency face in recruiting, hiring or retaining qualified workers?



12. If you selected "Other" in question 11 as anything but "Not A Challenge", please describe the challenge in detail.
    - The ability to incorporate minority and female candidates with the state's absolute veterans preference law and meet the skills requirements for a predominantly professional and technical engineering organization.
    - The perception of state government as an employer of choice creates serious challenges. The current economic situation for the state is resulting in the inability to fill vacancies and extreme workload for existing staff. There is also little to no travel allowed for professional development.

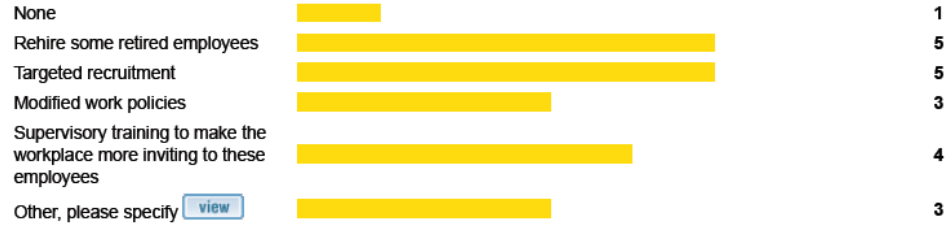
13. What innovative or extraordinary efforts are now being used to recruit transportation workers?

14. What innovative or extraordinary measures are being taken to retain workers?

15. Has your agency made any efforts to attract and retain foreign students or nationals?
    Two positive answers; five negative.

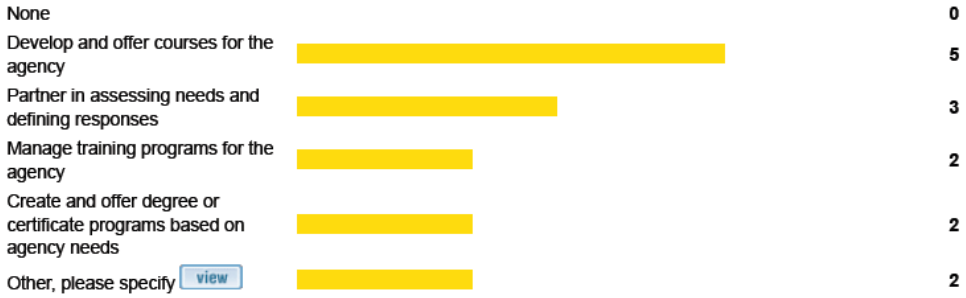
16. Please briefly outline the steps you have taken to attract and retain foreign nationals.
    - More aggressive recruitment of engineering or technical students in Puerto Rico and other Latin American countries as well as among Asian and African students studying in the United States.
    - We have made limited attempts to sponsor employees on H1B1 visas. This process was extremely time-consuming and complicated. It did not prove to be a worthwhile effort.

17. What efforts has your agency made to attract non-traditional workers: older workers, ethnic minorities, people who may desire non-traditional work schedules?



18. What employee development efforts does your agency use to ensure that employees have the skills needed for today and tomorrow's requirements?

19. What role do educational institutions in your state have in meeting development needs?



20. What efforts has your agency made to encourage students in K-12 to take an interest in math and science or transportation?
    - We have a large outreach program that includes speaking at K-12 schools throughout the state. We also partner with the Science Expo held at Ford Field every year. We have a strong TRAC program that partners with schools to teach science and math modules. Teaching those modules give teachers continuing education credits.
    - More career day opportunities hosted by Illinois DOT; more job fair appearances at schools and other secondary school presentations designed to let students know about job opportunities for engineers and technical professionals in transportation.
    - We have not had any organized efforts at this time. However, interaction with secondary education students is being discussed as a part of our recruitment plan.
    - Participate in TRAC program with numbers schools in Missouri, engaged in local chamber Partners in Education program with local middle schools, offer speakers bureau that includes time in local schools, participate in AASHTO National TRAC Bridge Competition with middle school children.
    - TRAC Program, Take Your Children to Work Program, Green Bay Career Expo, Program in Aviation
    - We've done some work with colleges and universities that target high school age young women interested in engineering. It has been limited.
    - STI participation, High School Career Fairs, Bring Your Child to Work Day, iBuild Construction Career Days, Job Shadowing for High School Students and undecided college students

21. Who in your agency is primarily concerned with the future workforce issues?

22. Who in your agency is primarily charged with developing strategies to meet future workforce needs?

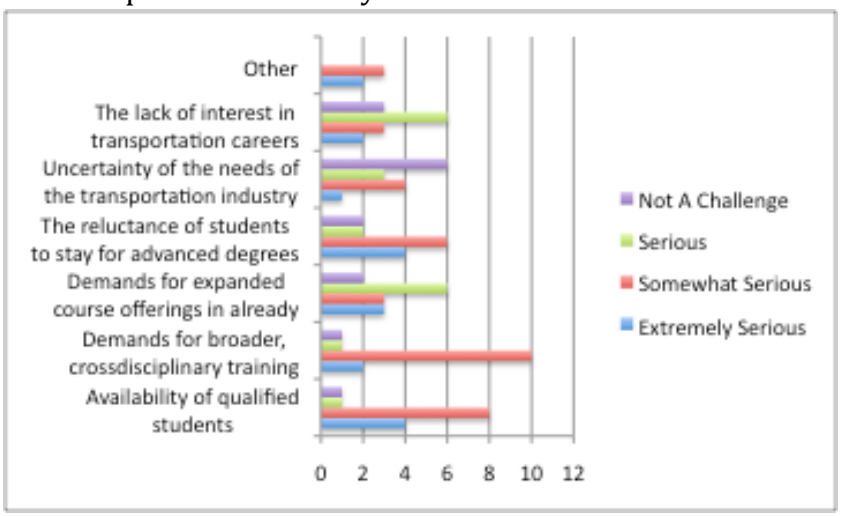
23. What other insights would you offer on the topic of the 21st Century workforce, how to build it, recruit it, develop it, and retain it?

- Courses that focus on moving goods and people effectively and efficiently. We must expand the classes to include more than technical aspects of building and maintaining the infrastructure. We must include looking at a larger picture and planning for the future.
- Emphasis on general management abilities and the ability to adapt management technique based on the job at hand, as opposed to hiring based on something like a professional engineering requirement for a management job that may not actually need an engineering degree and certification.
- There will be a need to utilize technology that people entering the workforce understand and use for communication in order to recruit them to our workforce. We will also need to look at the changing needs of the workforce (flexible work schedules, use of technology [facebook, blogging, avitars, twittering, etc.], balancing work and social life, etc.). Limited English proficiency will become a greater issue relative to the need to communicate with an expanding Latino community. A stronger awareness and understanding of financial and contract management will be needed at lower levels in the organization. Integration of contact sensitive solutions including a greater awareness by staff of cultural, historical, environmental aspects and relationships.
- Continued application of innovation is critical to the future of transportation. Younger generations demand and quickly adapt to technology change and innovation and incorporate it significantly in day to day life. DOTs must adjust accordingly to keep pace in order to attract and retain future generations entering the workforce.
- Flexibility in schedule, pay and benefits; upward mobility has been limited by downsizing of management positions; use of effective knowledge transfer and succession planning techniques to deal with attrition;
- I think that HR professionals must educate the management team about the importance of work process analysis not just as a tool to classify a job but as a business tool that can result in efficiency and economic gains as it relates to the types and number of staff needed. Additionally, HR professionals must be engaged and participate in the operational side of the business in order to provide the best advice and guidance to ensure the Agency can attract the types of employees that a proposed change in operation would require.
- Being open to new strategies is important. We will need to replace a fifth of our workforce over the next few years. Attracting more young people to Transportation careers is critical

Appendix C
Education Survey

The survey was sent to all UTCs and the major non-UTC institutions in the region. Fourteen responded.

1. What do you see as the challenges involved in preparing students for careers in the transportation industry?



2. If you selected "Other" in question 1 as anything but "Not A Challenge", please describe the challenge in detail.

- Students trained in engineering often have very little experience in thinking independently. They can do problem sets where the problem is defined for them but they don't do well at messy real world problems. Where part of their job is figuring out how to clarify the problem so they can do something with it. They also are not sufficiently trained in writing! Students trained in other disciplines often have too little math to do graduate work in TE easily.
- Post-911 Visa restrictions for international students, many of whom are extremely qualified.
- Many of the students entering from high school do not have a good foundation in math, science and communications skills.
- Salaries are depressed because of the strong influence of the public sector.
- Lack of understanding about what transportation is and how broad it is.

3. What changes have you made to your planning program to meet those challenges?

- Not enough! The joint TE-CRP program has been reasonably successful at improving the skill sets of each subgroup of students.

- Graduate Certificate in Transportation, Dual Degree between MS CE and M Urban and Regional Planning
- Established undergraduate enrollment controls re: demands for expanded course offerings in already crowded undergraduate programs.
- We are considering entrance exams to identify deficiencies and provide the student with a corrective action plan. We are also encouraging professors to raise the level of these skills in the classroom. We are also considering the addition of a class focused solely on engineering analysis techniques in the sophomore year.
- Attempted to make planning courses more quantitative and more computer intensive.
- We are trying to engage the faculty in a more forward look into the future. It is challenge to motivate faculty as many see "as is" situation as being fine. What is the problem?
- Interdisciplinary fellowships
- We have a new interdisciplinary program in bioregional and sustainable planning that includes an important transportation component.
- Addition of transportation planning course and expansion of another course. Active recruitment of students into Masters program. Currently revising curriculum to focus on planning and business applications.
- A broader overview of material to meet a wider array of student interest.
- More recruitment and financial aid
- Increased number of faculty, developing additional courses related to land use, transit, non-motorized transportation. Offered interdisciplinary graduate certificate program and interdisciplinary transportation student organization.

4. What changes have you made to your civil engineering program to meet those challenges?

- Graduate Certificate in Transportation, Dual Degree between MS CE and M Urban and Regional Planning
- Dual degree MS/MUP program with urban planning; deeper and more rigorous senior design capstone experience; raised freshmen admission standards; ABET "outcomes" have a broadening effect on all civil engineering programs.
- Offer top potential graduate students higher pay to entice them into our graduate program, use creative methods to get students Visas
- We have and are continuing to review every engineering course to ensure that prerequisite courses prepare students for the follow on courses.
- Have more courses taught by Civil Engineering rather than farm them out disciplines where they may learn the technique but not the application. We have also tried to make our classes more consistent with industry, for example, we switch to the CADD software more common used by road

designers in our highway design class. We also plan more importance on business processes and economics.

- We are starting to integrate more industry-based adjuncts to help fill the gap in the university and practice.
- Not many.
- We are conducting several research projects to learn more about outcomes and understandings required for students. We are also co-hosting a national conference in 2009 on the introductory undergraduate transportation engineering course.
- Different courses, more breath and less depth in entry-level courses.
- Not aware of any.
- Offered continuing education courses for topics such as construction management that may not be covered in undergraduate. Offered interdisciplinary graduate certificate program. Offered weekend masters program in infrastructure systems for practitioners and interdisciplinary transportation student organization.

5. What are the enrollment trends for transportation students compared to ten years ago?

6. What do you see enrollment to be in the next five years?

7. Have you done any post-graduation surveys of your civil or planning students?

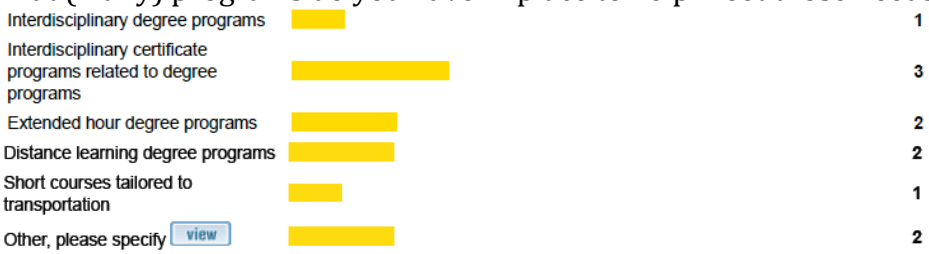
8. What proportion of your civil and planning graduates at the bachelors level are employed in the transportation industry?

9. What proportion of your civil and planning graduates at the bachelors level are employed in the transportation agencies?

10. What is the range of salaries for an entry-level professional with a bachelor's degree?

11. Are you a formal partner with the transportation industry - public agencies and private interests - in meeting the continuing educational needs of the transportation workforce?

12. What (if any) programs do you have in place to help meet those needs?



13. Has your institution established programs at the K-12 levels to encourage students to consider classes that will prepare them for careers in science and/or transportation?

- Not in any big way
- Yes, don't know details, check with CTS at U of Mn.
- No, but we are discussing such a program with the state DOT
- No.

- We have started a pilot program in a local high school to allow students to take an introduction to engineering.
- The college and the transportation center both run a high school career fair.
- Not anything formal.
- Yes Summer Transportation Institute
- In progress.
- No.
- Nothing formal; participate in Project Lead the Way and other student activities.
- Yes, participate in FHWA's NSTI program. Assisting Garrett A. Morgan grant recipient with Baltimore City Schools.
- We have developed course material and web tools for high school teachers to use in teaching about transportation

14. What other insights would you offer on the subject of preparing students for careers in transportation?

- The idea that civil engineering is a prerequisite for a career in transportation needs to be reconsidered. Increasingly the skills needed are planning, oral and written presentation, public outreach, management, economics and finance AS WELL AS engineering. Within engineering, computer sciences, electrical and mechanical engineering, operations research, and broader systems engineering are all relevant. Not everyone needs to do everything, but students need a broader education than most CE programs are providing. The CE curriculum is too chocked full of CE skills courses to give our students the broader education they need and deserve.
- The industry needs to pay more if it wants more and better students. The industry should reward graduate degrees more or it will not get skilled workers. The Midwest is especially cheap compared to salaries on the East and West Coast.
- Salaries need to be higher, especially at the state DOT, to compete with other areas of engineering. High school preparation is math is well below adequate for many students.
- Transportation is not a "sexy" career path for high schoolers. In fact, most don't even have a clue what transportation professionals do. Exposing high schoolers to the basic tasks of a career in transportation is necessary to boost our enrollment.
- Don't just concentrate on college and university ed; consider post secondary tech training too
- First we need to recognize that transportation needs include a wide variety of disciplines including engineering, geology, biological sciences, social science, business, etc. Unfortunately, we never teach students to work with other disciplines. The get their first taste when they enter the

work force. Discussion with industry reveals that students are accelerated into leadership positions far faster than the past. Consequently they are asking for students be provided leadership training in the undergraduate program. This does not necessarily require additional courses, but perhaps requiring leadership in the classroom.
- We have far too many transportation graduate programs competing for a smaller number of students. We need fewer transportation graduate transportation opportunities. Four (or more) in Wisconsin and three in Iowa is nuts.
- We need a better marketing message to connect with young people. We have to get off the engineering data case for the need and more beyond this.
- Understanding it is more than highways and building.
- Link study of transportation to issues of economic development, energy, and environment, as well as to computer science and other technologies, areas in which students may already have more of an intrinsic interest. Encourage development of skills in a variety of areas.
- Need to reconsider the traditional undergraduate curriculum for transportation students.
- Partner with transportation agencies to offer paid internships
- Students are influenced by job demand. Low salaries by public agencies hinder the recruitment of students to the field of transportation.

15. How can we improve the workshop?
    - Not sure. I am sure you will do a great job.
    - Recognize the obvious.
    - Don't know what you intend. Obviously, you should not ignore the role of secondary education as a critical link in the chain.
    - Invite CEO's who use transportation students to discuss their needs both in numbers and skill sets.
    - Allowing more schools to specialize rather than each state university having to do every thing for that state.
    - Have a blend of leaders from K-12, university, and practice side. These are three different cultures.
    - Discuss ways to establish stronger links between educational institutions and public agencies/private firms involved in transportation.
    - Consider educational and career paths of those considering, entering, or already in transportation professions.
    - Identify specific discussion topics and kept it focused.
    - Not familiar with your workshop, but put emphasis on internship opportunities
    - Disseminate results widely

16. What advice would you provide a student to prepare them for the career path?

- Take a broader set of courses than you are required to take. Make sure you have economics, statistics, history, maybe some political science or sociology as well as engineering courses. Learn to write. Do an internship or several with public and private agencies.
- Transportation is a mature sector that will give you a nice stable upper middle class income. The industry is so slow and static do not expect major changes on the infrastructure side compared to other engineering disciplines.
- Basics: writing and math.
- Focus on getting a well-rounded transportation education with some amount of co-op/internship experience mixed-in. The job market for transportation professionals is slow right now and may continue to be as gas tax revenues decline. Therefore, competition for entry level jobs will likely increase. Thus, it is important to be known and visible with your professors who often are asked by employers for potential candidates for jobs and for reference calls.
- Which specific career path?
- Develop not only the technical skills but also the people skills including communication and leadership skills.
- Go into a field of engineering other than Civil if you want a good chance at a good salary and respect in your job.
- Teach them what it means to be a professional. Expose them to enrichment experiences as part of undergraduate education...travel abroad, research, student organization and leadership, and practical experience via internships.
- Read policy documents - interdisciplinary advisory committees
- Develop knowledge in a variety of areas related to transportation in order to be conversant in policy, planning, economics, engineering, finance, analytical methods, etc., and also develop expertise in at least two specific areas.
- Develop core skills -- quantitative, technological, and written and oral communication.
- Be broad and capture several interests.
- Find out about all of the aid and internship opportunities to support your education
- Pursue an internship or summer job in transportation to test interests--they are available.

Appendix D
Interviews

Five telephone interviews were done to solicit information on the experience and views of people who have had experience in dealing with the workforce issues. Three were agency heads: Deb Miller, Kansas DOT; Rhonda Faught, New Mexico DOT; and Neil Pedersen, Maryland Highway Administration. Two are people who are involved in activities that represent the type of change that will impact the industry: Roberta Broeker, MoDOT CFO; and Phil Russell, TXDOT Assistant Executive Director for Innovative Projects.

The questions were designed to solicit their views on areas of change and the impact of that change.

Deb Miller, Secretary
Kansas Department of Transportation

Secretary Miller pointed out that Kansas is about to begin a number of big projects, projects in the $200 to $500 million range. Each of those projects will have to have a unique financing mechanism. This raises the importance of finance as a skill for public agencies. Agencies have to have people who understand tolling, public-private partnerships, and debt. Each agency may needs only a few such people, but they could determine the success of that agency.

Project management is another skill area that is something of a mindset change. Designers have to view themselves as the managers of projects, rather than as designers. They have to take responsibility for developing the overall project plan and of ensuring that others understand the schedule and work to support it.

Public communications is another skill area with growing importance. For example, KDOT is about to begin an online community to foster communication with its publics. While this tool is widely used in other arenas, they had great difficulty in finding technical skills in the consulting world to help them. They also have difficulty in finding people inside the agency who understand the concept and are comfortable in dealing with the public in this fashion. An agency should have a core group of people who can deal with this type of communication.

An online community may be a special type of communications, but speaking and presentation skills are critical for transportation professionals. Students should have some training in this area in schools. They should also be exposed to political science in school because civil engineers and planners will probably work directly for public agencies or for consultants who do the work of public agencies. Those professionals need to understand how governments work.

Even basic technical skills are changing so rapidly that some retraining existing employees may be needed.

To meet some of these needs KDOT has done some in-house training and they are developing relationships with their universities. For example, they have on-going research relationships with universities that allows needed work to be done while

offering students an opportunity to work on transportation issues. This may get them interested in transportation.

Retention has not been a major issue for KDOT. The agency was the ASCE employer of the year. In part this reflects a very active young engineers group that offers support and contacts for younger employees. They have also been able to make some changes in compensation to make the agency more attractive. More positions have been moved to unclassified status. This has offered more opportunity to get the right people in the right place. Planners have been the greatest challenge. KDOT has begun a rotational program that seems to have made the agency more attractive to planners.

Rhonda Faught, Secretary
New Mexico Department of Transportation
Secretary Faught pointed to a number of things that are changing in the transportation world:

- Green house gases are a problem. In part because of that problem, we have to have an energy policy. An energy policy will affect how we tax and the revenues available for transportation. It will also influence the investments that we make in our existing infrastructure. The issue also relates to congestion and safety. To address it, we will have to work with many new partners.
- Because of the global nature of the economy, we are looking at a global network, regardless of mode. States are looking at facilities from a regional basis. New Mexico is even looking at Mexico for a deep seaport south of San Diego, which could mean significant changes in border issues and in transportation requirements in the state.
- Sustainability as it relates to energy and land use is also a relatively new issue. In New Mexico they have developed several new commuter train services. Transit friendly development is required around train stops. Some state-owned land will be redeveloped for transit friendly development.
- Land use and transportation is a priority of the Governor. To be able to deal with the issue, the agency is trying to build partnership with MPOs and RPCs to find land use planners. Currently an agency employee is housed in their largest MPO, serving as a link between the agency and the MPO.
- Accountability and transparency are the two concepts that are much more than buzzwords. The state has made a major effort to make its processes understood by all stakeholders. The effort has resulted in support from the public and the legislature.

When asked about previous efforts that the state has made in outsourcing, she said that those efforts had had a negative effect on employees, who fear that their jobs will be outsourced. This is a symptom of the problem that public engineering agencies have in responding to change. They tend to be conservative, using proven methods. In many cases, they have to be encouraged to approach issues differently and to take risks.

Another issue that may be somewhat unique to New Mexico is the number of tribal governments with which the state must cooperate. Given the large number of sovereign nations, communications can be complex. Communication skills are thus important.

To begin dealing with these issues, the state works well with its universities. Universities provide many specialized services to the state such as bridge inspection, pavement management and demolition. They have also worked with the universities to promote more hands-on experience as a part of the undergraduate program.

Another innovative program is a cooperative training program that includes the state, its contractors and consultants. Private industry has been very supportive. If the agency had had more time to dedicate to the effort it would have gone further.

Neil Pedersen, Administrator
Maryland State Highway Administration
Administrator Pedersen contrasted the situation facing agencies today with what existed thirty years ago. At that time, engineers and construction dominated transportation agencies. Planning was done largely in support of new construction. Now the focus has changed to operating existing systems and the challenge is to maintain and rebuilt those systems under traffic.

Agencies also face challenges in the environmental area. Green house gases and climate change are issues that will have to be addressed. Similarly, dealing with sustainability and sustainable development will force agencies to examine how their actions influence land use and development patterns.

Agencies also tend to be challenged by the concept of customers as partners. For example, agencies seem to focus on capacity issues and assume that customers share those concerns. The first customer survey that Maryland did showed that the customers primary concern was with being able to see pavement markings. Some of the basics for treating customers as partners and of gathering customer input should be taught in schools. Tools like conducting focus groups are too basic to be left to on the job training.

Another area in which schools should be taking a stronger role is in teaching the skills of change management. Leading change is a major role for agencies, but most agency leaders have had neither training in schools nor on the job in leading change.

Engineers have tended to be the leaders in transportation. Engineers often have to go through a development process to be good leaders. They tend to want to solve problems directly. They need to learn how to work through others to solve problems.

Maryland has an in-house training program that uses some outside experts as trainers. Most current senior managers have come through this program.

Admittance to the program is limited and competitive. Most people who strive to advance to management see the program as needed for that advancement.

Other training programs include a partnership with the University of Maryland for project management. Because of the greater emphasis on accountability, project management has taken on much more importance to the agency.

Agency leaders also feel strongly that making the university experience real is important. Therefore, they take part in an intern program with several of their schools that provides students real experience in the agency. The program is treated as a learning experience. About 65 students took part last summer. Students often work on a specific project and present their conclusions to senior management at the close of the project. This tool has improved the learning experience, and it brought students to the agency who otherwise might not have gotten there.

The agency also supports for credit courses for all employees, as long as the courses are job-related. The agency does support public administration programs as well. With people from new disciplines, they try to create career paths. All employees are urged to take training to broaden their skill sets so they can compete.

Roberta Broeker, Chief Financial Officer
Missouri Department of Transportation

As Chief Financial Officer of the Missouri Department of Transportation Roberta has been involved in the financial aspects of several innovative projects. She explained the motivations for such innovative approaches: The public expectations of transportation agencies have changed over the last decade or so. Doing a project when its ready and spending what it costs is no longer acceptable. The public expects projects to be delivered quickly and they expect the agency to make the best use of the funds available.

These expectations have several impacts on how an agency does business and the skills needed in its workforce. First of all, financial forecasting is much more important. Particularly in a state like Missouri where funds received are available to the department without legislative appropriation, accurate forecasts of revenues are critical. To deal with this need, MoDOT employs an economist who utilizes a consultant-developed econometric model that has predicted transportation revenues with incredible accuracy even in times of volatility.

The other part of forecasting is the cash flow associated with projects so that the demands for cash can be met. To this end, finance people meet regularly with engineering staff to understand project schedules, the types of projects and the payout patterns expected. This may also place more emphasis on the importance of monitoring a project schedule.

If the state is utilizing public-private partnerships, they must also have some understanding of private sector financial analysis, which can be very complex. For example understanding the analysis underlying a lease agreement can require very sophisticated financial expertise. Even using more traditional 3P arrangements can

demand a high level of financial expertise to ensure that the public interest is protected.

Debt financing is also a growing part of the financial system. Understanding the bond market is basic. In Missouri this has not been terribly complex. Bonds are sold for groups of projects. An effort must be made to match the life of the bonds to the life of the constructed facilities, so that the life of the debt does not exceed the life of the facility.

Understanding and using other debt instruments is also useful so that the benefit of equipment and facilities is not totally dependent on the availability of cash. The acquisition of trucks through a leasing arrangement is an example. Sufficient cash funding was not available to purchase a large number of trucks. Leasing allowed the new equipment to be acquired.

In summary, today's transportation finance professionals are not your father's transportation finance professionals.

Phil Russell, Assistant Executive Director for Innovative Projects
Texas Department of Transportation

The Assistant Executive Director for Innovative Projects is involved in a range of innovative projects from design build, to public-private partnerships, to multi-modal corridors. He responded with the following observations in response to this question: What impact do the various types of innovative projects have on the skills required of a transportation professional?

Using design-build approaches requires moving from supervising all of the activities of a contractor to measuring outcomes in a performance specification. This is sometimes difficult for an engineer who has been trained to do things in one right way. They have to adjust to accepting that the outcome is what is important.

In a somewhat similar vein, people have to develop some understanding of the private sector business model. In that model, a bad decision may be preferable to no decision. While doing in-house projects, people are used to being able to take the time to ask another question and find more data and wait until that data becomes available. If a design-build contractor is working on the project, delay may cost money; it may force a key date to be pushed. It may be better to make the decision and move on. The benefits and risks have to be weighed.

Alternative approaches may also push the skills outside of the engineering field. Legal and financial skills are often very important in structuring 3P arrangements or even design-build projects. Those skills have to be found, either inside the organization or outside of it. This points to a key skill: the ability to say I don't know and then find someone who does know.

Projects that involve alternative modes also force people to think about things differently. The highway solution may not always be the appropriate solution. When

that project is high-profile, like the Trans-Texas Corridor, strong outreach and communications skills are also needed. Departments are usually looking for broader involvement, which means using the right techniques and thinking through the issues so they can be discussed and explained.

All of this points to a cultural change. While a firm grasp of engineering processes is still required, a broader-based educational background is desirable. An ability to communicate and take risks is important. Intellectual curiosity is needed. People have to be willing to think about alternative ways of doing business and alternative solutions to problems.

Appendix E
Workshop Participants

FIRST	NAME	ORG
Teresa	Adams	CFIRE
Adjo	Amekudzi	Georgia Tech University
Ruben	Anthony	Wisconsin DOT
Sandy	Beaupre	Wisconsin DOT
Jason	Bittner	CFIRE
Jody	Bohn	North Dakota State University
Roberta	Broeker	Missouri DOT
Brian	Brown	Ohio DOT
Brenda	Brown	Wisconsin DOT
Mike	Burk	FHWA
Frank	Busalacchi	Wisconsin DOT
Bob	Cook	HNTB
Stacy	Cook	CFIRE
Lea Ann	Curtis	Kansas DOT
Deogratias	Eustace	University of Dayton
Mahmud	Farooque	Purdue University
Tim	Gates	Wayne State University
Liz	Gill	CH2M Hill
Genevieve	Giuliano	METRANS Transportation Center, USC
Jessica	Guo	UW-Madison
Leon	Hank	Michigan DOT
Awad	Hanna	UW-Madison
Jeff	Hanson	Earth Tech AECOM
Keith	Hinkebein	HNTB
Tracey	Holloway	UW-Madison
Bob	Johns	University of Minnesota
Susan	Karcher	CFIRE
Micki	Knudsen	Missouri DOT
Zhongzhi	Li	Illinois Institute of Technology
Jane	Lin	University of IL-Chicago
Clark	Martin	FHWA
Tom	Martinelli	CTC & Associates
Tom	Maze	Iowa State University
Shashi	Nambisian	Iowa State University
David	Noyce	UW-Madison
Joetta	Parker	Michigan DOT
Joan	Petersen	Strand & Associates
Steve	Pudloski	UW-Madison
Michelle	Regenold	Iowa State
Rory	Rhinesmith	Wisconsin DOT
Julius	Rhodes	KnowledgeBank, Inc

Angela	Rolufs	Missouri Science & Technology
Howard	Rosen	UW-Madison
Jeff	Russell	UW-Madison
Todd	Sadler	Iowa DOT
Randy	Sarver	Wisconsin DOT
Steve	Schmitt	CFIRE
Andrea	Schokker	University of Minnesota-Duluth
Konstantin	Sobolev	UW-Milwaukee
Dawn	Spanhake	University of Minnesota
Richard	Stewart	UW-Superior
Tim	Strauss	University of Northern Iowa
Mike	Stringer	Kansas DOT
Scott	Tarry	University of Nebraska-Omaha
Denver	Tolliver	North Dakota State University
Mark	Vonderembse	University of Toledo
Tyler	Vorpagel	Office of Rep. Petri (R-WI)
Greg	Waidley	CFIRE
Van	Walling	CH2M Hill/ESM
John	Webber	Illinois DOT
Randy	West	Kansas DOT
Lee	Wilkinson	Iowa DOT
Ernie	Wittwer	CFIRE
David	Yu	UW-Milwaukee
Jan	Zander	Ayres & Associates