U.S. Department of Transportation

UNIVERSITY RESEARCH AND EDUCATION PLAN

DECEMBER 2000

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U.S. DEPARTMENT OF TRANSPORTATION

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Executive Summary

As the world community enters the 21st century, the traditional concepts that involve learning—encompassing both research and education—are radically changing. They are now overshadowed by new realities brought about by technology, globalization, changing demographics and innovative new learning opportunities. For example, cutting edge research can now be done via computer simulations and the Internet in addition to the traditional laboratory setting. New education concepts, such as virtual learning, challenge and build upon traditional teaching mechanisms.

All of this is important to the field of transportation since a vibrant system is based not only on a physical infrastructure, but also on human capital. The latter component is important because it develops the next generation of transportation professionals and acts as an 'engine of growth' for future innovation. Investments in human capital might support the mechanic who repairs equipment, the policy planner who envisions problems and solutions, or the administrator who is responsible for the entire system from planning through implementation to evaluation. It might also involve the student who is contemplating a career in transportation or the individual citizen who is interested in learning more about transportation issues.

This Plan is an initial attempt to consolidate and quantify the U.S. Department of Transportation's (DOT) overall options for supporting research and education at post secondary levels. It gives not only a framework to build results, but also the proposed methods to quantify success. At the same time, it is a compilation of current, Federal-based research and education activities in the field of transportation. The Plan is the start of a portfolio of collective learning investments that will complement the Department's overall strategic goals. Its conclusions highlight the vast potential payback that results from an innovative, international research and learning network set up to support 21st century transportation endeavors.

United States Department of Transportation
University Research and Education Plan

Transportation Learning: the Components of Research, Education, Technology Transfer and Professional Development That Provide for Enhancements in the Field of Transportation

I. Introduction

A. Statement of Purpose

The Plan is an initial attempt to consolidate and quantify the Department's overall options for supporting research and education at the post-secondary school levels. It features not only the expected results from this effort, but also the proposed methods to quantify success. The Plan also includes a compilation of current, Federal-based research and education activities in the field of transportation. The long-term goal is to exploit the vast potential that can result from an international network where research and learning support 21st century transportation endeavors. It is the start of a portfolio of collective investment in transportation learning mechanisms that complements the Department's overall strategic goals.

This Plan will challenge educators, administrators, and those supporters who are not part of the formal academic network. It also includes and builds upon the legacy that Secretary of Transportation Rodney Slater established through the Garrett A. Morgan Technology and Transportation Futures Program (GAM).[1] This effort interests and supports various stakeholder groups from school age children to traditional students of higher education, and from existing practitioners to individual citizens who are interested in learning more about transportation.

In order to implement this challenging initiative, it is important to define the overall mission, vision, and measures of success:

[1] The U.S. Department of Transportation's Garrett A. Morgan Technology and Transportation Futures Program encourages innovation in elementary, secondary, junior/community college, undergraduate, graduate, and life long learning endeavors.

Vision Statement

The vision of the Department's research and education endeavors is to prepare the domestic and global transportation systems for the 21st century through innovative education, training, research, and technology transfer.

Mission Statement

The mission of the Department's research and education endeavors is to prepare the next generation of transportation scholars and practitioners for the 21st century—as well as lead the way in innovative practices and policies—through a highly developed research agenda and a creative educational structure.

Measures of Success: Transportation & Education

- Traditional measures of success include items such as dollars spent, students in the system, amount of research budgets, patents, results of peer review and accreditation processes; distinguished awards given to students, faculty, and researchers.
- Non-traditional measures of success include the ability to innovate and coordinate with other dynamic growth areas of society (e.g., technology, computerization, communication) as well as public support for and understanding of what the research and education system is accomplishing.
- Future measures of success might include the ability to set up and maintain interactive, flexible learning frameworks. (Sample measures can be found in Section IV.A.8. on page 27)

B. Background

As the world enters the 21st century, the quality of research and education continues to be a major factor in the nation's ability to succeed and to excel. The United States has been fortunate in the payback received from its investment in learning at all levels. [For insight into a selective list of Federal Education Legislation, see Attachment One.] But past achievements and investments in research, education, training, and technology transfer do not ensure future success. While many U.S. policy areas have a long established commitment to learning, the focus on transportation issues has been relatively recent.[2]

[2] For example, at the Federal Government level, funding for agricultural research goes back to the Morrill Act of 1862 that established the Land Grant College system throughout the United States.

Developments in the field come about because of continuing demands and commitments at several levels. First, within the educational establishment, formal academic transportation programs have moved beyond traditional lines (e.g., engineering and science). As a result, they are becoming a formal area of study as well as a support to other established academic disciplines. For example, students and professors now broaden their fields of endeavor to include such areas as communication between public and private interests, strategic management of human and capital resources, environmental impacts, and most recently, the impacts of computerization and technology.

Second, the Federal Government now provides a financial and staff resource commitment—matched by state or local funding—through the national University Transportation Center (UTC) network.[3] [For a current list of Centers, see Attachment Two.] This includes funding for teaching and research, as well as a technology transfer component linked to transportation education needs. The outcome benefits not only the formal academic, but also the practitioner at various levels who wishes to learn new skills or enhance his/her current knowledge base.

The Federal Government's research commitment is a critical element in the innovation process. Advancing innovation through research and education is recognized as the key "enabler" for reaching DOT's strategic goals based upon safety, mobility, economic growth and trade, human and natural environment, and national security.[4] Basic research, undertaken by Federal research laboratories or through federally funded projects, supports the development of products and services that will create the transportation enterprise of the future. [5] Enabling research supports the transformation of existing products and services. The Department's various modes offer initiatives in each of their specialties. Federal funding and incentives for transportation activities also involve coordination with policy constituencies, such as defense, communications, energy, environment, and urban-rural affairs. [For Samples of Academic Efforts in Support of Federal Enabling Research, see Attachment Three.]

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[3] From legislative authority originating from the 1987 Surface Transportation and Uniform Relocation Assistance Act, Congress mandated a series of university transportation centers—later supplemented by university research institutes—to specifically provide leadership in transportation education teaching and research. The Intermodal Surface Transportation Equity Act of 1991 (ISTEA) and the 1998 Transportation Equity Act for the 21st Century (TEA-21) expanded the number, the funding, and the scope of these programs.

[4] The U.S. Department of Transportation Strategic Plan 1997-2002 highlights the following goals:
Safety: Promote the public health and safety by working toward the elimination of transportation-related deaths, injuries, and property damage.
Mobility: Shape America's future by ensuring a transportation system that is accessible, integrated, and efficient, and offers flexibility of choices.
Economic Growth and Trade: Advance America's economic growth and competitiveness domestically and internationally through efficient and flexible transportation.
Human and Natural Environment: Protect and enhance communities and the natural environmental affected by transportation.
National Security: Advance the nation's vital security interests in support of national strategies such as the National Security Strategy and National Drug Control Strategy by ensuring that the transportation system is secure and available for defense mobility and that our borders are safe from illegal intrusion.

[5] Most basic research continues to be carried out by the public sector, mainly the Federal Government.

At the same time, the Federal commitment seeks to achieve specialized goals in several other ways. For example, in order to interest young people in transportation careers, the Department encourages curricula and computer program development not only at higher education levels, but also at elementary/secondary levels. At the other end of the learning spectrum, professionals are adopting a life long learning process that continues education beyond the formal classroom setting. The process also involves those who are informally interested in transportation issues as well as expanding transportation-related opportunities to traditionally under-represented portions of the population. Support from higher education sources—through funding and encouragement at the Federal Government level—helps to plan, implement, and evaluate these various non-traditional activities.

Practitioners and private sector interests are a third force that impacts on developments in transportation learning. For example, public sector practitioners look for more efficient and effective ways to train and motivate their staffs. Education innovations, with emphasis on providing services to those with special needs (e.g., geographically isolated areas; technical training based on changing high technology, etc.), become part of the answer. At the same time, private sector interests are in benefiting from enhancements in transportation research. The development of new products and refinements in existing methodologies offers business opportunities, especially in a global marketplace.

In the field of transportation, one of the key components of the DOT University Research and Education Plan is the Department's Garrett A. Morgan Technology and Transportation Futures Program. It seeks as part of its mandate to foster public-private partnerships that increase the availability of, and enrollment in, multidisciplinary transportation degree programs as well as vocational programs.

Finally, transformations within the transportation enterprise itself are resulting in new developments. Demographics are a major impact. A review of U.S. Department of Labor (DOL) and Census Bureau statistics on the next page shows the current and projected types of job and career growth potential within transportation at the start of the 21st century.

Exhibit One

Bureau of Labor Statistics (BLS) Predictions for Growth in Transportation, Communications, Utilities										
Industry	Thousands of Jobs			Change (in thousands)		Percent Distribution* *percent of total SIC Codes			Average Annual Rate of Change	
	1986	1996	2006	1986 to 1996	1996 to 2006	1986	1996	2006	1986 to 1996	1996 to 2006
Transportation, communications, and utilities	5,247	6,260	7,111	1,014	851	04.7	04.7	04.7	1.8	1.3

Source: BLS Releases: New 1996-2006 Employment Projections. US Department of Labor (DOL), Bureau of Labor Statistics. Includes further breakdown of Transportation labor categories as defined by Department of Labor Standard Industry Classification (SIC) Codes.

Within the DOL-defined field of transportation, the outlook is as follows:

> The *transportation* sector is projected to have 4.7 million jobs in 2006, an increase of 691,000 from the 1996 level of 4 million. During the 1986-96 period, transportation employment grew by just under 1 million jobs, of which the *trucking and warehousing* industry accounted for 247,000. During the projected period, trucking and warehousing employment is expected to increase by another 219,000 jobs, rising from 1.6 million in 1996 to 1.9 million in 2006, at an average rate of 1.3 percent. Over the 1986-96 period, employment for trucking and warehousing grew at an average rate of 1.6 percent, while output grew at an annual rate of 4.6 percent, indicating strong gains in productivity. During the 1986-96 period, the *air transportation* industry gained 556,000 to 1.1 million jobs, at an annual growth rate of 7.1 percent. Over the 1996-2006 projections period, employment growth in air transportation is expected to slow to a rate of 2.2 percent, adding 279,000 jobs.
>
> **- Monthly Labor Review, "Employment Outlook: 1996-2006"**

At the same time, there is a "supply versus demand" issue in some technical specializations, such as engineering. The demands created by the new innovative environment impact on the supply of available academics, researchers, and practitioners. The positive results are excellent career opportunities while the negative implications are shortages in some crucial areas.

The factors mentioned above support the changing and evolving focus of the "transportation professional." Transportation education is no longer viewed as just a series of college courses, and transportation research is no longer viewed as incremental improvements to the existing

infrastructure. The transportation policy paradigm is shifting away from "bigger is better" to managing the existing infrastructure systems more effectively and building new infrastructures more efficiently. This is being done through enhanced management systems, improved products, and intelligent transportation systems that are dependent upon, in part, federally funded investments in research and education.

C. Methodology

The research methodology in this Plan involves interviews and focus group sessions with representatives of the various DOT modes, other Federal agencies such as the U.S. Department of Education (DOEd), education practitioners, researchers, etc. The Plan benefits from research already completed. For example, it builds on research into the Department's Intelligent Transportation System (ITS) Professional Capacity Building Program.[6] A June 1999 conference, hosted by the DOT Volpe National Transportation Systems Center on "the Spirit of Innovation in Transportation," provides another resource on current thinking in this area.[7] Finally, research into the ongoing activities of professional organizations that provide financial and policy support is another important methodology resource.

One of the challenges for a research team is to evaluate the vast number of activities and resources that are available on this topic. The examples presented in this Plan are representative samples and should not be taken as the only alternatives of learning-related activities in transportation. Another consideration is the rapid development of material and resources that are becoming available from diverse sources (e.g., traditional educational environments, professional associations, non-profit organizations, etc.) and through non-traditional means (e.g., Internet, web-based, satellite links, etc.). The document uses sidebars and exhibits to highlight some examples and provides websites so that the interested individual can do further research on his or her own.

[6] The Intelligent Transportation Systems (ITS) Professional Capacity Building (PCB) Program was launched in March of 1996, under the joint sponsorship of the Federal Highway Administration (FHWA) and the Federal Transit Administration (FTA). The Program is comprised of a partnership of organizations that work cooperatively to provide ITS professional capacity building, encompassing the public sector, the private sector and the academic community. For further insight, see: *www.its.dot.gov.*

[7] A conference session entitled *Transportation Workforce for the 21st Century – A Challenge to Education* provided a basis for learning about current ideas as well as a forum for writers and practitioners in this field. For further insight, see: *www.volpe.dot.gov.*

"The integration of research and education is the hallmark and strength of our research and education system. Indeed, an important rationale for the Federal investment in university-based research is derived from training a new generation of scientists and engineers."

- National Science and Technology Council, "Renewing the Federal Government-University Research Partnership for the 21st Century"

II. Federal Transportation-Related Research and Education in Higher Learning

A. Historical Progression

Formal academic research and education programs have not always been a determining factor in transportation's development. Nineteenth century innovations, such as steamboats and railroads, initially came from entrepreneurs' talents. These individuals were not dependent upon a formal, academic network. In the 20th century, transportation issues became more complex and other issues (e.g., economic development, environmental concerns, public spending) became more apparent.[8] Transportation issues were part of the academic agenda, but did not have a specific framework of their own.

In the 1950s and 1960s, educational endeavors in transportation centered at the collegiate level mainly through engineering programs. The focus was on the practical matters of building and maintaining America's growing land, marine, and air-based systems. In the latter part of the 20th century, transportation education became a discipline in its own right, not just an adjunct to other education programs. At the same time, technically oriented programs with a practitioner focus evolved at the junior and community college level.

B. The University-based Transportation Research and Education Community

University-based research and training in transportation involves several distinct partnerships. The largest, formal network revolves around the University Transportation Centers, a national consortium of universities, each of which has a specific thematic focus.[9] The UTC program's mission is to advance U.S. technology and expertise in the many disciplines comprising transportation through the mechanisms of education, research, and technology transfer at

[8] For a historical insight into the origin of the Federal Government's commitment to research and education, see Vannevar Bush's *Science – The Endless Frontier* (1945).

[9] For a history and assessment of the UTCs, see the February 1997 "Investing in Transportation's Future: An Examination of the University Transportation Centers Program" prepared by the U.S. Department of Transportation, Research and Special Programs Administration, John A. Volpe National Transportation Systems Center, Cambridge, Massachusetts.

university-based centers of excellence. [Attachment Two presents the currently participating institutions, based on TEA-21, PL 105-178.] These centers interact directly with the various modes within DOT, other Federal departments such as the U.S. Departments of Defense (DOD), Commerce (DOC), Education (DOEd), as well as other Federal partners like the National Science Foundation (NSF), the National Aeronautics and Space Administration (NASA), etc. Some have a focus that includes state, local, and municipal partners; non-profit and foundation participation; and partnerships with vocational and junior college programs.

The modal administrations within DOT have their own education- and learning-based programs based on their area(s) of specialization. In the maritime area, for example, the U.S. Coast Guard and Maritime Administration administer 4-year college education programs at academies focused on setting educational standards and providing a source of highly trained individuals to meet national needs in the maritime field. Scholarships, financial assistance, and intern programs are used to encourage educational focus on transportation careers, resulting in skilled leaders.

Maritime Area:

- **United States Coast Guard Academy** – Located in New London, Connecticut, the United States Coast Guard Academy provides a 4-year Bachelor of Science program in one of eight majors with a commission as an Ensign in the United States Coast Guard. Students are challenged academically, physically, and professionally by one of the finest and most selective colleges in the country.

- **United States Merchant Marine Academy** – Located in Kings Point, New York, the United States Merchant Marine Academy offers a unique combination of academic, military, and shipboard programs leading to a Bachelor of Science degree, a merchant marine license, and an appointment as a commissioned officer on reserve or active duty in the U.S. Armed Forces. The academy teaches how to succeed in the maritime and transportation industries.

Some DOT programs have an education focus (e.g., Operation Lifesaver, with funding from the Federal Railroad Administration [FRA] and the Association of American Railroads [AAR]), while others have a research focus (e.g., the Federal Transit Administration's [FTA] Transit Cooperative Research Program). Some have a public awareness focus and target a wide audience (e.g., the National Highway and Traffic Safety Administration's [NHTSA] Public Safety Awareness Program) while others devote their attention to individual development (e.g., Summer Transportation Internship Program for Diverse Groups, or STIPDG). A breakdown of the modal initiatives follows:[10]

[10] For Department of Transportation modal acronyms, see Acronym List on pages 75-77.

Exhibit Two

Matrix of Learning Opportunities Offered by Department of Transportation Modal Agencies

	FAA	FRA	FTA	RSPA	NHTSA	FHWA	MARAD	USCG	SLSC	BTS
College Institutions (4-yr.)							X	X		
Project Grants	X	X	X		X	X	X	X		X
Fellowships	X	X	X		X	X	X	X		X
Internships	X	X	X	X	X	X	X	X		X
Joint University Programs	X	X	X	X	X	X	X		X	
Centers of Excellence	X	X	X	X	X	X	X	X		
Mentoring Programs	X	X	X	X	X	X	X	X	X	X
Public/Private Partnerships	X	X	X		X	X	X			

Source: from briefing materials provided at DOT University Research and Education Plan Meeting, August 26, 1999, Arlington, Virginia

[Further insights into the opportunities within each mode are found in Attachments Four through Fifteen.]

DOT's efforts also involve coordination and partnerships with other federal agencies (e.g., Education, Defense, Energy, Commerce) to strengthen the learning environment. A major commitment is through the network of Federal research laboratories. Some of these have a specific focus while others support transportation initiatives as part of other policy interests.

The following examples highlight some DOT and other federally sponsored agencies who are involved in transportation-related research and development:

- **John A. Volpe National Transportation Systems Center** – As part of the U.S. Department of Transportation, under the Research and Special Programs Administration, the Volpe Center is a market-driven resource for innovation in transportation in relation to regional, Federal, and international initiatives. The Center applies its unique technical knowledge in planning, research, development, assessment, as well as technology integration and deployment. This enhances the effectiveness and responsiveness of Federal organizations having critical transportation issues.

- **Los Alamos National Laboratory** – This Department of Energy laboratory provides very broad scientific expertise. It includes innovative biological research; modeling global climate; using satellite imaging to solve transportation-related problems; and novel methods for examining material properties to explore the outer reaches of the solar system.

- **Oak Ridge National Laboratory** – This Department of Energy laboratory conducts basic and applied research and development. The outcomes create scientific knowledge and technological solutions that strengthen the nation's leadership in key areas of science; increase the availability of clean, abundant energy; restore and protect the environment; and contribute to national security.

- **William J. Hughes Technical Center –** This Federal Aviation Administration facility is the national scientific test base for FAA research, development and acquisition programs. Center activities encompass test and evaluation in air traffic control, communications, navigation, airports, and aircraft safety and security. Also included are long-range development of innovative systems and concepts, development of new equipment and software, and in-service modifications of existing systems.

- **Ames Research Center** – Part of the National Aeronautics and Space Administration, Ames specializes in research geared toward creating new knowledge and new technologies that span the spectrum of NASA interests. The Center's mission includes researching, developing and transferring leading edge aeronautical technologies through integration of computation, simulation, ground and flight experimentation, and information sciences. Its efforts answer fundamental questions concerning evolution, including the adaptation of living systems to outer space, and the development of technologies for space flight.

- **Wright Patterson Air Force Base** – This base is in many measures the largest, most diverse and organizationally complex within the United States Air Force. Missions include logistics management, research and development, education, flight operations, and many other defense related activities. It is the home of the headquarters of a vast worldwide logistics system supporting the entire Air Force.

Other opportunities exist through coordination with professional associations, such as American Association of State Highway and Transportation Officials (AASHTO), the American Public Transportation Association (APTA), and the American Public Works Association (APWA). Non-profit entities such as private foundations, unions, the Transportation Research Board (TRB) are other potential sources for partnership activity to foster and expand learning opportunities through education and research in transportation.

The following are just two examples of support provided by industry and labor organizations that support learning opportunities:

- **Professional Truck Driver Institute (PTDI)** – Under the auspices of the American trucking industry, the PTDI developed the first voluntary curriculum and certification standards recognized by both industry and government for truck drivers. It also serves as a public forum where stakeholders can share resources.
- **Paul Hall Center for Maritime Training and Education** – Founded by the Seafarers International Union (AFL-CIO), the Center provides basic safety courses, a million-dollar fire fighting/safety facility, USCG-approved courses in radar plotting aids, as well as company specific and on-site training.

C. Products and Services

Products and services in the transportation learning enterprise traditionally have been offered through formal degree programs in transportation and transportation-related disciplines (e.g., engineering, environment, urban planning, and public policy). Non-degree training packages initially provide enhanced skills or new expertise through short courses or in-service lecture series. The traditional beneficiaries include students at the undergraduate and graduate level.

During the past decade, the academic community realized that these traditional efforts were not enough to provide the skilled transportation workforce to adequately service existing systems and to create the necessary innovations for efficient 21st century operations. Several new, high priority audience groups evolved. These include students at the elementary and secondary levels; students at vocational and technical schools who could become system operators; practitioners looking to upgrade their existing skills as well as acquire new expertise; and interested citizens. Efforts have been taken to meet the needs of each of these special clients. In addition to traditional learning approaches, new communications initiatives (via web sites, Internet programs, distance learning, satellite linkages, etc.) now exist to make learning more available.

Research is the second line of products and services. Research traditionally had a very narrow focus (e.g., building a better road) for a specific audience. In its Strategic Plan, DOT addresses the need for broadening the direction of research efforts through better support of innovation in transportation.

DOT's University Research and Education Plan focuses on five major goals that are also reflected in the Departmental Strategic Plan.[11] Research is not limited to these topics, but the

[11] See footnote 4 on page 3.

five areas provide overall direction to meet the Department's priorities. Research topics now include such diverse issues as human factors, environmental concerns, energy alternatives, and financial considerations that will bring transportation into the 21st century. This creates opportunities for existing academics and practitioners as well as non-traditional, transportation-related scholars.

The combined benefits derived from enhanced research and education opportunities represent another area of products and services. This includes the fast growing field of technology use and transfer. Both education and research are becoming more dependent upon computerization, communication, and technology. The collective investment in transportation learning activities and products results in a massive sharing of knowledge and ideas that benefit the academic community, practitioners, end users, and the public who pay for and use the system.

Transportation learning offers other potential benefits beyond a formal, technical education. Transportation educators and advocates realize the importance of providing opportunities that lead to: 1) networking and career development; 2) diversity awareness; and 3) historical consciousness. The spinoffs of these additional benefits support not only transportation, but also its related policy endeavors, such as engineering, environmental, management, human resource, and diversity programs. This increases the multi-disciplinary aspect of the learning process and makes it a more attractive lifelong learning endeavor. It is also important as transportation careers become more global in character and approach.

Transportation-related research that comes from other Federal agencies is also an integral part of the overall research agenda. For example, the cabinet-level National Science and Technology Council (NSTC) has promoted the coordination of science and technology-related issues among Federal agencies. Part of the Council's mandate involves transportation-related issues. The Council's Committee on Transportation Research and Development (now a subcommittee of the new NSTC Committee on Technology) developed the first Transportation Science and Technology Strategy to help Congress, the White House, and Federal agencies establish transportation priorities and activities. The strategy identifies six long-term research areas that are consistent with the principles of the President's Committee of Advisors on Science and Technology. [See Attachment Three for a list of the six areas, as well as examples of how DOT, through the UTC program, directly supports the Federal transportation research agenda.]

An example of potential transportation learning that could involve both research and technology is Smartpath.

SMARTPATH:
Student Maturation & Achievement in Research & Technology That Advances Transportation Harmony

SMARTPATH is a proposed Federal program to support educational attainment at minority institutions: Historically Black Colleges and Universities, Hispanic-Serving Institutions, and Tribal Colleges and Universities.

The Program provides hands-on enrichment particularly in science and engineering instruction at DOT laboratories and research centers and an opportunity to work with the leading experts in transportation research and training (R&T). The ultimate outcome will be a diverse workforce with excellence in transportation R&T — a workforce that will leverage the future for DOT, governments, industry, and the nation.

"It is our obligation to provide our future citizens with a healthy infrastructure of cutting edge scientific research and graduate education, not just for today, but to serve the next quarter century and beyond."

- Eamon Kelly, Chairman, National Science Board

III. Twenty-First Century Challenges and Opportunities

In the 21st century, four areas will have a crucial impact on innovation: the impact of globalization, the role of technology, the challenges of changing demographics, and the implications of curricula development. The following sections present an insight into each while Part IV challenges the reader with a series of next steps in order to maintain the momentum for the Federal Government and its partners.

A. The Impact of Globalization

One of the major challenges facing the U.S. and the world at the beginning of the 21st century is the impact brought about by globalization.[12] In private sector transportation endeavors, organizations provide products, services, and research capabilities to a diverse world community that is becoming increasingly more competitive. In public sector transportation endeavors, governments at various levels are responsible for the development, implementation, and maintenance of existing and evolving transportation infrastructures. Innovations in transportation learning act as a catalyst to bind these endeavors together.

Globalization has and will continue to impact the changing academic environment. In a direct sense, it supports the internationalization of resources, not only in the individual classroom, but also in the research facility that extends out to the workplace environment. This promotes shared learning innovations as well as the latest research and development (R&D) endeavors that go beyond the academic setting. Global transportation education efforts support industrialization, the movement of goods and people, enhanced resources, better communication, and improvements in the quality of life for all countries. Because globalization enhances competition, there is an exciting opportunity for educational stakeholders to show leadership through innovative research projects as well as utilizing technology and communication to share resources and knowledge.

[12] Globalization has been defined as "...seeing the whole world as nationless or borderless." From Koh Sera's "Corporate Globalization: A New Trend."

B. The Role of Technology

Just as transportation innovations acted as an "engine of growth" in the 19th century during the Industrial Revolution, they are also one of the economic and environmental drivers of the technology revolution in the 21st century. The technology revolution going on inside and beyond the classroom has a major impact on transportation education. Within the teaching environment, the use of computers as a learning tool is revolutionizing how students study existing theoretical and practical problems, as well as plan future transportation solutions. Within the learning environment, research methodologies and outcomes are bringing about continuing change; for example, not only in tabulating and evaluating complex quantitative problems, but also in how information on transportation initiatives is shared through website addresses and communication links.

The revolution extends beyond the formal classroom since it opens up distance learning opportunities to the academic and to the practitioner, even in remote locations. Technology is also being used as an information and learning tool to interest young students as well as those who wish to know more about the field. As one example, the Garrett A. Morgan Technology and Transportation Futures Program web site at *http://education.dot.gov/* provides background information on transportation-related activities and career potential for "students" of all ages.

By combining technology and education endeavors, there is the opportunity to build new technology, improve existing infrastructure, develop world class facilities, enhance capital investments, create alternative energy sources, improve the environment, and make better communication alternatives. All of these complement the goals of the Department as presented in its Strategic Plan. At the same time, it can be used to create, test, implement, and monitor potential innovations before a financial, environmental, political, or research commitment is made.

C. The Challenges of Changing Demographics

In order for transportation education to be relevant to society's needs, it must take into account the changing demographics in the workplace. For example, the traditional scope of jobs and careers is broadening to include women and minorities in key managerial and leadership positions. Education is a key component in preparing and sustaining these individuals throughout their careers within the transportation hierarchy.[13] By law, DOT research and development programs, endowments, grants, and other federally funded programs do not discriminate on the basis of race, color, national origin, religion, age, disability, reprisal, or sexual orientation.

The following two examples highlight efforts to support the changing demographics:

[13] For further insight, see *REACHING THE TOP: A Report of the National Task Force on Minority High Achievement* "that underscores the need for a national 'Affirmative Development' campaign to improve high levels of educational excellence for African Americans, Hispanics, and Native Americans." [*www.collegeboard.org*]

Dwight David Eisenhower Transportation Fellowship Program

The Dwight David Eisenhower Transportation Fellowship Program, which was authorized under the Intermodal Surface Transportation Efficiency Act of 1991, consists of six categories of fellowships. The Program is intended to attract and retain "the Nation's brightest minds to the field of transportation," and to encourage transportation professionals to seek advanced degrees. The Program is managed by the National Highway Institute, with a funding level of approximately two million dollars each year. It supports about 100 students and faculty annually.

The six categories of fellowships are:

- Eisenhower Graduate Fellowships - assists students in pursuing Masters Degrees or Doctorates in transportation-related fields;
- Eisenhower Grants for Research Fellowships - helps students get acquainted with transportation research, development and technology activities in the United States;
- Eisenhower Faculty Fellowships - provides transportation faculty opportunities to improve their transportation knowledge by attending conferences, courses and workshops;
- Eisenhower Historically Black Colleges and Universities (HBCU) Fellowships;
- Eisenhower Hispanic Serving Institutions (HSI) Fellowships; and
- Eisenhower Tribal Colleges (TC) Fellowships - provide HBCU, HSI, and TC students additional opportunities to enter careers in transportation.

U.S. DOT Minority Serving Institutions (MSI) and Educational Partnership Office

This Office is one example of the Departmental organization that works to expand transportation learning efforts to traditionally under-represented students. A part of its duties includes:

- Administering the Departmental Minority Serving Institutions and Educational Partnerships Programs.
- Serving as Departmental Contractor's Technical Representative to ensure the validity of cost, service and performance as prescribed for MSI student internship, faculty and student exchanges and other MSI-related projects.
- Acting as Departmental Liaison to the White House Initiatives on Historically Black Colleges and Universities, Educational Excellence in Education for Hispanic Americans, and Tribal Colleges and Universities Programs. It develops procedures and guidelines affecting DOT in the administration of the following Executive Orders:

    - E.O. 12876 Historically Black Colleges and Universities
    - E.O. 12900 Educational Excellence for Hispanic Americans
    - E.O. 13021 Tribal Colleges and Universities
    - E.O. 13096 American Indian and Alaska Native Education
    - E.O. 13125 Asian Americans and Pacific Islanders in Federal Programs

The American transportation education network has broadened beyond the United States to become a world class model. Therefore, demographics also encompass an international component that prepares practitioners, researchers, and managers from all over the world to solve issues within their own countries as well as interdependent transportation issues within a regional or global context.

D. The Implications of Curricula Development

While the three areas discussed thus far are examples of external factors that will impact transportation education's future, there is a fourth, internal issue that is driving change: curricula development and reform. This is important as the effort grows in its own right and, at the same time, becomes an important sub-component in other policy areas.

The traditional focus of the engineering curricula is now supplemented by "soft skills" that stress management concepts (e.g., working in multi-disciplinary teams) and policy issues (e.g., moving beyond the needs of local society to cover global issues). At the same time, this can create tensions from an administrative and pedagogical standpoint. For example, at some state institutions there are limits to the number of credit hours required for a degree as mandated by the legislature. Therefore, there may be fewer opportunities to include these new, important topics.

The curricula focus continues to move beyond its traditional base to include other areas of specialization. For example, transportation professionals in the 21st century must have the ability to see how their work impacts the environment; not only in the cost to the air, land, and water, but also in energy resources. They must have the skills to understand how their decisions relate to community stakeholders (i.e., the politician who may make the decision and who provides or withholds support; the taxpayers who pay the expenses; the public who benefits from their efforts). At the same time, there is the ongoing upgrading of the curricula, based on the impacts of technology on infrastructure development, communication, and product design.

Some of these new specializations may be non-traditional. The topic of ethics as part of the education curricula—a growing component of business school programs in the United States—provides one example of this growing diversity. It is an issue that transcends disciplines and also relates to the training requirements of the transportation professional. It begins in the classroom where the opportunity exists to reinforce the implications of ethical dealings in business situations which students will face throughout their careers. It extends into the research environment where scholars must maintain integrity in their research efforts and relations with others. It continues on to preparing students for their role in the world of commerce, both in the public and private sectors. This involves not only making and upholding contractual obligations, but also maintaining a standard of integrity (especially in situations where ethical standards differ or do not exist).

Another important change taking place in the transportation field is the growing emphasis on intermodalism. In the past, transportation options were tied to specific modes (e.g., land, sea, air). Recent developments focus on a combination of modes for the same transportation goal (such as shipment of goods) so that travel time and cost can be minimized. Emerging technological innovations are making the option of intermodalism increasingly viable, and the needs of the profession in this area offer challenges for transportation education.

"...our greatest challenge is to build a transportation system that is international in reach; intermodal in form; intelligent in character; and inclusive in nature."

- Rodney E. Slater, Secretary of Transportation

IV. Components of a Transportation-Focused Research and Education Plan

A. Federal Government Implementation Mechanisms

Based on the challenges presented in the previous section, in what ways can the Federal Government support the transportation learning environment? This section presents a concise framework whereby government policy makers can examine and implement options to improve the quality of transportation learning. The process begins by examining existing efforts; then builds mechanisms and resources to support contributions from diverse partners; and concludes with disseminating information and achievements to the various stakeholders.[14] In developing the Plan's components, there is emphasis on the projected results of investments made by the numerous partners.[15] Each of the following steps presents the issues that must be addressed. The ultimate achievement will support the challenge as presented by Secretary of Transportation, Rodney Slater, in the above quotation.

1. Quantify Ongoing Efforts

To establish this Plan's focus, it is important to begin by studying the available resources. This involves learning-focused efforts sponsored by DOT, other Federal agencies, the academic sector, and other organizations.

DOT's research and education efforts traditionally have been mode-centered efforts. The UTC program, presented in Part II of this report, as well as new Department-wide partnerships with other government/industry cooperative research efforts represent recent effective multi-modal efforts benefiting from shared communication and resources. Communication and support in the UTC system, for example, are currently provided by formal and informal means: formal through an association of UTC directors; informal through the linkages and peer relationships that evolve between schools' academic and research faculties and industry.

[14] It is beyond the scope of this Plan to provide specific insights into the resource allocations needed to implement these recommendations. This may be the subject of further research efforts.

[15] The topic is already being examined on a broader research basis through the efforts of organizations, such as the National Science and Technology Council. See "Renewing the Federal Government-University Research Partnership for the 21st Century," a NSTC Presidential Review Directive – 4 (April 1999) from the National Science and Technology Council, Office of Science and Technology Policy, Executive Office of the President. Also, see the April 11, 2000 "Ensuring the 21st Century U.S. Scientific, Technical, and Engineering Workforce" by the Interagency Working Group on the U.S. Scientific, Technical, and Engineering Workforce of the Future, Committee on Science of the National Science and Technology Council.

An overview of modal efforts is found in Attachments Four through Fifteen. At the same time, other Federal agencies (e.g., Departments of Defense, Energy, and Commerce, as well as the EPA, NSF, and NASA) have research and education programs that directly or indirectly support transportation learning needs.[16] In some instances, there is a clear transportation focus while in others, the relationship is indirect. A common system does not exist at this point to bring together all these educational endeavors.

To develop a framework, the initial quantifying effort would require two parts. The first involves an understanding of who the participants are, and the second involves what they contribute. Because of the vast number and scope of activities, the challenge is to determine what is significant and what is readily available.

Potential Initial Step

As an initial step in this area, the Department – possibly in conjunction with other Federal organizations such as the NSTC – needs to determine the resource commitment to complete an initial assessment and to maintain an ongoing insight into transportation research and education activities at the post-secondary levels.

2. *Develop Mechanisms to Share Resources and Knowledge Within/Beyond the Transportation Learning Community*

The second step in developing a learning plan involves going beyond the documentation of past and current efforts to sharing resources and knowledge. The goal is to develop a framework so that transportation-related learning materials and opportunities are transferred to those who can benefit from them. It is an ongoing effort that is nowadays supported by technology through the Internet (e.g., websites) and communication mechanisms (e.g., e-mails and chat rooms), as well as linkages to other resources.

To understand the needs of existing and potential stakeholders, it is important to solicit their attitudes and requirements. This involves broadening the transportation partnership to include the new and evolving stakeholders: school-age children, vocational/technical school students, college/university students, academics, academic administrators, researchers, private sector employers, practitioners at various levels, taxpayers, policymakers, interested citizens, and the transportation customer base. Different constituencies have different learning needs. Some want educational programs. Others want research data. Some want teaching materials. Others want access to additional learning resources.

At present, there is no uniform, systematic compilation of resource needs. Therefore, decision makers and implementers will want to answer at least four important questions:

[16] The focus of this Plan is on the efforts of the Department of Transportation. Additional insights into the efforts and investments by other Federal Government agencies can be found in the National Science and Technology Council's Transportation Strategic Research Plan (May 1999).

What do learning stakeholders want?
When do they want it?
In what form do they want it?
How can this material best be provided?

Success depends in part upon three factors: 1) the extent of the outreach used to include diverse viewpoints; 2) the depth of the resources documented and promoted; and 3) the commitment to build, maintain, and evaluate this type of system.

The resource compilation has an added potential benefit. It can help policy planners in developing performance measures that go beyond traditional indicators. In education circles, evaluation is usually done through a quantitative measurement process that tracks items such as enrollments, dollars spent, graduation rates, etc. In research circles, this is usually done through a qualitative peer review process and/or a quantitative process involving publications and presentations.

Efforts are now underway to broaden this perspective. This is important for several reasons. The development of updated performance measures puts transportation initiatives on a more recognized footing along with other topics (e.g., technology, computerization, and communication) that are revolutionizing society. Also, by enhancing benchmarks for success, transportation educators and researchers are in a better position to inform the public.

Potential Initial Step

As an initial step in this area, the Department needs not only to develop and maintain a list of stakeholders, but also to establish a formal methodology to solicit their insights and feedback on an ongoing basis.

3. Build and Target Departmental Research and Education Resources

As part of the process in quantifying and sharing resources, the Department needs to determine and coordinate its own internal commitment. Several networks already exist to highlight and promote the efforts of transportation learning. The Department's Garrett A. Morgan Technology and Transportation Futures Program is one option. The planned UTC database, which would contain annual performance indicator data, would be a second option. Libraries and computerized resources of academic institutions that receive Federal funding are a third option.

The challenge is not only to share knowledge, but also to continually look for ways to eliminate duplication and to build cross cutting efforts. The achievements of other Federal agencies provide a benchmark. For example, the U.S. Department of Agriculture (USDA) has built a system that supports a domestic and international network of research and education activities.

The USDA utilizes its land grant college system, Agricultural Graduate School, research laboratories, National Agricultural Library, and Cooperative Extension Service.

All of these support a distinct part of the agricultural learning environment. The Land Grant College system, with a USDA-funded college in each state, meets the needs of the higher education community. Research is further enhanced and disseminated by the National Agriculture Library. Efforts to provide learning experiences to students at the secondary and elementary level as well as to interested citizens are available through the Cooperative Extension Service (with its offices located within each county of the United States). The professional is able to update his/her existing skills or develop additional ones through the offerings of the USDA Graduate School.

Potential Initial Step

As an initial step in this area, the Department needs to assess the effectiveness of its individual modal efforts and multi-modal efforts, as well as the Garrett A. Morgan Technology and Transportation Futures Program. With this information, Departmental policymakers can determine future resource commitments based on existing successful models, current possible overlap, and projected future goals.

4. Instituting a Process for Selecting and Evaluating DOT-Sponsored Research

Instituting a process or methodology for objectively selecting and evaluating Departmental-supported research is necessary. This ensures that appropriate transportation research is supported; Departmental goals are being met; and a process to support research decisions is in place to present to the American taxpayer. Each Departmental mode would be responsible for developing and instituting such a methodology. It would include performance measures which also will be reflected in each mode's performance plan.

Methodologies may vary according to research area. Therefore, at a minimum, the methodologies must include an objective peer review process for research selection and for evaluating the quality of research results.

Potential Initial Step

As an initial step in this area, Departmental modes will develop and implement an objective peer review process for selecting, monitoring, and evaluating research supported through the Department, including evaluating the progress of such research toward stated Departmental goals.

5. *Leverage Other Federal Research*

Research completed by Departmental resources is only one part of the overall commitment to innovation in transportation.[17] Other branches and agencies within the Federal system are also involved directly and indirectly in this effort. For example, the financial resources set aside by the Department of the Defense for transportation-related research are much larger than those of the DOT. While some of these efforts have specialized significance for military needs, others have a broader payback to support the overall population in areas such as safety and technology innovations.

Many efforts undertaken by other Federal agencies offer promising areas for interagency cooperation. Samples of the ongoing and potential research activities are presented below:

- Design to Accommodate Aging Drivers (DOT/FHWA, DOT/NHTSA)
- Human Cognition and Perception, Social Psychology, Decision, Risk, and Management (NSF)
- Implementation of Piloting Navigation Aids (DOT/MARAD)
- Shipbuilding Research, Maritime Administration (DOD, DOT/MARAD)
- Positive Train Control Systems (DOT/FRA and DOT/FTA)
- Information Technology for Improved Aviation Operational Systems (NASA)
- Knowledge and Distributed Intelligence High-Performance Computing and Communications (NSF)
- Materials program for light and heavy highway vehicles to reduce weight and improve fuel economy (DOE)
- Logistics and cargo handling efforts by industry and academic cooperatives (MARAD, DOD, industry).

Federal partnerships include not only cabinet departments, but also specialized agencies such as NASA, EPA, and NSF. All of these have an active transportation-related research agenda that in the long run meets the needs of specialized interests as well as providing positive benefits to the general population.

Federal Governmental efforts to quantify the research effort take place through its Research and Development in the U.S. (RaDiUS) program. This massive computer-based effort, established by the Office of Science and Technology Policy (OSTP), provides a database to quantify all research carried on by Federal agencies. While it quantifies specific transportation programs, it is difficult to determine transportation efforts supported by agencies beyond the DOT.

[17] For the foreseeable future, the University Transportation Centers will continue to be the focus for Department-wide efforts, especially as they evolve with a more intermodal focus. In most instances, individual centers' stress is on applied as opposed to basic research. Most university/college settings do not have the financial resources and commitment to conducting research that has no clear payback within a given framework.

Potential Initial Step

As an initial step in this area, the Department needs to determine what resources currently exist in the Federal sector to document transportation research and how these might be incorporated into an overall transportation learning system.

6. *Foster Public/Private/Non-Profit Partnerships*

As the DOT builds its resource base, it also needs to enhance existing and to create new partnerships. The Department is a logical focal point to establish and maintain this type of effort both within and beyond the Federal system. On an intra-governmental level, this might entail strengthening linkages within the Department so that resources in each of the modal administrations are better known and publicized. On an inter-governmental level – as presented in the previous section – this might entail coordinating with other Federal agencies and specialized laboratories in order to share information, avoid duplication, and develop complimentary resources.

At different levels of government, this might involve new opportunities with state, local, and municipal governments, especially those with special needs or limitations. Beyond the public sector, there is potential for partnering with traditional learning allies (i.e., academic institutions, non-profits, and the private sector) and new partners (e.g., foundations, unions). The overall goal is to build all these concentric linkages together in order to promote transportation learning in a seamless manner. The outcome will be a mechanism (or a series of mechanisms) to ascertain who the outside interests are; what they do; and how these efforts relate to DOT's mission.

Potential Initial Step

As an initial step in this area, the Department can consider: 1) examining what other sectors are currently doing in post-secondary transportation learning and 2) targeting Departmental resources to build ongoing partnerships with these entities.

7. *Strengthen the DOT University Network of Recognized Centers of Excellence in Transportation Research and Education*

Congress provided both direction and support when it authorized the expansion of the University Transportation Centers Program through TEA-21. The initial 10 regional university centers funded through the Surface Transportation and Uniform Relocation Assistance Act of 1987 have grown into a national effort of 33 centers whose partnerships include a network of colleges and universities that deal with local, regional, national, and international transportation issues. The Federal Aviation Administration also sponsors a Centers of Excellence program which consists of consortiums of colleges and universities promoting long-term research and development in the areas of airport pavement, airworthiness assurance, and operations research.

This provides both opportunities and challenges. On the one hand, it offers exceptional opportunities to develop the transportation research and education agenda. On the other hand, it is a challenge to coordinate and share research agendas and results in order to avoid duplication and stimulate further innovation. The university setting offers a unique collection of experts with a set of technical and policy skills within a broad geographic base. Many have access to the newest innovations and a motive that extends beyond financial incentives. The universities also have a regional base to partner with industry and local/state governmental entities and to potentially achieve early and successful innovations.

The model built up over a century by the USDA in Section IV.A.3 on page 23 provides one alternative for the DOT to build and continue supporting its university network in teaching, research, and technology transfer.

Potential Initial Step

As an initial step in this area, the Department should assess procedures associated with DOT university transportation centers in order to ensure ongoing innovation and recognition of the centers' achievements.

8. *Performance Measures: Establish Baselines*

One of the most important components of the DOT University Transportation Research and Education Plan is measuring the success of individual programs within the research and education collaborative. A baseline must first be established for all measures of success. Subsequent years would be measured against these baselines to determine the rate of progress or success in meeting programmatic goals (i.e., quantifiable results).

The sample metrics below offer a potential method to standardize and quantify results in order to bring about accountability. The metrics have four goals:

1) to benchmark the success of individual programs;
2) to develop documentation on the overall success of research and education programs to outside parties;
3) to highlight additional potential of research and education programs; and
4) to show where improvements need to be made.

The metrics include traditional and innovative measures of success, grouped according to four basic areas: Human Resources, Education, Research, and Innovation/Dissemination. The groupings represent the four areas that DOT modal representatives agreed were the most important in the development of a departmental research and education plan.

The items below are meant as sample measures only. However, the qualitative and quantitative ongoing results from this performance measure effort will provide the basis to gauge success and to determine the direction for future initiatives that meet the needs of Congress, the transportation community, the taxpayers, and the general public.

Sample Performance Measures for DOT
University Transportation Research and Education Plan

Human Resources

University-Oriented

1) Number of DOT partnerships with university-level educational institutions, the private sector, and local transportation agencies that contribute to the preparedness of individuals in or going into the transportation field.

2) Number of universities with transportation-related degree programs receiving DOT funding.

3) Number of partnerships by non-DOT entities resulting in transportation-related activities that contribute to the preparedness of individuals in or going into the transportation field.

4) Number of departments within university providing support (e.g., teaching, facilities, funding, etc.) for transportation programs.

Student-Oriented

1) Number of students graduating with transportation-related (undergraduate and graduate) degrees from universities receiving DOT funding.

2) Diversity of those receiving transportation-related degrees from universities receiving DOT funding.

3) Number of graduates from universities receiving DOT funding moving into transportation-related jobs as first career move.

4) Diversity of graduates from universities receiving DOT funding moving into transportation-related jobs as first career move.

5) Job sector of graduates from universities receiving DOT funding (U.S. citizens or permanent residents) whose first career move has placed them in transportation-related positions.

Education

1) Amount of DOT funding for university-level education programs.

2) Funding received by universities (already receiving DOT funds) from diverse sources (e.g., other governmental, foundation, university, individuals, etc.).

3) Number of transportation-related courses offered by university-level institutions receiving DOT funding.

4) Number of academic departments offering above courses.

5) Number of students completing above courses (one student completing three courses counts as three students).

6) Number of students involved in transportation research projects (one student involved in three research projects counts as three students).

7) Other informal/formal transportation programs sponsored by university-level institutions (e.g., certificate programs).

Research

1) Amount of DOT funding spent for research programs at university-level institutions.

2) Number of university or professional-level transportation research projects conducted in institutions receiving DOT funding.

3) Number of peer-reviewed transportation research reports and books published by institutions receiving DOT funding.

4) Number of transportation research papers and presentations accepted for presentation at academic/professional meetings by institutions receiving DOT funding.

5) Number of external awards received for transportation research by institutions receiving DOT funding.

6) Number of students doing research that has been published.

7) Number and types of external awards and recognition received.

Innovation/Dissemination

Dissemination-focused

1) Number of public/private partnerships formed between DOT and private transportation entities (e.g., educational institutions, professional, etc.) and State DOTs.

2) Number of peer-reviewed transportation research publications available on websites of institutions receiving DOT funding.

3) Number of transportation seminars, symposia, etc., conducted for students and practicing professionals by institutions receiving DOT funding.

4) Number of participants in above events.

5) Number of transportation-related newsletters and periodicals published by institutions receiving DOT funding.

6) Total circulation of above newsletters and periodicals published.

Innovation-focused

1) Total number of individuals employed in transportation-related R&D activities at institutions receiving DOT funding.

2) Amount of funding spent on transportation-related R&D in institutions receiving DOT funding.

3) Amount of funding spent on transportation-related R&D activities with foreign countries by institutions receiving DOT funding.

4) Number of patents and copyrights received by institutions receiving DOT funding.

5) Number of patents and copyrights listed above whose information has been made publicly available.

6) Amount of funding spent on transportation-related R&D by university-level institutions that do not receive DOT funding.

7) Specialized efforts to utilize technology transfer (e.g., Internet-based activities).

Potential Initial Step

As an initial step in this area, the Department needs to determine what baseline measures are appropriate for measuring the overall success of DOT research and education programs. After determining the baselines, measurement data would be annually collected on DOT programs. Mechanisms for collecting measurement data need to be established by DOT modal offices.

9. Publicize Achievements

The final step involves a multi-part process that tracks results, makes resource adjustments (where necessary) and publicizes accomplishments. This is important for several reasons. First, there is a finite set of learning resources (i.e., financial, personnel, tangible linkages such as buildings, intangible linkages such as commitment) available for this type of process. While technology brings about improvements in speed and capacity, it may involve large initial or ongoing expenditures that are beyond the means of many learning establishments. At the same time, needs and expectations are continually changing as research opens up new opportunities. Therefore, the Federal Government's investment in transportation learning involves not only providing support, but also informing the public of the benefits and challenges derived from the nation's investment in transportation research and education. In this way the commitment becomes an ongoing activity instead of something that is examined only at the time of reauthorization or annual budget appropriations.

Potential Initial Step

As an initial step in this area, the Department might convene a group of academics, researchers, and non-partisan external experts in order to examine how to publicize the achievements and future potential of transportation learning efforts.

B. Projected Results

For the planning process to be effective and efficient, it is important to prepare a projected list of expectations that the Federal Government (or in conjunction with other partners) would derive from the resource commitment needed to establish and implement an ongoing research and education plan. This is important even though specific priorities might change since it shows the overall commitment to the process.

The introduction to this document provides an insight into the numerous stakeholders who either impact or are affected by the research and education efforts in transportation. Each of these groups, as listed in Exhibit Three on the next page, should expect the following benefit(s) for participating in the learning process:

Exhibit Three

	Students	Researchers	Teachers	Academic Administrators	Governmental Agencies	Private Sector Partners	Citizens/Taxpayers
Develops Skills	X	X	X				
Enhances Career Opportunities	X	X	X				
Generates Knowledge and Understanding	X	X	X	X	X	X	X
Brings New Students into Field			X	X			
Builds Curricula/Programs	X	X	X	X			X
Prepares Workforce	X				X	X	X
Devises New Services/Products		X			X	X	X
Supports National Well-being		X	X	X	X	X	X
Provides Source of Employment	X	X	X	X	X	X	X

The specific benefits derived from each of these select stakeholders have an important impact on the greater common good.[18] A successfully implemented plan will foster additional creativity and innovation within the transportation system. As presented at the beginning of this document, it will help to maintain America's pre-eminent role as a leader in transportation research and learning, not only in a domestic sense, but also in an international perspective. Learning then becomes both a means and an end to achieve a better world community through an enhanced transportation system.

[18] As leaders in transportation research and education plan for the exciting changes they face in the 21st century, they must prepare both researchers and students—as well as those who currently operate the system—in several ways. In order to compete and to demonstrate leadership, they must have: 1) technical knowledge and skills; 2) analytical ability; 3) communications (and in some cases, intercultural) skills; and 4) technology/computerization skills. At the same time, they need non-traditional skills, such as the ability to negotiate between diverse interests; insights into strategic management of human and capital resources; as well as specialized policy skills (e.g., environmental, financial, operations, human resource, etc.).

"The caliber of the human resource base must be actively nurtured; it is one of the nation's key assets."

- Debra Van Opstal, Vice-President
Council of Competitiveness

V. Conclusion: Establishing and Maintaining a Total Learning Environment in the 21st Century

The ideas presented in this Plan provide the framework to build learning tools for the 21st century. From a practical standpoint, the Plan develops the next generation of transportation leadership and supplements the needs of the existing leaders. At the same time, it strengthens the transportation learning infrastructure. Policymakers throughout the Department may want to examine ways they can implement all or parts of the Plan. The following three steps serve as an initial follow up:

- Request feedback from internal and external sources regarding the major points presented in this document.
- Complete a targeted, prioritized needs inventory as well as determining the different costs involved in implementing portions of the Plan.
- Prepare a resource assessment and projected commitment.

After the preliminary planning process is completed, the Department will be in a better position to determine what part (or parts) of the organization would have ultimate accountability and responsibility for planning, implementing, maintaining, and evaluating the process. In addition, it will need to link learning endeavors to the Department's overall strategic planning process.

The benefits derived from using a university network to support transportation innovations in research and education are found in four areas.

- *Education*

The obvious benefits of training the next generation of transportation-related scholars and practitioners are now part of a greater educational agenda. University settings are becoming part of an effort that extends down to the secondary and elementary effort, in order to interest students in transportation issues and careers.

- *Human Resource Development*

University- and college-based transportation programs prepare the next generation of research scholars, teachers at all levels, practitioners, and operators. This impacts not only on those directly involved, but also on individuals who work in related fields such as defense, environment, energy, etc. The benefits include updating the skills of practitioners and coordinating vocational programs that train transportation operators and mechanics.

- *Research*

The university commitment to research supports the transportation community in numerous ways. There is basic research to develop innovation in a broad topic area with no specific payback date. There is applied research that is more focused to support a targeted agenda with a specific framework for implementation. Finally, there is developmental research that has a very select agenda to meet a highly specific goal.

- *Dissemination of and Support for Future Innovation*

The role of university-based transportation programs is expanding beyond the traditional roles for education and research. An evolving benefit relates to its role as an information resource base. This supports educational institutions, scholars, researchers, the private sector, education programs at the secondary and elementary level (to interest students in transportation and transportation-related careers), as well as the general public.

The successful implementation of this framework builds new learning opportunities and creates the necessary innovation that meets both expected and unexpected challenges. The ideas presented in this Plan support the Secretary's goal of developing a safe, efficient transportation system that not only meets America's—and the world's—needs, but also remains the benchmark for research, education, training, and technology transfer in the highly competitive 21st century environment.

Attachment One

Federal Education Legislation

A capsule view of the history of Federal education activities is provided in the following list of selected legislation:

1787 *Northwest Ordinance* authorized land grants for the establishment of educational institutions.

1802 *An Act Fixing the Military Peace Establishment of the United States* established the U.S. Military Academy. (The U.S. Naval Academy was established in 1845 by the Secretary of the Navy.)

1862 *First Morrill Act* authorized public land grants to the states for the establishment and maintenance of agricultural and mechanical colleges.

1867 *Department of Education Act* authorized the establishment of the U.S. Department of Education.*

* The U.S. Department of Education as established in 1867 was later known as the Office of Education. In 1980, under Public Law 96-88, it became a cabinet-level department. Therefore, for purposes of consistency, it is referred to as the "U.S. Department of Education" even in those tables covering years when it was officially the Office of Education.

1876 *Appropriation Act*, U.S. Department of the Treasury, established the U.S. Coast Guard Academy.

1890 *Second Morrill Act* provided for money grants for support of instruction in the agricultural and mechanical colleges.

1911 *State Marine School Act* authorized Federal funds to be used for the benefit of any nautical school in any of 11 specified state seaport cities.

1935 *Bankhead-Jones Act* (Public Law 74-182) authorized grants to states for agricultural experiment stations.

1936 *An Act to Further the Development and Maintenance of an Adequate and Well-Balanced American Merchant Marine* (Public Law 74-415) established the U.S. Merchant Marine Academy.

1944 *Servicemen's Readjustment Act* (Public Law 78-346), known as the GI Bill, provided assistance for the education of veterans.

1946 *George-Barden Act* (Public Law 80-402) expanded Federal support of vocational education.

1954 *An Act for the Establishment of the United States Air Force Academy and Other Purposes* (Public Law 83-325) established the U.S. Air Force Academy.

Educational Research Act (Public Law 83-531) authorized cooperative arrangements with universities, colleges, and state educational agencies for educational research.

1958 *National Defense Education Act* (Public Law 85-864) provided assistance to state and local school systems for strengthening instruction in science, mathematics, modern foreign languages, and other critical subjects; improvement of state statistical services; guidance, counseling, and testing services and training institutes; higher education student loans and fellowships; foreign language study and training provided by colleges and universities; experimentation and dissemination of information on more effective utilization of television, motion pictures, and related media for educational purposes; and vocational education for technical occupations necessary to the national defense.

1963 *Vocational Education Act of 1963* (Part of Public Law 88-210) increased Federal support of vocational education schools; vocational work-study programs; and research, training, and demonstrations in vocational education.

1964 *Economic Opportunity Act of 1964* (Public Law 88-452) authorized grants for college work-study programs for students from low-income families; established a Job Corps program and authorized support for work-training programs to provide education and vocational training and work experience opportunities in welfare programs; authorized support of education and training activities and of community action programs, including Head Start, Follow Through, and Upward Bound; and authorized the establishment of Volunteers in Service to America (VISTA).

1965 *Higher Education Act of 1965* (Public Law 89-329) provided grants for university community service programs, college library assistance, library training and research, strengthening developing institutions, teacher training programs, and undergraduate instructional equipment. Authorized insured student loans, established a National Teacher Corps, and provided for graduate teacher training fellowships.

1966 *National Sea Grant College and Program Act* (Public Law 89-688) authorized the establishment and operation of Sea Grant Colleges and programs by initiating and supporting programs of education and research in the various fields relating to the development of marine resources.

Adult Education Act (Public Law 89-750) authorized grants to states for the encouragement and expansion of educational programs for adults, including training of teachers of adults and demonstrations in adult education (previously part of Economic Opportunity Act of 1964).

1968 *Vocational Education Amendments of 1968* (Public Law 90-576) modified existing programs and provided for a National Advisory Council on Vocational Education and collection and dissemination of information for programs administered by the Commissioner of Education.

1972 *Education Amendments of 1972* (Public Law 92-318) established the Education Division in the U.S. Department of Health, Education, and Welfare and the National Institute of Education; general aid for institutions of higher education; Federal matching grants for state Student Incentive Grants; a National Commission on Financing Postsecondary Education; State Advisory Councils on Community Colleges; a Bureau of Occupational and Adult Education and State Grants for the design, establishment, and conduct of postsecondary occupational education; and a bureau-level Office of Indian Education. Amended current U.S. Department of Education programs to increase their effectiveness and better meet special needs. Prohibited sex bias in admission to vocational, professional, and graduate schools, and public institutions of undergraduate higher education.

1974 *Education Amendments of 1974* (Public Law 93-380) provided for the consolidation of certain programs; and established a National Center for Education Statistics.

1975 *Indochina Migration and Refugee Assistance Act of 1975* (Public Law 94-23) authorized funds to be used for education and training of aliens who have fled from Cambodia or Vietnam.

1976 *Education Amendments of 1976* (Public Law 94-482) extended and revised Federal programs for education assistance for higher education, vocational education, and a variety of other programs.

1978 *Tribally Controlled Community College Assistance Act of 1978* (Public Law 95-471) provided Federal funds for the operation and improvement of tribally controlled community colleges for Indian students.
Middle Income Student Assistance Act (Public Law 95-566) modified the provisions for student financial assistance programs to allow middle-income as well as low-income students attending college or other post-secondary institutions to qualify for Federal education assistance.

1979 *Department of Education Organization Act* (Public Law 96-88) established a U.S. Department of Education containing functions from the Education Division of the U.S. Department of Health, Education, and Welfare along with other selected education programs from HEW, the U.S. Department of Justice, U.S. Department of Labor, and the National Science Foundation.

1983 *Challenge Grant Amendments of 1983* (Public Law 98-95) amended Title III, Higher Education Act, and added authorization of Challenge Grant program. The Challenge Grant program provides funds to eligible institutions on a matching basis as an incentive to seek alternative sources of funding.

1984 *Education for Economic Security Act* (Public Law 98-377) added new science and mathematics programs for elementary, secondary, and postsecondary education. The new programs included magnet schools, excellence in education, and equal access.

1985 *Montgomery GI Bill - Active Duty* (Public Law 98-525), brought about a new GI Bill for individuals who initially entered active military duty on or after July 1, 1985.

Montgomery GI Bill - Selected Reserve (Public Law 98-525), is an education program for members of the Selected Reserve (which includes the National Guard) who enlist, reenlist, or extend an enlistment after June 30, 1985, for a 6-year period.

1987 *Higher Education Act Amendments of 1987* (Public Law 100-50) made technical corrections, clarifications, or conforming amendments related to the enactment of the Higher Education Amendments of 1986.

1990 *Excellence in Mathematics, Science and Engineering Education Act of 1990* (Public Law 101-589) promotes excellence in American mathematics, science, and engineering education by creating a national mathematics and science clearinghouse, and creating several other mathematics, science, and engineering education programs.

Public Service Assistance Education Act (Enacted as part of Department of Defense Authorization Act, Public Law 101-510) gave Federal agencies authority to provide new educational benefits to employees by paying for an employee to obtain an academic degree for which there is an agency shortage of qualified personnel, and by repaying up to $6,000 per year of the student loan of a qualified employee in exchange for a 3-year commitment.

1991 *National Defense Authorization Act for Fiscal Years 1992 and 1993* (Public Law 102-190) authorized appropriations for education functions of the U.S. Department of Defense. Included Defense Manufacturing Education Program and planning for science, mathematics, and engineering education.

Veterans' Educational Assistance Amendments of 1991 (Public Law 102-127) restored certain educational benefits available to reserve and active-duty personnel under the Montgomery GI Bill to students whose course studies were interrupted by the Persian Gulf War.

1992 *Higher Education Amendments of 1992* (Public Law 102-325) amended the Higher Education Act of 1965 to revise and reauthorize funding for its various programs.

1994 *School-To-Work Opportunities Act of 1994* (Public Law 103-239) established a national framework within which states and communities can develop School-To-Work Opportunities systems to prepare young people for first jobs and continuing education. The Act also provided money to states and communities to develop a system of programs that include work-based learning, school-based learning, and connecting activities components.

School-To-Work programs will provide students with a high school diploma (or its equivalent), a nationally recognized skill certificate, or an associate degree (if appropriate) and may lead to a first job or further education.

Educational Research, Development, Dissemination, and Improvement Act of 1994 (Part of Public Law 103-227) authorized the educational research and dissemination activities of the Office of Educational Research and Improvement. The regional educational laboratories and university-based research and development centers are authorized under this act.

1996 *Remove Grant Limits on Historically Black Colleges* (Public Law 104-141) amended section 326 of the Higher Education Act of 1965 to permit continued participation by historically black graduate and professional schools in the grant program authorized by that section.

1997 *The Taxpayer Relief Act of 1997* (Public Law 105-34) enacted the Hope Scholarship and Life-Long Learning Tax Credit provisions into law.

Individuals with Disabilities Education Act Amendments of 1997 (Public Law 105-17) amends the Individuals with Disabilities Education Act (IDEA) to revise its provisions and extend through fiscal year 2002 the authorization of appropriations for IDEA programs.

For a more complete listing of Federal Education Legislation, refer to website of National Center for Education Statistics:

http://nces.ed.gov/

Attachment Two

Current University Transportation Centers Program

The University Transportation Centers (UTC) program, initiated in 1987 under the Surface Transportation and Uniform Relocation Assistance Act, authorized the establishment and operation of transportation centers in each of the 10 standard Federal regions. The Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA) reauthorized the UTCs for an additional 6 years and added four national centers and 6 University Research Institutes (URI). The mission of the 14 UTCs was to advance U.S. expertise and technology transfer. The six URIs each had a specific transportation research and development mandate.

The Transportation Equity Act for the 21st Century (TEA-21), enacted on June 9, 1998, established 13 new UTCs, and reauthorized 14 existing UTCs and six centers formerly known as University Research Institutes (URIs) previously funded under ISTEA. TEA-21 established education as one of the primary objectives of a university transportation center, institutionalized the use of strategic planning in university grant management, and reinforced the program's focus on multi-modal transportation. The UTC program is administered by RSPA, with funding from FHWA and FTA.

Listed below are the 33 current UTCs.

- **Assumption College**; Worcester, Massachusetts (Group B*)

  Center Theme: Transportation and Environmental Education for the Twenty-First Century
  Yrs. of Operation as a UTC: 1998-2002

- **City College of New York**; New York, New York (Group A*)

  Center Theme: Planning and Management of Regional Transportation Systems
  Yrs. of Operation as a UTC: 1988-2004

- **George Mason University (w/consortium of VA universities)**; Fairfax, Virginia (Group D*)

  Center Theme: Deployment of Intelligent Transportation Systems (ITS)
  Yrs. of Operation as a UTC: 1998-2004

- **Iowa State University**; Ames, Iowa (Group A*)

  Center Theme: Sustainable Transportation Asset Management
  Yrs. of Operation as a UTC: 1988-1995*; 1999-2004
  *[from 1988-1995, Center theme was Intelligent Transportation Systems (ITS) and Geographic Information Systems (GIS). From 1995-1999, Center operated without DOT funding.]

- **Marshall University (w/consortium of WV universities)**; Huntington, West Virginia (Group D*)

  Center Theme: Transportation and Economic Development in Mountain Regions
  Yrs. of Operation as a UTC: 1998-2004

- **Massachusetts Institute of Technology**; Cambridge, Massachusetts (Group A*)

  ***Center Theme*:** Strategic Management of Transportation Systems
  Yrs. of Operation as a UTC: 1988-2004

- **Montana State University, Bozeman**; Bozeman, Montana (Group D*)

  Center Theme: Rural Travel and Transportation
  Yrs. of Operation as a UTC: 1998-2004

- **Morgan State University**; Baltimore, Maryland (Group C*)

  Center Theme: Transportation: A Key to Human and Economic Development
  Yrs. of Operation as a UTC: 1992-2002

- **New Jersey Institute of Technology**; Newark, New Jersey (Group C*)

  Center Theme: Productivity Increases Through Transportation Improvements
  Yrs. of Operation as a UTC: 1992-2002

- **North Carolina A&T State University**; Greensboro, North Carolina (Group C*)

  Center Theme: Urban Transit Performance in Small and Rural Areas
  Yrs. of Operation as a UTC: 1992-2002

- **North Carolina State University**; Raleigh, North Carolina (Group C*)

  Center Theme: Transportation and the Environment
  Yrs. of Operation as a UTC: 1992-2002

- **North Dakota State University**; Fargo, North Dakota (Group A*)

  Center Theme: Rural and Intermodal Transportation
  Yrs. of Operation as a UTC: 1988-2004

- **Northwestern University**; Evanston, Illinois (Group D*)

  Center Theme: Infrastructure Technology
  Yrs. of Operation as a UTC: 1992-2004

- **Pennsylvania State University**; University Park, Pennsylvania (Group A*)

  Center Theme: Advanced Technologies in Transportation Operations and Management
  Yrs. of Operation as a UTC: 1988-2004

- **Purdue University**; West Lafayette, Indiana (Group B*)

  Center Theme: Safe, Quiet and Durable Highways
  Yrs. of Operation as a UTC: 1998-2002

- **Rutgers University**; Piscataway, New Jersey (Group B*)

  Center Theme: Advanced Transportation Infrastructure: Maintenance and Operation of High Volume Systems
  Yrs. of Operation as a UTC: 1998-2002

- **San Jose State University**; San Jose, California (Group C*)

  Center Theme: Policy Guidance of Transportation Management Systems
  Yrs. of Operation as a UTC: 1992-2002

- **South Carolina State University**; Orangeburg, South Carolina (Group B*)

  Center Theme: Professional Capacity Building in Transportation
  Yrs. of Operation as a UTC: 1998-2002

- **Texas A&M University**; College Station, Texas (Group A*)

  Center Theme: Transportation Solutions to Enhance Prosperity and the Quality of Life
  Yrs. of Operation as a UTC: 1988-2004

- **University of Alabama**; Tuscaloosa, Alabama (Group C*)

  Center Theme: Management and Safety of Transportation Systems
  Yrs. of Operation as a UTC: 1998-2002

- **University of Arkansas**; Fayetteville, Arkansas (Group C*)

  Center Theme: Rural Transportation
  Yrs. of Operation as a UTC: 1988-2002

- **University of California**; Berkeley, California (Group A*)

  Center Theme: Transportation Systems Analysis and Policy
  Yrs. of Operation as a UTC: 1988-2004

- **University of Central Florida**; Orlando, Florida (Group B*)

  Center Theme: Advanced Transportation Systems Simulation
  Yrs. of Operation as a UTC: 1998-2002

- **University of Denver and Mississippi State University**; Denver, Colorado and Mississippi State, Mississippi (Group B*)

  Center Theme: Intermodal Transportation: Assessment, Planning, and Design
  Yrs. of Operation as a UTC: 1998-2002

- **University of Idaho**; Moscow, Idaho (Group C*)

  Center Theme: Advanced Transportation Technology
  Yrs. of Operation as a UTC: 1992-2002

- **University of Minnesota**; Minneapolis, Minneapolis (Group D*)

  Center Theme: Human-Centered Transportation Technology
  Yrs. of Operation as a UTC: 1992-2004

- **University of Missouri, Rolla**; Rolla, Missouri (Group B*)

  Center Theme: Advanced Materials and Non-Destructive Testing Technologies
  Yrs. of Operation as a UTC: 1998-2002

- **University of Rhode Island**; Kingston, Rhode Island (Group D*)

  Center Theme: Surface Intermodal Transportation Systems and Advanced Transportation Infrastructure with Special Reference to the Marine Environment
  Yrs. of Operation as a UTC: 1998-2004

- **University of Southern California and California State University, Long Beach**; Los Angeles, California and Long Beach, California (Group B*)

  Center Theme: Metropolitan Transportation
  Yrs. of Operation as a UTC: 1998-2002

- **University of South Florida**; Tampa, Florida (Group C*)

  Center Theme: Transit and Alternative Forms of Urban Transportation
  Yrs. of Operation as a UTC: 1992-2002

- **University of Tennessee**; Knoxville, Tennessee (Group A*)

  Center Theme: Transportation Safety
  Yrs. of Operation as a UTC: 1988-2004

- **University of Washington**; Seattle, Washington (Group A*)

  Center Theme: Transportation Operations and Planning
  Yrs. of Operation as a UTC: 1988-2004

- **University of Wisconsin-Madison**; Madison, Wisconsin (Group A*)

  Center Theme: Optimization of Transportation Investment and Operations
  Yrs. of Operation as a UTC: 1999-2004

***FUNDING, BY GROUP:**

Group A: 10 UTCs funded at $1M/Year for 5 Years, (1999-2003).

Group B*: 8 UTCs funded at $300K/Year for first two years (1998-1999); $500K/Year for years 3 and 4 (2000-2001).

Group C*: 9 UTCs funded at $750K/Year for first 4 years (1998-2001).

*In years 5 and 6, there will be a competition among Groups B and C for a total of 10 grants funded at $1M each per year (2002-2003).

Group D: 6 UTCs funded at $2M/Year for 6 years (1998-2003).

Attachment Three

Samples of Academic Efforts in Support of Federal Enabling Research

Categories of Enabling Research	***Samples of University Research Efforts***
- Human Performance And Behavior *(Research to increase understanding of factors that affect human performance and behavior within the transportation system, and to guide development of technologies and procedures that maximize human safety and efficiency in transportation-related activities)*	A University of Minnesota research team, working to increase the safety of snowplow and emergency vehicle operation in low visibility conditions, has received a $2.65 million boost from the Federal Highway Administration (FHWA), the Minnesota Department of Transportation (MN/DOT), and transportation-related industries.
- Advanced Materials *(Research on new generations of vehicle components, vehicle propulsion systems, and transportation-related construction materials, that achieve cost savings high-performance, and enhanced efficiency)*	A University of Missouri-Rolla project is building a concrete box culvert bridge using composite reinforcing bars, and will monitor its behavior over time. Experimental tests are carried out in the laboratory on full-size elements to validate feasibility of the design and structural performance.
- Computer, Information, and Communication Systems *(Research on the development and application of advanced technologies to support information processing and communications in 21st Century transportation systems)*	TEL8, a telecommunications system, has been established to serve the needs of the state departments of transportation and the universities of the Mountain-Plains Consortium. The Consortium is headed by North Dakota State University (NDSU). Making use of interactive video conferencing, TEL8 serves the state DOTs in North Dakota, South Dakota, Montana, Utah, and Wyoming, as well as NDSU, Colorado State University, the University of Utah, and the University of Wyoming. NDSU serves as the administrative site. TEL8 allows for the interchange of activities such as the sharing of graduate courses or short courses geared toward professionals on various subjects of interest such as ITS and traffic signaling.

- Energy and Environment

(Research on transportation technologies, policies, and strategies to reduce pollution, conserve resources, and otherwise protect the environment)

A project at North Carolina State University will develop a new method for evaluating the impacts of strategies aimed at preventing motor vehicle air pollutant emissions through better traffic management. Measurement of actual on-road emissions is used as a basis for determining proposed mitigation strategies.

- Sensing and Measurement

(Research on the development and application of technologies to monitor, analyze, quantify, and thereby improve the safety and performance of transportation systems)

A project at the New Jersey Institute of Technology is evaluating automatic vehicle location (AVL) performance under standard operational conditions. It will also evaluate the aptness of NJ Transit digital mapping datasets for AVL applications. A computer program will be developed to match the location provided by the AVL system with a feature on a digital map.

- Tools for Transportation Modeling, Design, and Construction

(Research on state-of-the-art tools and procedures for simulation, modeling, design, and analysis of transportation systems and their components to improve the assessment of system requirements)

A study at the University of Texas is developing a framework of a dynamic system to simulate the life-cycle performance of pavements. System analysis will be carried out to identify and define the system requirements, such as operational requirements, functional requirements, and data requirements. Based on the defined system requirements, a system framework will be developed such that all information affecting pavement performance will be included. All the required system models will then be identified.

Attachment Four

U.S. DOT University and Research Programs
Federal Aviation Administration (FAA)

Aviation Research Grants Program:

Participants focus on applied research topics relevant to program requirements on safety and security.

Centers of Excellence:

This program represents a consortium of colleges and universities promoting long-term research and development in the areas of airport pavement, airworthiness assurance, and operations research.

FAA Fellows Program:

Participants are chosen from FAA employees and are provided opportunities for graduate education and research.

Joint University Program (JUP):

Participants focus on basic research in topics related to air traffic management, control theory, aided decision making, human factors, and communications, navigation, and surveillance. Massachusetts Institute of Technology, Ohio State University, and Princeton University participate jointly with the FAA and NASA.

University Fellows Program:

Participating universities choose and support graduate fellows to work on relevant FAA defined projects. Students are encouraged to spend summers at the FAA's Technical Center in Atlantic City working on aviation-related projects. Rutgers University and Drexel University are the current participating universities.

Internet Site:
www.faa.dot.gov

Attachment Five

U.S. DOT University and Research Programs
Federal Highway Administration (FHWA)

Dwight David Eisenhower Transportation Fellowship Program (DDETFP):

Through this program, the best and brightest minds are attracted to transportation-related careers. Fellowship awards categories include: Grants for Research Fellowships (GRF), Graduate Fellowships (GRAD), Faculty Fellowships (FF), Historically Black Colleges and Universities (HBCU) Fellowships, Hispanic Serving Institutions (HSI) Fellowships, and Tribal Colleges Fellowships (TCF).

Intelligent Transportation System (ITS) Professional Capacity Building Program:

A number of universities are supporting this program through the development of curricula based on needs analysis and the development of web-based pilot courses.

Local Technical Assistance Program (LTAP):

This program provides funding and program support to technology transfer centers serving 38,000 towns, counties, and tribal governments in all 50 States, Puerto Rico, and Native American Tribal governments. Thirty-eight of the fifty-seven centers are managed by universities, with the remaining centers managed by state Departments of Transportation.

National Highway Institute (NHI) Training:

NHI offers education and training programs to transportation employees at all levels of the Federal, State, and local governments, U.S. industry, and the international transportation community. Courses cover a wide range of topics including pavement research, congestion management, ITS planning, seismic design and retrofitting of bridges, etc.

National Summer Transportation Institutes for Secondary Students (NSTI):

This program provides the opportunity for students in grades 9-11 to spend 4 weeks on college campuses to increase their awareness of the transportation field and career opportunities.

RD&T Administered University Grants and Contracts:

Under provisions in TEA-21, this program provides grants and contracts to 14 universities to conduct research on a wide variety of transportation- related topics.

Summer Transportation Intern Program for Diverse Groups:

This program offers participants 10-week summer internships for undergraduates involving research and hands-on experience in the work of the U.S. DOT.

University Transportation Centers Program:

FHWA participates in the UTC program as the funding agency for certain universities participating in the program. FHWA also participates in UTC activities in an advisory capacity as appropriate.

Internet Site:
www.fhwa.dot.gov

Attachment Six

U.S. DOT University and Research Programs
Federal Transit Administration (FTA)

Joint Partnership Program (JPP) for Deployment of Innovation:

The JPP is the primary implementation mechanism for the activities of the FTA's National Research and Technology Program. The JPP includes partners from industry, state and local governments, as well as with national laboratories and universities.

National Transit Institute (NTI):

The National Transit Institute develops and teaches new methods and techniques to improve transit workforce performance and to increase productivity in the workplace. Courses are taught locally and cover a wide range of subjects. In addition, the Institute conducts Transit Trainer Workshops which bring together trainers and human resource specialists.

Transit Cooperative Research Program (TCRP):

This program focuses on issues significant to the transit industry with emphasis on local problem solving research. Research fields include planning, service concepts, operations research, human resources, policy, and administrative practices.

University Transportation Centers Program:

FTA participates in the UTC Program as the funding agency for the following UTCs: North Carolina State University, Northwestern University, Morgan State University, and the University of Minnesota. FTA also participates as desired in other UTCs whose themes involve transit issues.

Internet Site:
www.fta.dot.gov

Attachment Seven

U.S. DOT University and Research Programs
United States Coast Guard (USCG)

United States Coast Guard Academy:

The United States Coast Guard Academy at New London, Connecticut offers tuition-free college education to qualified applicants. Admission to the Academy is based on nationwide competition. An average of 265 students enter the Academy each year out of approximately 5500 applicants. Each graduate receives a Bachelor of Science degree in one of eight majors and a commission as an Ensign in the U.S. Coast Guard. Each graduate is required to serve a minimum of 5 years of active duty upon graduation.

United States Coast Guard Research and Development Center:

The United States Coast Guard Research and Development Center, Groton, Connecticut conducts research into maritime safety, search and rescue, and the use of cutting edge technologies to achieve the mission of the Coast Guard. The Center works in partnership with universities, industry, the Department of Defense, the Environmental Protection Agency, and national laboratories. It has a number of grant and fellowship programs that provide exposure to the maritime environment.

Internet Site:
www.uscg.dot.gov

Attachment Eight

U.S. DOT University and Research Programs
U.S. Maritime Administration (MARAD)

U.S. Merchant Marine Academy:

The United States Merchant Marine Academy, Kings Point, New York provides highly qualified personnel to both the maritime industry and the military. Graduates receive a Bachelor of Science degree, a U.S. Coast Guard license as a Third Mate or Third Assistant Engineer, and a commission in the U.S. Navy.

The Academy engages in collaborative educational and research ventures with other academic institutions, government agencies, and corporations to leverage resources and strengths. Examples of these are:

1) Faculty/student exchanges and joint R&D programs with the University Transportation Centers at Penn State University and Northwestern University, and a consortium of European universities;
2) Cooperative education, research, and training agreements with DOT modal administrations;
3) Logistics and Transportation research internship with the Volpe National Transportation Systems Center;
4) Joint case study development project with Sea-Land Service, Inc.; and
5) Expanded internships and a new mentoring program.

U.S. Merchant Marine Academy's Continuing Education Program:

This program provides professional education and training for personnel in both military and commercial organizations. Examples are: *Strategic Intermodal Transportation* and *Global Logistics Management.*

Center for Commercial Deployment of Transportation Technologies (CCDoTT):

CCDoTT located at California State University, Long Beach, is chartered to demonstrate agile port and high-speed sealift and other rapid vessel deployment technologies. MARAD and the U.S. Transportation Command (DOD) partner with CCDoTT which is also a consortium of five universities. Technologies under development help the military to deploy more quickly, increase total asset visibility, and expand the ability of commercial transportation infrastructure to accommodate military surge cargo while minimizing commercial cargo disruption.

Summer Internship Program with St. Mary's College:

In its second year, this program is designed for students interested in learning about careers in transportation and the challenges facing this industry in the 21st century. The students work with agency mentors to help with MARAD's mission and have the option of taking the internship for credit.

Internet Site:
www.marad.dot.gov

Attachment Nine

U.S. DOT University and Research Programs
National Highway Traffic Safety Administration (NHTSA)

Cooperative Research Agreements and Partnerships:

NHTSA's Office of Safety Assurance has a number of cooperative research agreements including the National Crash Center at the University of Maryland and a biomedical research agreement with Ohio State University, the University of Michigan, the University of Virginia, the University of Wisconsin, George Washington University, and Virginia Tech.

The National Advanced Driving Simulator (NADS) represents a cooperative research agreement with the University of Iowa and industry – including TRW, Dynamic Research Inc., Evans & Sutherland, I*SIM, and MTS Systems.

Partnership for a New Generation of Vehicles (PNGV) is a consortia of the auto industry as well as government agencies.

NHTSA's Office of Traffic Safety Programs has current and previous assignments for one year and longer to work on various TSP initiatives with George Washington University, West Virginia University, Morgan State University, and Howard University.

NHTSA's Office of State and Community Services has cooperative agreements with a number of universities including Boston University and Clark University. These agreements allow minority students to gain hands-on experience in the field of traffic safety and other related areas. In the past, State and Community Services has held a cooperative agreement with Morgan State University.

TEA-21 State Highway Safety Program/Grants:

This program provides in excess of $2 billion for highway safety research and development grants.

Internet Site:
www.nhtsa.dot.gov

Attachment Ten

U.S. DOT University and Research Programs
Federal Railroad Administration (FRA)

Next Generation High Speed Rail:

- **Broad Agency Announcement (BAA):** FRA provides discretionary funding in the areas of Grade Crossing, Hazard Mitigation, Track & Structures, and Advanced Train Control Systems. Using the BAA as a mechanism, proposals are solicited from a wide range of organizations and institutions, including academia.

- **Innovations Deserving Exploratory Analysis (IDEA):** FRA provides funding to the Transportation Research Board (TRB) under the IDEA program for Intelligent Transportation Systems (ITS) and for High Speed Rail. Program participants include academic institutions as well as other organizations involved in advanced transportation technology.

Transportation Technology Center:

In conjunction with the Transportation Technical Center, Inc. (TTCI), a wholly owned subsidiary of the Association of American Railroads (AAR), this state-of-the-art facility in Pueblo, Colorado serves as a testing and evaluation site for rail technologies. It provides support as required to FRA-sponsored research, including those under university grant projects. It also provides direct field experience to both students and faculty in cooperation with the TTCI as appropriate.

University Research Grant Program:

This program is intended to foster long-range enhancement of FRA's program of research in support of railroad safety by developing cooperative research relationships between the FRA and selected university research organizations. The program supports two goals of the *National Transportation Science and Technology Strategy*: establishing strategic partnership initiatives and supporting transportation education and training. Awards are made to selected universities which have expertise useful in complementing FRA's R&D program. It is expected that each year a small number of grants will be awarded in the $100,000 - $200,000 range, with a combined value of about $1,000,000. Cost sharing is encouraged.

Internet Site:
www.fra.dot.gov

Attachment Eleven

U.S. DOT University and Research Programs
Saint Lawrence Seaway Development Corporation (SLSDC)

Partnership with Clarkson University and the St. Lawrence County School System:

This agreement, established in 1997, partners SLSDC, Clarkson University of Potsdam, New York, and the St. Lawrence County school system. The partnership combines aspects of the Garrett A. Morgan Program and the county's "Tech Prep Program" with the goal of giving high school students an opportunity to supplement their classroom experience in the real business world at local companies and agencies.

Internet Site:
www.dot.gov/slsdc

Attachment Twelve

U.S. DOT University and Research Programs
Research and Special Programs Administration (RSPA)

Garrett A. Morgan Technology and Transportation Futures Program:

RSPA leads a wide range of activities under the Garrett A. Morgan Technology and Transportation Futures Program. This Department-wide grassroots effort serves as a catalyst for enhancing transportation education at all levels.

University Transportation Centers Program:

This Program includes 33 centers located at universities and colleges throughout the U.S. The purpose of the centers is to advance U.S. technology and expertise in the many disciplines comprising transportation through the mechanisms of education, research and technology transfer at university-based centers of excellence. Goals include: the inclusion of a multi-disciplinary approach reflecting the chosen theme of the center; increasing the numbers of students, faculty and staff involved in the undergraduate, graduate and professional programs of the center; increasing participation and awareness of transportation-related disciplines; providing diversity in the transportation community; providing an objective process for reviewing and selecting research projects; and providing for both an on-going program of basic and applied research as well as a technology transfer program. RSPA administers the UTC Program with funding from FHWA and FTA.

Internet Site:
www.rspa.dot.gov

Attachment Thirteen

U.S. DOT University and Research Programs
Bureau of Transportation Statistics (BTS)

Transportation Statistics Research Grants:

This grant program was established in 2000 to advance the field of transportation statistics. BTS will award up to $500,000 annually to institutions of higher education for innovative projects that support the development of the field of transportation statistics or involve research and development in transportation statistics.

National Transportation Library:

The National Transportation Library is administered by BTS and is a repository of materials from public and private organizations throughout the U.S. Its purpose is to facilitate the exchange of information related to transportation.

The Intermodal Transportation Data Base:

BTS is building the Intermodal Transportation Data Base, a web-based transportation data access tool with on-line documentation and links across data sets. This will increase the accessibility and usability of transportation statistics for researchers and others.

Internet Site:
www.bts.dot.gov

Attachment Fourteen

Federal Motor Carrier Safety Administration (FMCSA)

The Federal Motor Carrier Safety Administration was established on January 1, 2000, as a new operating administration within the Department of Transportation. The efforts of FMCSA include:

National Training Center:

The FMCSA's National Training Center provides training to Federal, state, and local officials in new roadside inspection procedures and accompanying technologies for commercial trucks and buses. Professionals can update their existing skills or develop additional ones in a supportive learning environment.

Research and Development Program:

This program advances research and technology for crash causation and risk factors; regulatory evaluation and reform; compliance and enforcement; hazardous materials safety and cargo tank integrity; commercial driver training and performance enhancement; driver alertness and fatigue; driver physical qualifications; and car-truck proximity. University research centers are primary targets of opportunity for commercial vehicle research and technology.

Safety Outreach Program:

This outreach program, directed to both industry and the public, focuses on fatigue recognition, management, and countermeasures and has broad appeal beyond the trucking industry.

Cooperative Research Agreements and Partnerships:

FMCSA Partnership for Sharing the Road/"No-Zone" campaign, directed toward the driving public, was created to educate motorists on how to safely share the road with large trucks and motor coaches. The Technology Truck is designed to demonstrate, educate and inform state regulatory agencies, decision makers and motor carrier communities about the technologies and potential benefits of the ITS/CVO program.

The New Mexico State University's Physical Science Laboratory, together with the FMCSA and New Mexico State Highway and Public Safety Departments, will produce state-of-the-art technologies to improve the safety and efficiency of commercial vehicle traffic crossing the international border and support New Mexico's Commercial Vehicle Information Systems and Networks deployment activities.

Internet Site:
www.fmcsa.dot.gov

Attachment Fifteen

Office of Civil Rights
Office of Minority Serving Institutions and Educational Partnerships

DOT is committed to increasing diversity in its workforce by providing internship opportunities. Interns work during the spring, summer and fall months in one of the DOT administrations nationwide. The Office of Minority Serving Institutions (MSI) and Educational Partnerships Office in Washington, DC coordinates and administers the Department's MSI programs. DOT maintains partnerships with many non-profit educational organizations including the National Association for Equal Opportunity in Higher Education (NAFEO), Hispanic Association of Colleges and Universities (HACU), and Tribal Colleges and Universities (TCU) through American University's Washington Internships for Native Students Program.

Equal Opportunity Statement: DOT research and development programs, endowments, grants and other federally funded programs do not discriminate on the basis of race, color, national origin, religion, age, disability, reprisal, or sexual orientation. For further information contact: Office of Civil Rights, DOT, 400 7th St., SW, Rm. 10215, Washington, DC 20590.

The objectives of the MSI and Educational Partnerships Office include:

- Administering program requirements prescribed by the following Executive Orders (E.O.) to increase educational opportunities for under-served populations and to ensure equal opportunity in and access to all DOT educational programs and activities:

  E.O. 12876: Historically Black Colleges and Universities
  E.O. 12900: Educational Excellence for Hispanic Americans
  E.O. 13021: Tribal Colleges and Universities
  E.O. 13096: American Indian and Alaska Native Education

- Merging academic study with practical work experience for students majoring in relevant fields and related disciplines.

- Creating a pool of talented students to explore and understand professional practices within DOT through exposure to research and development, technology, administration, and the Federal Government environment.

- Providing professional experience for ethnically diverse students and students with disabilities that will enable them to make informed career choices.

- Creating a pool of potential future employees who have had positive, meaningful work experiences with the Federal Government, and consider DOT as a serious career choice.

Internet Site:
www.dot.gov/msi/msihome.htm

Internet Sites

Government Sites:

1.	www.dot.gov	US Department of Transportation
2.	www.dol.gov	US Department of Labor
3.	http://stats.bls.gov/blshome.htm	US Bureau of Labor Statistics
4.	www.ed.gov	US Department of Education
5.	http://nces.ed.gov/	National Center for Education Statistics
6.	www.ed.gov/NLE	National Library of Education
7.	http://www.ed.gov/offices/OVAE/	Office of Adult and Vocational Education
8.	www.doc.gov	US Department of Commerce
9.	www.nsf.gov	National Science Foundation
10.	http://education.dot.gov/	Garrett A. Morgan Technology & Transportation Futures Program

University Transportation Sites: *(past and current UTCs are listed)*

1.	http://www.assumption.edu/acad/Institutes/UTC/html/main.html	Assumption College
2.	http://www.ccny.cuny.edu/	City College of New York
3.	http://www.paragoncom.com/ITS/	George Mason University
4.	http://www.ctre.iastate.edu/mtc/index.htm	Iowa State University
5.	http://www.marshall.edu/	Marshall University (w/West Virginia consortium)
6.	http://web.mit.edu/cts/www/research/re_utc.html	Massachusetts Institute of Technology
7.	http://www.coe.montana.edu/wti	Montana State University
8.	http://www.eng.morgan.edu/~ntc/	Morgan State University
9.	http://kimon.njit.edu/nctip/	New Jersey Institute of Technology
10.	http://www.ncat.edu/	North Carolina A&T University
11.	http://itre.ncsu.edu/cte/cte.html	North Carolina State University
12.	http://www.ugpti.org/mpc.htm	North Dakota State University
13.	http://www.iti.northwestern.edu/	Northwestern University
14.	http://www.pti.psu.edu/mautc/index.htm	Pennsylvania State University
15.	http://widget.ecn.purdue.edu/~sqdh/	Purdue University

16. http://www.cait.rutgers.edu/	Rutgers University
17. http://www.utc.scsu.edu/	South Carolina State University
18. http://transweb.sjsu.edu/	San Jose State University
19. http://swutc.tamu.edu/	Texas A&M University
20. http://bama.ua.edu/~utca/	University of Alabama
21. http://www.cveg.uark.edu/mbtc/	University of Arkansas
22. http://violet.berkeley.edu/~uctc/	University of California
23. http://www.ucf.edu/	University of Central Florida
24. http://www.ie.msstate.edu/ncit/	University of Denver and Mississippi State University
25. http://niatt.uidaho.edu/niatt	University of Idaho
26. http://www.umtri.umich.edu/glcttr/	University of Michigan
27. http://www.its.umn.edu/	University of Minnesota
28. http://www.utc.umr.edu/	University of Missouri – Rolla
29. http://www.unl.edu/	University of Nebraska – Lincoln
30. http://www.uri.edu/uritc/	University of Rhode Island
31. http://www.nctr.usf.edu/	University of South Florida
32. http://www.metrans.org/	University of Southern California and California State Long Beach
33. http://www.ra.utk.edu/stc/	University of Tennessee
34. http://depts.washington.edu/transnow/	University of Washington
35. http://www.engr.wisc.edu/centers/utc/	University of Wisconsin-Madison

Education-Related Sites:

1. www.aaup.org	American Association of University Professors
2. www.aera.net	The Education and Research Network
3. www.acteonline.org	Association for Career and Technical Education
4. www.chronicle.merit.edu	Chronicle of Higher Education
5. www.iteawww.org	International Technical Education Association

Acronym List

AAR	Association of American Railroads
AASHTO	American Association of State Highway and Transportation Officials
AIHEC	American Indian Higher Education Consortium
APTA	American Public Transportation Association
APWA	American Public Works Association
ATP	Advanced Technology Program
AVL	Automatic Vehicle Location
BAA	Broad Agency Announcement
BLS	Bureau of Labor Statistics
BTS	Bureau of Transportation Statistics
CCDoTT	Center for Commercial Deployment of Transportation Technologies
CRADA	Cooperative Research and Development Agreement
DARPA	Defense Advance Research Programs Agency
DDETFP	Dwight David Eisenhower Transportation Fellowship Program
DOC	U.S. Department of Commerce
DOD	U.S. Department of Defense
DOE	U.S. Department of Energy
DOEd	U.S. Department of Education
DOL	U.S. Department of Labor
DOT	U.S. Department of Transportation
EO	Executive Order
FAA	Federal Aviation Administration
FF	Faculty Fellowships
FHWA	Federal Highway Administration
FMCSA	Federal Motor Carrier Safety Administration
FRA	Federal Railroad Administration
FTA	Federal Transit Administration
GAM	Garrett A. Morgan Technology and Transportation Futures Program

GIS	Geographic Information Systems
GRAD	Graduate Fellowships
GRF	Grants for Research Fellowships
HACU	Hispanic Association of Colleges and Universities
HBCU	Historically Black Colleges and Universities
HSI	Hispanic Serving Institutions
IDEA	Innovations Deserving Exploratory Analysis
ISTEA	Intermodal Surface Transportation Efficiency Act
ITS	Intelligent Transportation Systems
JPP	Joint Partnership Program
JUP	Joint University Program
LTAP	Local Technical Assistance Program
MARAD	Maritime Administration
MIHE	Minority Institution of Higher Education
MSI	Minority Serving Institutions
NADS	National Advanced Driving Simulator
NASA	National Aeronautics and Space Administration
NAFEO	National Association for Equal Opportunity in Higher Education
NCHRP	National Cooperative Highway Research Program
NDSU	North Dakota State University
NHI	National Highway Institute
NHTSA	National Highway Traffic Safety Administration
NSF	National Science Foundation
NSTC	National Science and Technology Council
NSTI	National Summer Transportation Institutes for Secondary Students
NTI	National Transit Institute
OSTP	Office of Science and Technology Policy
PCB	Professional Capacity Building
PNGV	Partnership for a New Generation of Vehicles
PTDI	Professional Truck Driver Institute, Inc.
RaDiUS	Research and Development in the United States

R&D	Research and Development
R&T	Research and Training
RSPA	Research and Special Programs Administration
S&T	Science and Technology
SBIR	Small Business Innovative Research Program
SIC	Standard Industry Classification
SLSDC	Saint Lawrence Seaway Development Corporation
SMARTPATH	Student Maturation and Achievement in Research and Technology that Advances Transportation Harmony
SSIP	Student Summer Internship Programs
STIPDG	Summer Transportation Intern Program for Diverse Groups
TEA-21	Transportation Equity Act for the 21st Century
TC	Tribal Colleges Fellowships
TCU	Tribal Colleges and Universities
TCRP	Transit Cooperative Research Program
TRB	Transportation Research Board
TRP	Technology Reinvestment Project
TTCI	Transportation Technical Center, Inc.
URI	University Research Institute
US	United States
USCG	United States Coast Guard
USDA	U.S. Department of Agriculture
UTC	University Transportation Centers Program