

**University Transportation Center**

**US DOT Region 5**

**Strategic Plan**

**April 17, 2000**

**University of Wisconsin – Madison (lead institution)**

**University of Chicago**

**University of Cincinnati**

**Lac Courte Oreilles Ojibwa Community College**

**Marquette University**

**University of Wisconsin – Milwaukee**

**Northwestern University**

**Richard Daley College**

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## SECTION I – PROGRAM OVERVIEW

### I.A. Glossary

AASHTO	American Association of State Highway and Transportation Officials
ASCE	American Society of Civil Engineers
CEE	Civil and Environmental Engineering
DOTs	State Departments of Transportation
EPD	Engineering Professional Development
FHWA	Federal Highway Administration
GIS-T	Geographic Information System for Transportation
ISTEA	Intermodal Surface Transportation Efficiency Act
LCOOCC	Lac Courte Oreilles Ojibwa Community College
MnDOT	Minnesota Department of Transportation
MPO	Metropolitan Planning Organization
NAS	National Academy of Science
RFP	Request For Proposal
SP & R	Special Projects and Research
TEA-21	Transportation Equity Act, 2001
TOC	Technical Oversight Committee
TIC	Transportation Information Center
TRB	Transportation Research Board
USDOT	United States Department of Transportation
UTC	University Transportation Center
WisDOT	Wisconsin Department of Transportation

### I.B. Center Theme

The theme of this Region V University Transportation Center is the *Optimization of Transportation Investment and Operations*. The focus of our Center is to educate current and future transportation professionals who will contribute significantly to the planning, design, deployment, operation and maintenance of the complex transportation system that will enhance America's economic competitiveness in the 21<sup>st</sup> century. Transportation plays an important role in the vitality of our nation and its economy and is a critical element for meeting the national goal of long-term economic growth. It is this long-term economic growth that creates jobs and can work towards protecting the environment.

Optimizing transportation investment and operations is a systematic process of maintaining, upgrading, and operating multi-modal transportation assets in order to maximize the social benefits they provide. It combines engineering principles with sound business practices and economic analysis that allows for tradeoffs. It provides tools to facilitate a more organized logical approach to decision-making and facilitates decision-making based on principles drawn from engineering, economics, accounting, public policy, risk management, and customer service

to ensure efficient resource allocation. The management and optimization of transportation investment and operations combines multiple disciplines to solve the transportation problems of the twenty-first century.

Currently, most state transportation agencies have methods in-place to manage individual assets but few are taking more comprehensive approaches to include life-cycle costs, user impacts, safety concerns, or secondary impacts in the allocation of limited resources. The asset management and optimization focus of the Center will allow for a better understanding and analysis of the broad array of tradeoffs made in any public transportation investment decisions.

This draft of the strategic plan has been revised to reflect regional discussions with state DOTs and to align the three focus areas of the UTC with AASHTO's conceptual framework for addressing the major challenges facing states today. The thrusts of previous drafts have been maintenance, performance measures, and multi-modal systems. This draft is more broadly defined as *System Management and Monitoring, Valuation and Investment, and Multi-Modal Systems*. As a living document, the draft recognizes the evolving nature of the UTC and issues of asset management. Additional regional discussions will further define issues. All UTC partners are committed to meeting the needs of transportation users through continuous quality improvement efforts and customer surveys. In order to capitalize on work already taking place, the UTC will draw on findings from the AASHTO peer exchange workshop recently held in Arizona, monitor the NCHRP research project on asset management, participate in activities of the AASHTO Task Force and coordinate training and technology transfer offered through these broader forums.

Optimizing transportation investments and operations represents a dramatic shift in the historical paradigm of monitoring conditions and then planning projects to address the "worst first". Optimization seeks to *maximize* the greatest public good from infrastructure investments rather than *minimize* the investment required to reach a given performance level. It also requires new skill sets for transportation professionals. In the 1950-60s, new construction dominated the landscape and highway agencies sought out engineering specialists. Yesterday's highway agencies are today's multi-modal Departments of Transportation with far broader challenges that require managers to obtain additional expertise in economics, sociology, environmental and land use policy as well as conflict resolution. The UTC can be instrumental in educating current and future transportation professionals with the right skill mix to be successful in the 21<sup>st</sup> Century.

Asset management is a developing concept that has come of age because of changes in the transportation environment including changes in public expectations and extraordinary advances in technology. Transportation budgets are strained by significant and growing demand for transportation services, state DOTs face challenges in addressing system preservation, and users demand transportation systems that are environmentally sensitive while maintaining engineering credibility and financial feasibility.

Asset management as a business process and decision-making framework promises states new tools to demonstrate sound investment decisions that will be increasingly demanded of

transportation professionals. Since every state possesses these assets and each state must be accountable to taxpayers demanding returns on transportation investments, it is imperative that we develop tools, processes, and understanding to help transportation professionals. Defining common management strategies regardless of states' diverse transportation needs will require research, training, and technology transfer.

The education, research, and technology transfer that is related to the *Optimization of Transportation Investment and Operations* at the UTC will focus on three thrust areas: (1) System Management and Monitoring; (2) Valuation and Investment; and (3) Multi-Modal Systems. These thrust areas will be further defined during a stakeholder workshop and planning meeting tentatively scheduled for late spring of 2000. Specific projects are determined in the methods detailed further in this Strategic Plan.

#### ➤ System Management and Monitoring

System management and monitoring presents major research challenges as states struggle to integrate diverse data collection efforts required under ISTEA and forge them into "management information systems" that cut across all modes and divisions within state DOT agencies. Each transportation organization has a unique inventory of assets, many with common attributes. Transportation agency assets include the physical infrastructure for multi-modal travel, including highways, bridges, airports, harbors, rail and transit systems, and bike and pedestrian facilities. Assets may also include human resources, equipment, technology, and other items of value, such as rights-of-way, databases, and financial capacities.

ISTEA laid the foundation for data collection in several management areas (pavements, bridges, maintenance, financial). States are now recognizing that ISTEA planning and data collection efforts must be linked with state of the art engineering, economic, and business practices to yield strategic programming and resource allocation decisions. Among the challenges facing states today is the need to translate data into information for decision making purposes. Extraordinary advances in technology provide agencies with more sophisticated analytical tools and techniques.

Asset management relies on technology in two key areas: 1) the collection, storage, and analysis of data; and 2) the presentation and communication of analytical results to an array of decisionmakers both inside and outside the agency.

1) Data is a corporate asset but agencies are struggling with how to collect it to maintain quality and comparability while doing so in a cost effective manner. Data storage and use are also major concerns that may require departmentwide database integration and continuous updating to provide meaningful information to assist decisionmakers. State agencies are often data rich but information poor. This problem is exacerbated by institutional structures that do not facilitate information sharing either horizontally or vertically within state DOTs. Optimizing investments in system preservation and operations will require agencies to move beyond

"stovepipe" mentalities and integrate all information from modal asset inventories across operational functions like planning, design, construction, and operations to meet multiple system objectives (service, conditions, safety, cost, social-economic, and emergency considerations).

2) Political realities also make it difficult to "sell" the need for and benefits of long term preservation strategies when legislators must make short term budget decisions that place an emphasis on minimizing costs to stretch limited financial resources. Research on alternative finance mechanisms and effective communication strategies can help bridge the financial gap facing regional transportation investments.

#### ➤ Valuation and Investment

Asset optimization requires that we assess the benefits and costs of the transportation system as broadly and carefully as possible. This means we must measure the performance of the system not only in terms of structural and functional compliance with design expectations but also in terms of compliance with customer expectations. Likewise we need to measure past, current and projected investments as they relate to performance. This means developing ways of relating the costs of transportation inputs—including design, construction, maintenance and operations—to the satisfaction of the public and other stakeholders.

Performance measures already in use such as standards, guidelines, protocols and engineering principles will need to be expanded to adequately consider public satisfaction and cost/benefit analyses. This means identifying and quantifying the relative importance of various public expectations, their costs and the extent to which the public perceives they have actually been met. Expectations needing to be measured may include, for example, congestion, commute time, comfort, safety, environmental or social impact, and related public and private expenditures.

The goal of research in this area will be development of an analytical framework and integrated measurement system that identifies, quantifies and monitors all of these parameters as a measure of the overall quality of the transportation network. This will enable us to address the questions of valuation of the entire system and the long-term investment required to assure that its quality is continually improving.

The second requirement of this effort is an accurate measure of the costs (past and future) of establishing, maintaining and improving transportation systems in such a way that they continue to meet customer needs. Here we need to relate the performance of system components—long-term pavement life, transit time from home to work—to customer satisfaction.

#### ➤ Multi-Modal Systems

The multi-modal thrust will develop strategies for investment and operation to achieve a highly integrated, efficient, sustainable, and flexible transportation system. Optimization of transportation investment and operations in a multi-modal systems context is a complex subject, but also an area that is in need of considerable effort. Key work needs to be done to define a basis for optimization and to identify the tradeoffs between modes that are involved in determining optimal strategies. There are three areas that need attention: (1) multi-modal planning and programming; (2) further incorporating inter-modal considerations into project planning and development, and (3) operations of major system components, particularly for modes not directly involved in moving automobiles.

Multi-modal system planning and programming concerns the tradeoffs between modes, long-term investment strategies, financial considerations in transportation investment, sequencing modal projects, and reconciling operational conflicts between modes. Multi-modal planning also must consider the interface/interaction between modes as well as issues of sustainability, environmental impacts, community impacts - including environmental justice, and land use policy as related to impacts of investment strategies on growth patterns and efficiencies of public services. Examples of key issues that need to be addressed include creation of methodologies that could be applied immediately toward:

- developing optimized investments in the overall system that would result in investments in non-motor vehicle modes that would provide adequate mobility for non-drivers and provide mobility choices, and investments in highways that would address highway needs and reflect the proportion of overall system trips forecast to be accommodated by the highway system;
- conducting environmental impact, community impact, and environmental justice analysis at the system-plan level in order to address public demand for potential impacts of system plan recommendations and to respond to TEA-21 related environmental streamlining initiatives; and
- improving the ability to evaluate potential secondary land use impacts at the system-plan, regional, and corridor levels.

It is imperative that the Center recognize and build upon the many existing and on-going research efforts related to these system planning and programming issues that have been undertaken by the Transportation Research Board and others. Examples of some completed TRB research on related issues include Innovative Practices for Multi-Modal Transportation Planning for Freight and Passengers and Integration of Land-Use Planning with Multi-modal Transportation Planning.

Inter-modal issues also need to be better incorporated in planning and development for individual projects. In addition to the need to include inter-modal considerations at the multi-modal system planning level, inter-modal considerations also must be included in project planning and development. These project level inter-modal considerations again include the

interface between modes, ability of passengers to travel on more than one mode in a journey, ability of shippers to use more than one mode for commodity movement, interactions between modes involved, environmental impacts, and the public sector role in inter-modal operations. Inadequate incorporation of inter-modal considerations at the project planning and development stages would significantly limit the benefits and efficiencies of multi-modal system plan recommendations.

Finally, operation of major systems concerns the efficiency and sustainability of individual modes, particularly in an overall multi-modal systems context.

Education, research, and technology transfer could range over a variety of topics, but would include a balance between user benefits and impacts. The research recognizes the need for effective partnerships to build and maintain multi-modal and inter-modal transportation systems. Effective partnerships depend on the modes involved, but would typically include the US DOT, state DOTs, local government and private operators. To enhance partnerships and to promote lasting benefits from the research, this topic area will include a significant technology transfer component.

### **I.C. Center Director's Summary**

The UW-Madison has formed a consortium with other leading universities in the region to focus on the *Optimization of Transportation Investment and Operations*. Within this consortium, a large effort will be focused on the education, research, and technology transfer of asset optimization and management techniques for transportation facilities. The vision of the Center is that it will provide innovative changes that will be critical in leading the transportation community into the 21<sup>st</sup> century and beyond. The Center will provide benefits for the region's state Departments of Transportation (DOTs) and consortium academic institutions. These benefits will include stakeholder positions on advisory groups, enabling the formation of a high quality research team or regional experts, leveraging available resources, and expanded partnerships among stakeholders. This proposal outlines the specific goals and objectives that this UTC plans to pursue.

The vision of the UTC will be to (1) facilitate application and integration of private and public sector and academic intellectual talent within Region V; (2) foster multi-campus, multi-disciplinary, and multi-state research; (3) include selected diversity institutions such that they advance their programs and student interest within transportation; (4) facilitate timely technology transfer using a variety of mediums such as videotapes, video conferences, Internet and more; (5) assist public and private sector professionals to develop a comprehensive framework that considers the technical, financial, and political factors that affect investment decisions; and (6) educate current and future leaders who must understand the processes, tools and management techniques to optimize system benefit/cost performance. The program will pool knowledge and resources available for existing asset optimization and management tools and, through research, develop and improve strategies for the implementation of these tools.

One other operational theme of this Center is that excellent research is primarily achieved through research problem statements that are designed with broad stakeholder consensus and research funding that is based upon a peer review process. At the same time, it is imperative that the educational mission of the university be advanced through this research. To this end, a key component of the Center is that funding of research proposals is designed to support the advancement of the application and implementation of methods optimizing transportation investment and operations while maintaining the educational goals of the institutions involved.

#### Sustainability of Center:

Strong partnerships and staffing among academia, state agencies, USDOT, and others will be key to building a permanent institution for the Midwest region. Building strong working relationships and trust are key components of sustainability. All of us must work together to identify educational, research, and technology transfer priorities that are not duplicated elsewhere so the Center quickly builds as reputation as a national leader in this area. The quality and value of the center's research and its applicability to practice will encourage additional funding from states and potentially could include funding from cities and counties within our region. This

value is achieved by listening to the customers, state DOTs, and others and truly understanding that there are obstacles to effective asset management

When federal seed money is discontinued after 2003, it will be state DOT agencies, industry, and academia which will need to fully fund the Center. It will be important to establish early successes and capture the attention of the Executive Committee, Advisory Committee, and TOCs so they remain committed over the long term and can see real benefit in the Center's products.

For example, a key theme of the next federal Reauthorization is likely to be "Preserving the Public Trust". The asset management framework will provide states with a number of tools to demonstrate accountability to Congress and state legislators of the soundness of their investment decisions. A "quick win" for the region could be a research project that would identify the financial needs of the Midwest states to preserve and maintain their deteriorating systems. Financial assessments and alternative financing techniques are always in the forefront of issues confronting transportation professionals and the UTC can assist in defining issues and developing appropriate communication strategies.

The technology transfer aspects of the UTC will promote its sustainability. By transferring cutting edge information to industry professionals and allowing professionals to provide input on research topics, the UTC will develop a partnership with state DOTs and industry. This partnership will help continue the education process for many professionals. In addition, the partnership will be vital in its ability to contribute innovative research ideas to the center. By consistently producing pertinent research, the center will have a sustainable source of funding.

The proposed UTC will achieve this goal of sustainability by following the plan outlined herein. The plan we propose contains a unique blend of intellectual and institutional resources. Its components are well integrated because university faculty, staff and students, State Department of Transportation personnel, and industry will be involved in education and research, and will also support technology transfer. This cross involvement will allow for the direct dissemination of skills and insights to practicing professionals, as well as to students who represent the future leaders in the field of transportation professionals.

## **SECTION II – PROGRAM ACTIVITIES**

### **II.A. Education**

Education Goal: A multidisciplinary program of course work and experiential learning that reinforces the transportation theme of the Center.

#### **1. Baseline Measures**

See Baseline Measures 1a and 1b in Appendix A

#### **2. Education Program Outcome**

Within Region V, the UTC at the UW-Madison will connect several well-developed transportation programs of the consortium institutions. Though each institution in and of itself does not possess all aspects of a comprehensive transportation program, the combined aggregate of the institutions covers the essential aspects of the transportation field. As these educational programs are already developed, they do not require a significant upfront investment to establish a comprehensive transportation program.

In addition, the Center will establish partnerships with a variety of educational disciplines. The La Follette Institute of Public Affairs and the Business School at UW-Madison are expected partners on multi-disciplinary research and other programs. The Center will foster a comprehensive approach across our region to improve and enhance transportation education.

It is the mission of the Center to continue to provide quality education within the research program of the UTC and to develop the new employment skills needed for current and future transportation professionals. It is the Center's intention to include substantial educational components within all research undertaken through the UTC. The center will offer a number of new multidisciplinary courses along with refined versions of the courses that are presently in-place.

State DOTs have a vital interest in the UTC's curriculum development and educational program outcome. We must ensure that current and future leaders have the right mix of employment skills needed to address the complex area of asset management. While former emphasis was placed on engineering, training in policy, economics, land use planning, and conflict resolution will be even greater in the future. Drawing on multi-disciplinary courses may draw new talent to the transportation industry and provide a valuable recruitment tool for state agencies.

#### **3. Planned Activities**

- Offer new multidisciplinary courses in transportation policy and planning, developed after research and experience with the program during initial Center operations.

- Modify and re-arrange existing courses to include Transportation Policy issues at the La Follette Institute of Public Affairs and the School of Business at the University of Wisconsin and where applicable, at consortium institutions.
- Use EPD courses as a tool to integrate students with the professional aspect of the industry, allowing students to sit-in on these courses for free.
- Establish an annual UTC meeting with participating state DOTs and academic institutions in order to discuss the Center's goals and to foster the multi-state/campus relationships, allowing the Center to adapt its educational offerings to the Region.
- Use resources available to create distance learning programs.
- Recommend new continuing education programs or courses through the Technical Oversight Committees as needed.
- Hold regional meeting of all stakeholders and UTCs targeted at advancing specific educational goals, including the integration of asset management into coursework, and coordinating regional educational efforts.
- Establish internship positions at state DOTs, MPOs, and other public transportation agencies. These positions will be open to both graduate and undergraduate students.
- Create summer, part-time employment, and co-op positions with the private sector of the industry.

### **3.a. Required Activities**

Each Center's education program is required to include multidisciplinary course work and student participation in research. This Center will accomplish that by cooperating with other departments on all of the member institutions to ensure diverse and multidisciplinary inputs.

In addition, the Center will choose (or decline to choose) one outstanding student of the year. The Center shall award its Student of the Year \$1000 and the costs for the student to attend the award ceremony in Washington, D.C., during the annual winter meeting of the Transportation Research Board (TRB). These students will be recognized for their efforts in transportation-related fields. Experience outside of the academic environment may be considered. The selection process will ensure that each consortium member institution will submit student nominations to the UTC Director and Staff for final selection. An effort will be made to ensure that all consortium institutions nominate (or decline to nominate) students for consideration.

### **4. Performance Indicators**

The performance measures identified in "Exhibit C" of the reporting requirement guidelines will be collected at the end of each semester by the UTC Director and Staff. For data requested which involves specific academic programs, this information will be requested from the academic department (e.g., Civil Engineering, Public Affairs, etc.). Each of the consortium members agree to collect and report this

data as specified in the subcontracts with each of the member institutions. Data from the University of Wisconsin – Madison will be collected by the Program Manager/Director. This data is currently available through each of the academic departments at the University of Wisconsin – Madison.

## **II.B. Human Resources**

Human Resources Goal: an increased number of students, faculty, and staff who are attracted to and substantively involved in the undergraduate, graduate and professional programs of the center.

### **1. Baseline Measures**

See Baseline Measures 2a and 2b in Appendix A

### **2. Human Resources Program Outcome**

As this Center is new to the University of Wisconsin, a great deal of effort will be made to incorporate the maximum involvement possible from the students, faculty, and staff. The ability to attract more professionals to the transportation fields and the ability to attract a larger number of faculty members to transportation related education hinges upon the Center's efforts to attract and recruit people. The UTC will also work toward the expansion of programs at universities with small or no transportation related educational and research programs. These include LCOOCC and the Richard J. Daley College in Chicago. It is our goal to establish and build strength into the transportation programs existing within all consortium partners. The UTC grant and assistance from other consortium members will work to establish new programs within departments at partner institutions.

Our plan involves not only traditional undergraduate and graduate students but also practicing professionals. We will increase the participation of women and diversity students and faculty in transportation using university channels for recruitment, as well as new recruiting approaches developed through the UTC. The UTC will continue to strengthen UW-Madison's current cooperative efforts in transportation with a number of diversity institutions in the region including direct involvement with Richard J. Daley College and Lac Courte Oriellas Ojibwa Community College.

### **3. Planned Activities**

- Actively recruit and involve faculty through presentations, memoranda, and one-on-one conversations at professional meetings.
- Increase internal awareness through department, college, and campus publications.
- Involve undergraduates in the efforts of the program and focus on increasing the number of students in graduate research. Students will be involved from several disciplines including public policy, economics, business, and regional planning in addition to traditional engineering programs.

- The Center will use an Awareness, Retention, and Curriculum (ARC) model to recruit, maintain, and better educate students. Through its relationship with the ARC Transportation Focus Group, the Center has compiled a database of existing parallel programs within which joint efforts can be coordinated. These include programs with WisDOT, the National Society of Professional Engineers, MnDOT and others. Efforts will be made to integrate these parallel programs with the UTC efforts. Such integration and cooperation shall allow funding to be leveraged successfully across institutions and disciplines.
- Increase external awareness through the *CE Conduit*, a semi-annual newsletter distributed by e-mail, and the Center website.
- Actively recruit and involve students through presentations, Center website materials, and a new semi-annual Center newsletter.

These activities will be supplemented by visits to regional universities to recruit transportation graduate students and encourage faculty to participate in transportation-related research. As part of the research selection and solicitation process, center staff will attempt to visit with as many faculty and students at member institutions as possible.

#### **4. Performance Indicators**

2a. Participating universities will be asked to update this information annually. As before, when appropriate data will be collected by center staff from the appropriate level (school, department, university). Academic Partners agree to provide said information.

2b. Each of the consortium members agree to collect and report this data as specified in the subcontracts with each of the member institutions. Data from the University of Wisconsin – Madison will be collected by the Program Manager/Director. Career data will be collected by the Program Manager.

### **II.C. Diversity**

Diversity Goal: Students, faculty and staff who reflect the growing diversity of the US workforce and are substantively involved in the undergraduate, graduate, and professional programs of the Center.

#### **1. Baseline Measures**

See Baseline Measure 3 in Appendix A.

#### **2. Diversity Program Outcome**

As the Center sees an increase in number of students, staff, and faculty involved, the diversity of the program (in terms of percentages) will increase incrementally at a rate that will result in greater diversity by the end of the grant. Significant work with our

partner institutions at LCOOCC and the Richard J. Daley College will increase the rate of diversity population participation.

### **3. Planned Activities**

- Work with the Diversity Affairs office presently in place at the University of Wisconsin-Madison to recruit, mentor, and retain participation of women and diversity students, faculty and staff at the Center. The UTC will be actively involved in the McNair scholars program, the federally funded program to help low income, first generation and minority undergraduates pursue graduate education through advising and mentoring, research and teaching experiences, seminars and workshops. The McNair Scholars Program aims to increase numbers of groups underrepresented in doctoral programs. Participation by all consortium members will be encouraged to attract diversity students to transportation programs.
- Coordinate, facilitate, and integrate people already involved in diversity programs at other campuses, DOTs, and the FHWA through annual meetings. This will ensure that UTC presence is felt throughout each of these programs.
- Participate in present national, regional, and campus activities and organizations involving diversity affairs such as the Society of Women Engineers (SWE), the Wisconsin Black Engineering Student Society (WBESS), and the Society of Hispanic Professional Engineers (SHPE). Sponsorship of events will also be considered.
- Expand the existing Engineers and Scientists of Milwaukee (ESM) program which operates an extensive career guidance program in Southeastern Wisconsin with offices in the College of Engineering at Marquette University, and the AASHTO-TRAC program in Southeast Wisconsin and the Wisconsin Section, ITE throughout the state. This could be a model for other states and metro areas across the county to target high school seniors outside of general "career days."
- Establish annual programs at Richard J. Daley College and LCOOCC to encourage students to pursue advanced undergraduate and graduate studies in transportation fields.
- Fund at least six (6) graduate or undergraduate level fellowships, scholarships, or student assistantships aimed at assisting qualified students from Richard J. Daley or LCOOCC pursue advanced degrees in transportation related fields.

### **4. Performance Indicators**

Each of the consortium members agree to collect and report this data as specified in the subcontracts with each of the member institutions. Data from the University of Wisconsin – Madison will be collected by the Program Manager/Director. Such data is currently collected at the University of Wisconsin Madison's Office of Diversity Affairs for the College of Engineering.

## II.D. Research Selection

Research Selection Goal: an objective process for selecting and reviewing research that balances the multiple objectives of the program.

### 1. Baseline Measures

See baseline Measure 4 in Appendix A.

### 2. Research Selection Program Outcome

The Center will establish and maintain a peer-review selection process that integrates interests of state DOTs, US DOT, and the private sector. This process will be predicated on the assumption that educational missions of the consortium institutions are considered. Research projects will reflect the theme of the Center and the priorities of state DOTs in the region consistent with the priorities expressed in the Strategic Plan of the US DOT.

Research conducted will focus on the theme of *Optimization of Transportation Investment and Operations* characterized by three thrust areas: (1) System Management and Monitoring; (2) Valuation and Investment; and (3) Multi-Modal Systems. For each of the thrust areas, a Technical Oversight Committee (TOC) will be created to prepare a research strategic plan, prepare requests for proposals (RFP's), and review and recommend research contracts. Each TOC will recommend new educational programs such as continuing education and new academic courses. The TOCs will include diverse membership with appropriate expertise from affected stakeholders (state DOTs within the Region, US DOT, industry professionals, and academics). The research thrust areas will be further defined and membership on these TOCs determined at a stakeholder meeting tentatively scheduled for late spring of 2000.

The research thrust areas incorporate the idea that obstacles exist to effective asset management currently. Obstacles include a variety of practical application issues such as inadequate inventory information, lack of deterioration curves for infrastructure components, the need to find ways of objectively determining the relative benefit/costs of alternative techniques, agreement on how to apply the values to indirect costs, and the consideration that must be given to functional obsolescence when the optimal life cycle cost strategy for an asset is often irrelevant because of changing system needs. *The goal of the research will be to address these issues through broad stakeholder involvement, ensuring that the research is useful to state DOTs and others.* Among potential areas needing research are bridge analysis, roadside development and maintenance, and relative impacts of safety, capacity, delays, geometrics, shoulder widths, maintenance and other issues on the programming process.

### **3. Planned Activities**

The Center will address issues in selecting research useful to transportation officials across the region. These are predicated on the needs that the region identifies through the work of the state DOTs, the Center Director and Staff, the Executive and Advisory Committees, the TOCs, and US DOT officials. The evolving research agenda will incorporate efforts in other states.

The Center's structure for research selection will be as follows:

#### **1.) Establish Technical Oversight Committees (TOCs)**

The TOCs will be designed to oversee the program goals in the three thrust areas: (1) System Management and Monitoring; (2) Valuation and Investment; and (3) Multi-Modal Systems. An individual TOC will provide technical support, input, and advice as well as oversee research projects in its assigned subject area. TOCs will also serve as a forum for an exchange of ideas among asset management interests and it will actively promote involvement and input from all transportation sectors. The TOCs will perform this function by: (a) developing and updating annual and longer range education, technology transfer, and research plans with input from knowledgeable professionals representing state DOTs, FHWA, academia, industry, and other sources; (b) creating and reviewing research problem statements; (c) evaluating and recommending research proposals to the Center Director and Advisory committee; (d) identifying and recommending principal investigators for approved research projects to the Advisory committee; (e) reviewing and recommending research modifications, extensions, or terminations to the Center Director; (f) promoting the education and transfer of the new technologies; and (g) accepting the reports and other contract deliverables.

The TOCs will consist of chairperson(s) and individual members. Members will be solicited from state DOTs, US DOT, AASHTO, academia, industry, and other interested groups. The Center staff will make recommendations to the Advisory Committee of the TOC memberships.

#### **2.) Identify Potential Research Projects**

The TOCs will recommend proposed research projects to the Advisory Committee. During the first year of operation, the Center will formally define the research thrust areas and develop a research agenda and strategies in a stakeholder planning and workshop meeting to be held in late spring of 2000. This meeting will include the members of each state DOT in the region and representatives from each of the university consortium members. Other stakeholders may include industry professionals and federal officials. This meeting shall set the foundation upon which the future direction of the Center and its research is established. In following years of operation, the Center will

identify potential research proposals through TOC recommendation to the Advisory Committee.

3.) Establish Evaluation Criteria

Evaluation criteria will be based upon regional expertise and need, USDOT research goals, and State DOT priorities. This model will further incorporate the research capabilities and interests of consortium members, priorities of state DOTs in the region, and proposals submitted by the academic research institutions in the region. Priority will be given to research problem statements submitted by consortium universities in partnership with state departments of transportation, FHWA, and private industry. The Advisory Committee will establish criteria to determine which projects are funded by a pooled research fund and which projects will be required to have a matching fund component.

This policy will reflect strong consideration for the educational missions of consortium institutions. Respondents to calls for research problem statements and research RFPs will be limited to academic institutions within the region. Private research institutes will not be permitted to submit proposals except in partnership with academic institutions. The Advisory Committee shall establish criteria for matching proposals with the capabilities of faculty, students, and their home institution when awarding research projects.

4.) Solicit Proposals

Proposals will be solicited electronically via the Center's website and in printed mailings to research institutions within Region V, including but not limited to institutions included in the consortium. This model will include provisions that the Advisory Committee may determine that certain research projects can be handled through a "Request for Proposals" process and that other proposed projects fitting within the scope of the Center theme will be acceptable on a project by project basis.

5.) Peer Reviews

Proposals will be submitted for review to peers at other UTCs and other State DOTs. At least two peer reviews on each project proposal will be required.

6.) Project Selection

Final project selection will be made by the Executive Committee based upon the comments and recommendations received.

In addition, the Center plans to undertake the following:

- Review available documents describing the current level of understanding and implementation challenges to asset management, including the results from the recently conducted AASHTO Task Force on Asset Management meeting held in December 1999 and the NCHRP research results, when available. Knowledgeable professionals such as Dr. Sue McNeil, Carnegie Mellon, and Arizona DOT Director Mary Peters will be consulted.
- After start up, revisit the model and modify, if necessary and as needed, to incorporate stakeholder concerns.

### **3a. Required Activities**

The Center Director will ensure all required activities under this Section are implemented.

### **4. Performance Indicators**

4a. Data will be updated annually based on reports submitted by participating universities and data collected by UTC staff.

4b. In subsequent years, the number and budgeted costs of all research projects which the Center has funded will be reported and broken out according to the primary subject of the research. This data will be updated annually based on reports submitted by participating universities and data collected by UTC staff.

4c. In subsequent years, the number and budgeted costs of the research projects which the Center has funded during the year will be reported, broken out according to special focus area. Unlike the previous break-out by research subject, this assessment will include some double-counting, as projects may involve more than one goal, issue or mode. This data will be updated annually based on reports submitted by participating universities and data collected by UTC staff. Each of the consortium members agree to collect and report this data as specified in the subcontracts with each of the member institutions. Data from the University of Wisconsin – Madison will be collected by the Program Manager/Director.

## **II.E. Research Performance**

Research Performance Goal: an ongoing program of basic and applied research, the products of which are judged by peers or other experts in the field to advance the body of knowledge in transportation.

### **1. Baseline Measures**

See Baseline Measure 5 in Appendix A.

### **2. Research Performance Program Outcome**

The Center will conduct high quality research useful to the Region and consistent with US DOT and State DOT priorities.

### **3. Planned Activities**

- Establish a procedure to ensure that research is progressing with the following requirements:

1. Each new PI will be required to keep the respective TOC on each project informed of the research progress and asked to provide feedback. The TOC will provide advice and feedback to the PI during the duration of the project and will be review the final project report.

2. The Center Director and Region V UTC Staff will also continuously monitor the research projects with respect to progress and budget. The Program Manager/Director will keep track of the local match expenditures as they are reported. If the local match expenditures fall seriously behind the federal expenditures on a particular research project, immediate efforts will be taken to remedy the situation.

3. At the discretion of the Center Director, projects that are unable to meet their local match requirements or are not making significant progress will be discontinued or significantly reduced.

- Implement the following research performance objectives:

1. A two-month period of review and revision will be part of each project's schedule. Two months prior to the project end date, the PI will be required to submit a draft final report for review. (Each project, however, is allowed one no-cost extension if approved by the Director and if the request is received by the draft final report due date. All no-cost extensions are limited to six months duration.)

2. The draft final report will be sent out for peer review to (1) a faculty member from another consortium university or University Transportation Center, and (2) the appropriate TOC.

3. Upon receipt of the reviewers' comments, the PI will revise the draft report accordingly and produce a final project report by the project end date. This report will then be placed on the UTC website and distributed to major agencies and clearinghouses. Copies of each technical report will be sent to the USDOT, NTIS, UTC clearinghouse, TRIS, and selected state and local professionals. Upon request, additional copies of each technical report will be sent to individuals at cost. Copies may be requested by people or organizations as these reports become available, and to Center web site visitors who can also review the latest report list.

- The encouragement and support of transferring the research results into technical reports, conference papers, peer reviewed journal entries, and technical presentations.

#### 4. **Performance Indicators**

In addition to the baseline data presented in Appendix A, specific indicators will be used to measure research performance. These include:

For program expansion, the:

- Number of pooled fund or multi-state projects
- Number of Private Contractors/Suppliers involved
- Number of multi-university projects involved in program

For development of academia expertise, the:

- Number of educational programs
- Number of new faculty hires
- Number of internships
- Number of courses & students
- Number of funded students

For assessing needs of partners, the:

- Number of Ideas (RFPs) for Research
- Number of industrial partners involved in program
- Use of a survey of customer satisfaction

For Integration of Program Goals and Outputs with Other Transportation Activities, the:

- Number of communications
- Number of redundant projects
- Number of joint efforts
- Simple integration with other existing Transportation Centers

For overall effectiveness of the research performed, the:

- Number of evaluations
- Assessment of Project Quality and Timeliness
- Project Long-term Impact and Customer satisfaction

Necessary data will be updated annually based on reports submitted by participating universities. Each of the consortium members agree to collect and report this data as specified in the subcontracts with each of the member institutions. Data from the University of Wisconsin – Madison will be collected by the Program Manager/Director.

## **II.F. Technology Transfer**

Technology Transfer Goal: availability of research results to potential users in a form that can be directly implemented, utilized or otherwise applied.

### **1. Baseline Measures**

See Baseline Measure 6 in Appendix A.

### **2. Technology Transfer Program Outcome**

The Center will have a process in place that enables efficient and effective transferring of research results to primary implementers.

The UW-Madison possesses a strong technology transfer program in its Engineering Professional Development (EPD) program. The EPD's continuing education program represents an active and ongoing collaboration with other educational resources within the region. Faculty from UW-Madison, UW-Platteville, UW-Milwaukee, Marquette University, and Northwestern University as well as many other schools in the U.S. participate as instructors in EPD courses. Practitioners from consulting firms and from state and local governments in the region provide a "dose of reality" through their practical insights and case studies in EPD short courses. The new UTC will augment the EPD program and continue to build on established transportation programs.

State agencies also have a strong interest in making sure that research results are implemented and evaluated. The UTC will coordinate with existing state programs for technology transfer as well as AASHTO's nascent technology transfer committee and other national training and education program opportunities.

### **3. Planned Activities**

- Identify technology transfer needs for each of the thrust areas and at jurisdiction of transportation agency, state, district, MPO, county, etc. The late spring of 2000 meeting including regional stakeholders will include this agenda item. Following this meeting, the specific activities will be better defined. These may include annual or semi-annual symposiums, specific procedures for disseminating information, or other activities.
- Defining a model process to share with the TOCs and principal investigators. This process will use the existing programs in place involving the Engineering Professional Development (EPD) program, including seminars, ARC Application Symposium, continuing learning short courses (both online and in person), and other electronic and printed publications.
- Maintain a library of UTC research publications.

- The UTC will host regional symposiums and research and demonstration workshops to present research results. At least two such workshops will be held during the Grant Period.
- Create and maintain a Center website that allows electronic access to research reports, progress reports, newsletters, and course information.
- Publish results and findings in a newly created Center newsletter, distributed to regional DOTs, academic institutions, and private sector counterparts.
- Coordinating efforts with AASHTO's technology transfer committee.

**4. Performance Indicators**

Data will be updated annually based on reports submitted by participating universities. Each of the consortium members agree to collect and report this data as specified in the subcontracts with each of the member institutions. Data from the University of Wisconsin – Madison will be collected by the Program Manager/Director.

**SECTION III – MANAGEMENT APPROACH**

**III.A. Institutional Resources**

The consortium allows for the pooling of all institutional resources to allow for a concentrated effort in advancing transportation education, research, and technology transfer. It is expected that the consortium will produce more functional research by pooling the expertise and resources of all institutions. One important aspect of the proposed center is that it will bring together the students, faculty, and research facilities of the consortium universities. These universities possess strong transportation education, research, and technology transfer programs. Figure 2 lists the major schools in the consortium and an initial list of researchers interested in participating in the UTC.

<b>UW-Madison</b>			<b>Northwestern University</b>		
<i>Business</i>			<i>Business</i>		
Kevin Weng	Don Harmatuck	Donald Hausch	Edwin Mills		
Edward Marien	Rafael Lazimy	Jim Morris	<i>Transportation Center</i>		
<i>Civil and Environmental Engineering</i>			Aaron Gellman		
Teresa Adams	Peter Bosscher	David Mezera	<i>Infrastructure Technology Institute</i>		
Bin Ran	Jeffrey Russell	Michael Oliva	David Schulz		
Robert Smith	Steven Cramer	Jose Pinchera	<i>Civil and Environmental Engineering</i>		
Alan Vonderohe	Larry Bank	Tuncer Edil	Anthanasios Ziliaskopoulos		
Awad Hanna	Hussain Bahia	Thomas Lillesand	Joseph Schofer		
<i>Consortium for Global Electronic Commerce</i>			<b>UW-Milwaukee</b>		
Raj Veramani			<i>Civil Engineering</i>		
<i>Economics</i>			Edward Beimborn		
Phil Haile	Derrick Neal	Arik Levison	Alan Horowitz		
James Andreoni			<i>Urban Planning</i>		
<i>Engineering Professional Development</i>			Nancy Frank		
Howard Rosen	Stephen Pudloski	Donald Walker	Zhong-Ren Peng		
Allen Wortley			<b>University of Cincinnati</b>		
<i>Urban and Regional Planning</i>			<i>Civil and Environmental Engineering</i>		
Jack Huddleston			Prahlad Pant		
<i>La Follette Institute of Public Affairs</i>			Issam Minkarah		
John Witte			Makarand Hastak		
<b>Marquette</b>			Amir Mirmiran		
<i>Civil and Environmental Engineering</i>			<b>University of Chicago</b>		
David Kuemmel	Thomas Wenzel	James Crovetti	<i>School of Business</i>		
Ronald Sonntag	Alex Drakopoulos	Christopher Foley	Sam Peltzman		
<i>Communications and Journalism</i>					
Robert Griffin					
<b>Diversity Institutions</b>					
<b>Richard J. Daley</b>		<b>Lac Courte Oriellas Ojibwa</b>			
James Charney	Tracy Mofle				
Prem Sud					

Consortium Schools:**I. UW-Madison**

The primary focus of transportation research at the UW-Madison is the Department of Civil and Environmental Engineering (CEE) in the College of Engineering. The CEE Department has 26 full-time faculty and nearly 175 graduate students of which about 50 are working on transportation-related research. A substantial number of graduate students are working on transportation related programs in construction, geotechnical engineering, information systems, geo-spatial information engineering, materials, and structures. The UTC will combine these research areas. The three full-time transportation faculty members provide a full range of transportation courses covering planning, operations, highway design and materials. Eight other faculty members support the transportation program in GIS-T, geotechnical, structures, materials, and construction engineering and management areas.

Laboratory facilities for transportation research are available in the Transportation Computer Lab, which has the latest software for transportation planning, and traffic engineering research. The Geotechnical/Materials lab has recently been upgraded with modern equipment for geosynthetics and asphalt material research. Equipment for research on concrete is available in the Structures and Material Testing Lab. PC's, workstations, GPS, and remote sensing equipment are used for GIS-T research. The Wendt Library in the College of Engineering provides a full-range of transportation journals and access to the literature through CD ROM search capabilities.

The Department of Engineering Professional Development in the College of Engineering conducts an active program of technology transfer in transportation through its Transportation Information Center. Additional technical educational programs in transportation are provided as part of the regular EPD course offerings.

The transportation research activities in the CEE Department are complemented by research on transportation economics and business logistics in the School of Business. Interest in transportation research also exists in the institute for Environmental Studies and the new program in Air Resources Management. Facilities for survey research are available at the Wisconsin Survey Research Center.

With the 1998 opening of the Pyle Center, UW-Extension's new Distance Education and Conference Center, the university has an outstanding distance learning resource. With 11 interactive, multi-media classrooms, 15 conference rooms, production space, computer facilities, and a technical operations center, the Pyle Center is a unique facility, enabling on-site and distance learning through state-of-the-art media and methods, such as computer conferencing via Internet, interactive two-way video, audiographics, teleconferencing, and satellite delivered programs. Pyle Center staff and College of Engineering staff have a successful track record of distance learning delivery in undergraduate, graduate, and continuing education and outreach courses, conferences, and programs. A national satellite conference produced by EPD on Residential Traffic Calming and Control had over 120 downlink sites across the United States and Canada and reached more than 3,500 participants. The distance learning resources of the

university and the Pyle Center link UW-Madison with learners and resources throughout the state, the region, the nation, and the world.

The UW-Madison is also home to the Consortium for Global Electronic Commerce. This consortium is a university-industry-government collaborative initiative to create, integrate, transfer and apply knowledge of E-Commerce technologies, business processes and organizational strategies to enhance the and effectiveness of companies (particularly in manufacturing, design and construction, retailing and associated industry) and government agencies. It helps conduct multidisciplinary research and industry-based collaborative on new E-Commerce paradigms for business-to-customer, intra-business, and business-to-business. The consortium provides a learning community for organizations to share E-Commerce experiences, lessons learned, best practices and performance metrics for mutual benchmarking. Consortium projects focus on emerging ideas, alternative technologies and business for E-Commerce, including feasibility assessment, proof of concept system development, demonstration and validation, performance evaluation and best practices. Consortium participants range from small, medium, and large companies to faculty and students from multiple disciplines such as engineering, computer sciences, business, economics, and sociology.

The Robert M. La Follette Institute of Public Affairs at the University of Wisconsin was established by the Wisconsin legislature in 1984 with a multifaceted mission—to engage in instruction, research, and outreach. The institute fulfills this mission by offering both a domestic and an international master's degree in public policy; encouraging scholarly research on numerous issues that have public policy implications; and offering enrichment and training opportunities to policymakers at all levels of government.

## **II. Northwestern University**

The Transportation Center at Northwestern University serves industry, government, and the public through its comprehensive research agenda, graduate-level degree programs, executive education programs, and outreach activities. The strength of the Center lies in the quality and productivity of its faculty, its focus on scholarly research, its analytic and policy orientations, and its responsiveness to the problems of industry.

Transportation Center research contributes to the identification, analysis, and resolution of transportation problems and issues concerning all modes in all settings-urban, regional, national, and international. The Center's core faculty members, all of whom have appointments in Northwestern academic departments, are skilled researchers and effective teachers. The Center enhances its intellectual capital with the involvement of affiliated faculty, also drawn from Northwestern's many academic disciplines, which work within the Center on specific research projects. Because of its diverse faculty, the Center is able to integrate in its research analytical methods and theories from the fields of economics, engineering, marketing, finance, logistics, operations, information systems, management, the social sciences, and law.

The Center offers thorough, interdisciplinary transportation courses to students undertaking Northwestern's Master of Science in Transportation, Master of Management, Master of Science in Civil Engineering, and doctoral programs. In addition to rigorous academic courses, the Center provides opportunities to participate in research projects, transportation-oriented special events and activities, and recruitment and placement services.

Transportation Center Executive Programs help transportation industry professionals excel in this competitive climate by expanding their knowledge and sharpening their critical transportation management skills. Executive Programs are designed for middle- and upper-level managers serving in all parts of the logistics network- shippers, carriers, and third parties- as well as high-potential managers in the energy industry. Course faculty are leading experts in industry, academia, and government. In addition, custom seminars can be designed to meet the specific needs of individual companies.

As a leading member of the transportation community, the Transportation Center has a responsibility to ensure that the exchange of ideas and information between academia, industry, government offices, and the public remains fluid. To facilitate this exchange, the Center develops and supports research conferences, promotes faculty service, and participates in the collection and distribution of transport information. By initiating interaction between transportation publics, the Center advances the interdependent structure of the transportation industry.

Widely recognized as one of the finest graduate business programs in the world, the Kellogg Graduate School of Management at Northwestern University is home to a renowned, research-based faculty and bright, ambitious management students from around the globe. Kellogg offers a challenging but flexible curriculum. Kellogg's Master of Management (MM) degree can be achieved through any of three programs, each led by the same faculty: a full-time day program, a part-time evening program and a part-time weekend program. Kellogg has three joint international executive MBA programs with schools in Israel, Germany and Hong Kong.

Kellogg provides three full-time options: (1) the traditional two-year, (2) Six-Quarter program (6Q), in which students attend classes in the fall, winter, and spring quarters and work during the summer quarter; and (3) the Four-Quarter program (4Q), in which students who have undergraduate business degrees or the equivalent of our business core courses (accounting, finance, marketing, organizational behavior, quantitative methods, operations and economics).

Kellogg also offers options for working professionals seeking advanced degrees. The Managers' Program (TMP), is Kellogg's part-time, evening program. TMP is consistently ranked among the top three part-time graduate business programs in the U.S. The Executive Master's Program (EMP) is a two-year, general management program leading to the MM degree for participants with at least 10 years experience in business. The EMP courses are offered on the weekends.

To develop a stronger presence internationally, Kellogg has initiated joint international executive MBA programs with three business schools overseas: the Recanati Graduate School of Business Administration at Tel Aviv University in Israel; the Otto Beisheim Graduate School at the Koblenz School of Corporate Management in Germany; and the Hong Kong School of Science and Technology. As in the U.S., the curriculum will use instructional methods tailored to the skills and needs of experienced managers.

Research is a vital component of Kellogg's program, and faculty members have developed ground-breaking theories in many academic fields, including marketing, banking, and game theory. Kellogg faculty members direct nine research centers, on topics ranging from ethics to banking. In addition, five scholarly journals are edited at Kellogg, three of which - the Journal of Financial Intermediation, the Journal of Economics and Management Strategy, and Games and Economic Behavior - were founded at Kellogg as well.

### **III. UW-Milwaukee**

The center for Urban Transportation Studies at the UW-Milwaukee (UWM) is an interdisciplinary program that addresses problems of land use/transportation interactions, research utilization, urban mass transit, private sector participation in transportation projects, transportation management, energy constraints on transportation, travel demand forecasting, environmental impacts, community impacts, and transportation planning. The Center has helped to develop and implement a wide variety of continuing education and outreach programs for transit agencies. These include the two-week Transit Management Workshop offered to entry level and mid-level managers from transit systems throughout North America. UWM is one of the few organizations in the country with a base of transit experience that ranges from basic theory of travel behavior to applied research to planning, design and operations, and technology transfer.

In order to more effectively respond to inquiries for information requested by transit operators, government agencies, industry and communities, a transportation resource center has been established at the UW-Milwaukee. The purpose of the resource center is to bring together diverse sources of information on transportation matters into a single location, particularly in the area of land use/transit issues. This information includes government reports, technical studies, periodicals, microfiche, film, slides, and data files. It also serves as an access point to computerized information retrieval services currently only available in the field of transportation. The resource center is designed to students, faculty, local government agencies, transit operators, transportation planners, traffic engineers, and the general public.

### **IV. Marquette University**

The Center of Highway and Traffic Engineering at Marquette University was created to conduct research, perform testing, and provide training in the areas of transportation facility maintenance and operations, traffic engineering, highway pavements, transportation materials and construction. Ongoing research areas include facility snow and ice control, highway design,

facility materials, highway pavements, concrete and asphalt technology, facility structures, non-destructive testing, pavement drainage systems, traffic engineering, traffic control devices, traffic safety, clean air act-demand management, transportation planning.

Marquette's Department of Civil and Environmental Engineering maintains laboratories related to studies in hydraulics, environmental Engineering, structural models, structural testing, geotechnical engineering, and concrete and asphalt, as well as computational facilities. Topics of currently funded research include: (a) Public's Perception of the Midwest's Pavements, (b) Cost Effective PCC Pavement Cross-sections, and (c) Effectiveness of Grinding PCC Pavements.

## **V. University of Cincinnati**

The University of Cincinnati is one of the largest research universities in the country with an enrollment of close to 35,000 students. The College of Engineering, with the first and only mandatory undergraduate cooperative education, has earned an international reputation through superior teaching and aggressive multidisciplinary research. About 2000 undergraduate and 1,100 graduate students are taught by 154 full-time faculty who conduct sponsored research at almost \$18 million annually. The civil engineering division of the Department of Civil and Environmental Engineering includes focal areas of Construction, Geotechnical, Structures and Materials, and Transportation. The construction engineering and management program is designed to provide a strong theoretical and applied background in all areas of construction and covers planning, scheduling, equipment, construction operations analysis, computer application, project management, engineering economics, and strategic planning. The structures and materials program covers structures made of steel, concrete, masonry, wood, and advanced composites. The geotechnical engineering program interfaces with programs in geology and environmental engineering to provide students a wide range of study and research topics. The transportation engineering program is designed to provide state of the art education in Traffic Engineering and Control with emphasis in Highway Safety, Intelligent Transportation Systems, Transportation Planning, and Emerging Technologies in Transportation. In addition, the environmental engineering and science division encompasses areas of air quality, environmental hydrology, hazardous waste management, and water quality processes.

All these specialties as well as contributing areas throughout the College of Engineering (electrical engineering, materials science and engineering, mechanical engineering, and aerospace engineering) are interconnected under the umbrella of Cincinnati Infrastructure Institute (CII), which is housed in the Department of Civil & Environmental Engineering. CII is a multi-disciplinary group of infrastructure experts taken from academia, industry, and government that collaborate for addressing issues related to the evaluation, maintenance, and enhancement of existing infrastructure (bridges, highways, and pavements). The goal of CII is to deliver infrastructure maintenance and management solutions at the cutting edge with true competitive advantage for respective governing agencies. The CII also serves as a clearinghouse and a resource center that provides continuous support to the community in the form of workshops and annual conferences, and publications of newsletters. The CII that was originally established in 1988, is well suited to address many of the educational and research paradigms required to meet

21st century problems facing transportation professionals. Expanded facilities in the new Engineering Research Center and the Center Hill allow CII to meet its mission of serving the student and industrial communities with an increasing amount of research based information. This Center brings together computer and information science, environmental engineering, fluid mechanics, materials sciences and engineering, systems engineering and urban studies to address critical needs in the areas of deterioration science, condition assessment and renewal engineering.

The main research focus areas of the CII include the following:

- Condition assessment of existing infrastructure facilities through non-destructive laboratory or field tests, and coordinated experimental and analytical studies.
- Development and application of new construction materials such as high performance steel, high performance concrete, and high performance composites (or advanced fiber composites) to increase the life cycle of bridge and pavement structures.
- Real-time and long term response monitoring of bridges and pavements to improve basic understanding of live load and environmental effects, to enhance current rating systems, to develop more efficient repair and maintenance techniques and strategies, and to improve design methods.
- Real-time applications of latest technologies and communications to roadways to increase safety, reduce congestion, enhance mobility, and minimize environmental impact.
- Advanced construction management techniques.

## **VI. The University of Chicago**

The Graduate School of Business offers six full- and part-time programs leading to the M.B.A. degree. In addition, Chicago offers a Ph.D. program, open enrollment executive education seminars, and custom programs tailored to the needs of individual companies. The school operates two campuses in Chicago and one in Barcelona, and will open an Asian campus in Singapore in mid-2000.

At the University of Chicago the George J. Stigler Center for the Study of the Economy and the State was established in 1977 to study the effects of economic life on political life and the reciprocal effects of political life on economic life. The center is a joint enterprise of the Graduate School of Business, the Department of Economics, and the Law School.

## **VII. Richard J. Daley College**

Richard J. Daley College is one of seven colleges in the City Colleges of Chicago District. The manufacturing technology laboratories have extensive equipment, much of which was donated by interested companies. Richard Daley College offers an applied science degree in Railroad Operations. Approached by Daley College houses a Freight Conductor program in a partnership with CSX. Daley College works with METRA (Metropolitan Rail) for training 130 signalmen. Additionally, the college is working with the Railroad Association Degree Symposiums (R.A.D.S) to offer a program in railroad operations.

Richard Daley College partners with the Illinois Institute of Technology (IIT). Its mission is to educate people from all countries for complex professional roles in a changing technological world and to advance knowledge through research and scholarship. IIT is a private, Ph.D.-granting university with programs in engineering, science, psychology, architecture, business, design and law. Current research strengths include fluid dynamics and aerospace, synchrotron radiation science, environmental engineering and regulatory policy, polymer science and recycling, food safety and technology, and transportation and infrastructure.

### **VIII. Lac Courte Oreilles Ojibwa Community College**

Lac Courte Oreilles Ojibwa Community College (LCOOCC) has a partnership with the Wisconsin Department of Transportation (WisDOT) and the Federal Highway Administration (FHWA) to plan, develop and foster careers and business development for Native Americans in the transportation industry. LCOOCC has developed two one-day seminars for Native American road contractors, established a resource library for entrepreneurs, and actively sought out Native Americans Entrepreneurs for referral to WisDOT's DBE program. LCOOCC has also hosted a National Summer Transportation Institute for Secondary School Students to attract minority and low-income youths into the transportation industry. LCOOCC hosted a workshop to increase the employment and retention of Native Americans in highway construction. A website was constructed by LCOOCC to assist Native American Road Contractors with their business and technical needs. LCOOCC has hired three students to perform GIS mapping of roads in the Ontongon National Forest through a Dwight David Eisenhower Transportation Fellowship. The goal of these fellowships is to introduce students to GIS principles and methods in the transportation industry and allow them to experience interactive learning that will enable them to become trained for careers in the area of transportation.

#### Advisory Groups

An **Executive Committee** will be formed to provide direction to the center. This committee will include the following members (10):

- Three (3) representatives from State DOTs
- Three (3) representatives from Industry
- Three (3) representatives from Consortium Institutions
- One (1) representative from the AASHTO Asset Management Committee

The committee will monitor the scope of the center to assure that it is in line with the Region's transportation concerns and make recommendations to the Director.

The Center Director and Associate Director will be non-voting members on the Executive Committee. A special effort will be made to recruit the chair of the AASHTO Asset Management Task Force. This will bring valuable national leadership to the executive committee while representing this region's transportation agencies.

The Executive Committee shall evaluate the performance of the Center Director annually and make recommendations based upon this evaluation to the Dean of the College of Engineering at the University of Wisconsin Madison.

An **Advisory Committee** will be formed to provide specific directions and advice to the Center Director and oversee selection of research emerging through TOCs. This committee will assist in development of policies and procedures for the solicitation, selection and evaluation of research. The committee will also monitor the scope of the center to assure that it is in line with the Region’s transportation concerns and make recommendations to the Director in concert with the Executive Committee. Representatives from at least three participating consortium institutions not represented on the executive committee shall serve on the Advisory Committee in addition to members identified through the Spring meeting of regional stakeholders.

The current proposed organizational structure for the Center is shown in Figure G1.

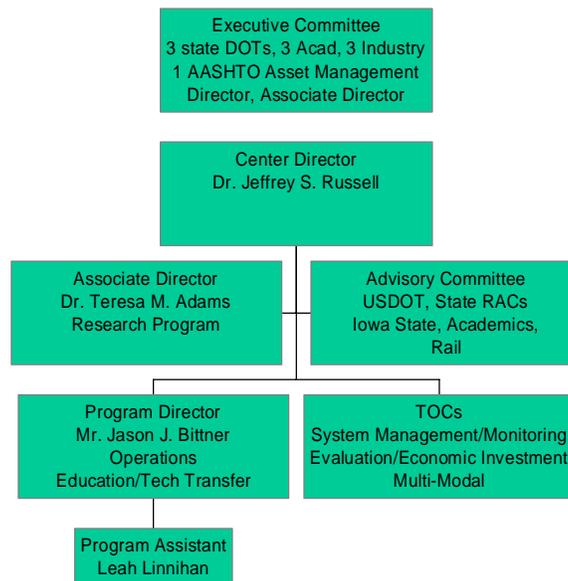


Figure G1. Center Organizational Structure

The role of the Advisory Committee is to provide policy and program advice for the Center Director and coordinating education, technology transfer, and research goals with the strategic goals, emphasis areas, and business needs of the USDOT. As previously indicated, membership on this Advisory Committee shall include stakeholders from government units, academics, and industry. Special attention will be given to include representatives from AASHTO and Iowa State University, the Region VII UTC with a complementary asset management theme, to provide useful research within the region on the Center’s thrust areas. The Center also is working to include a representative of rail interests on the Advisory Committee. In addition, Mr. Frank Botelho from the FHWA Asset Management office has agreed to serve on this advisory committee.

The Advisory Committee will: (1) advise the Director and executive committee on the formal criteria used in rating research project proposals; (2) approve any priority for research emphasis areas or research project proposals emerging from the TOCs; (3) advise the Director on the appointment of members and chairpersons for all TOCs; (4) review individual research study results each year and the proposed direction and scope for the following year's study; and (5) receive all final research reports and be notified about presentations prior to public distribution or discussion.

As previously indicated in the Research Selection Process, the Technical Oversight Committees (TOCs) will be designed to oversee the program goals in the three thrust areas: (1) System Management and Monitoring; (2) Valuation and Investment; and (3) Multi-Modal Systems. An individual TOC will provide technical support, input, and advice as well as oversee research projects in its assigned subject area. TOCs will also serve as a forum for an exchange of ideas among asset management interests and it will actively promote involvement and input from all transportation sectors. The TOCs will perform this function by: (a) developing and updating annual and longer range education, technology transfer, and research plans with input from knowledgeable professionals representing state DOTs, FHWA, academia, industry, and other sources; (b) creating and reviewing research problem statements; (c) evaluating and recommending research proposals to the Center Director and Advisory committee; (d) identifying and recommending principal investigators for approved research projects to the Advisory committee; (e) reviewing and recommending research modifications, extensions, or terminations to the Center Director; (f) promoting the education and transfer of the new technologies; and (g) accepting the reports and other contract deliverables. The Advisory Committee shall make necessary efforts to coordinate the work of these TOCs and prevent duplicative work products.

The TOCs will consist of chairperson(s) and individual members. Members will be solicited from state DOTs, US DOT, AASHTO, academia, industry, and other interested groups. The Center staff will make recommendations to the Advisory Committee of the TOC memberships.

### **III.B. Center Director**

Upon the initiation of the Center, the Center's Director will be Dr. Jeffrey S. Russell. He will have the responsibility of administering the Center's programs. The Director will be responsible for the coordination of the consortium universities to ensure the productive performance of the Center. It is the intention of the Center to hire a full-time permanent director who is appropriately qualified. It is highly desirable that the Director possess significant state DOT experience including experience with asset management research and policy issues.

The administrative, financial and technical management of the Center will be performed at the University of Wisconsin-Madison. The management of activities at UW-Madison, along with other consortium universities, will be planned to ensure an effective coordination and quality performance. The Center Director is responsible for implementing the Center's Strategic Plan and ensuring compliance with all other UTC Program requirements. The Director will also

oversee the day-to-day management of the center and be responsible for developing and facilitating external relationships with Washington D.C. and Region 5 state DOTs.

The Center Director will ultimately be responsible for assuring that:

- Research, education, and technology transfer activities at the Center are being performed to the best of the Center's ability;
- All activities at the Center are completed on time;
- Deliverables and reporting requirements are submitted on time;
- Problems and conflicts are resolved; and
- Proper planning for Center growth is conducted.

The Director will communicate with other centers and national transportation institutes and organizations. The Director will work with public and private agencies to develop Center activities and develop programs to increase student and faculty diversity. Finally, the Director will actively pursue new opportunities to expand the education, research, and technology transfer areas of the Center. The Center Director will work closely with the Executive Committee, Advisory Committee, and partner university contacts. The Center Director will serve on the Executive Committee as a non-voting member. The existing Interim Director will be appointed at a 50% level until such time as a Permanent Director can be recruited.

### **III.C. Center Faculty and Staff**

It is perceived that the long-term viability of the Center will benefit significantly from the active involvement and leadership from the region's state DOTs. As such, it is desirable to have a staff member with significant state DOT experience and knowledge actively involved in achieving the stakeholders' goals for the Center.

Upon the initiation of the Center, however, Dr. Teresa M. Adams will serve as Associate Director. Dr. Adams has a background in infrastructure management theory and instruction. This appointment shall be considered as an interim appointment with further definition considered at the regional stakeholder meeting planned for late spring of 2000. Experience with infrastructure management theory will be a highly desirable trait of the 50% appointment Associate Director, making them an effective leader in the research on the Center's Theme. The Associate Director will also be responsible for coordinating and maintaining relationships with the state DOTs in Region 5 and nationally and will have oversight responsibilities for the research program. Overall responsibility in the Center will be to assist in the development and management of the program by implementing the specific activities defined in this Strategic Plan. The Associate Director will also serve as a non-voting member of the Advisory Committee. If an experienced candidate assumes the Director's position, the position of Associate Director may not be filled permanently. If this occurs, the Director will assume the specific duties outlined below.

The Associate Director will be ultimately responsible for:

- Creating a research agenda and strategies for each thrust area in concert with the Center Director, Executive Committee, Advisory Committee, and TOCs;
- Managing the formation of TOC teams;
- Creating RFPs where appropriate;
- Evaluating RFPs and award research;
- Monitoring research results; and
- Monitoring and continuous improvement of the research agenda strategies.

Mr. Jason J. Bittner will be designated Program Manager/Director. The full-time (100%) Program Manager/Director shall be responsible for administration and day-to-day operations of the Center. This position shall report to the Center's Director. The Program Manger/Director will also provide management of the Education and Technology Transfer components of the Center.

The Program Manager/Director will be ultimately responsible for:

- Creating an education agenda focused on district and State DOT personnel in concert with the Director, consortium members, and the Executive Committee;
- Developing and delivering education materials, including professional short courses, recruitment oriented programs, and other educational requirements;
- Creating a process to transfer research to practice, including scheduling seminars or symposiums where appropriate;
- Implementing appropriate technology, including the maintenance and updating of a Center website;
- Monitoring and continuous improvement of the implementation process of center operations;
- Ensuring compliance with all requirements of the contract agreement, including the collection of performance data on each Center goal, and the preparation and submittal of annual reports, newsletters, and other Center publications.

The staff of the Center will also include administrative support in the way of telephone, correspondence, and weekly planning assistance. At the present time, this position is filled by Ms. Leah Linnihan. This program assistant shall be appointed by the Director.

The Program Manager/Director and Associate Director will be responsible to the Director and shall attend all meetings related to the planning and operation of the Center.

It is understood that once the Center becomes operational, staffing requirements will be re-evaluated and any needed modifications will be undertaken.

### **III.D. Multiparty Arrangements**

The UW-Madison has established a consortium or partnership arrangement with other academic institutions, regional DOTs, industry, consultants, and the FHWA. The UW-Madison, as the direct and primary recipient of DOT funds, will perform a substantive role in carrying out

Center activities and not merely serve as a conduit for funding to another party. The University will organize the Center in such a fashion to ensure that the partners have a significant role in contributing to the Center's goals and objectives.

The consortium of academic partners allows the Region a great deal of opportunity. As mentioned previously, no one member of the consortium has the complete package of expertise and resources to take on the theme that the Center has. By pulling together this consortium, significant collaborative efforts can be undertaken which will greatly enhance the research, education, and technology transfer activities for each university and for the region as a whole. Some possible examples of how this relationship may work out include: creation of some core transportation course materials related to asset management, available only to these consortium members, or distance learning opportunities. Since this Center is new, these interrelationships will be developed during the course of the grant with the end result being a long-lasting partnership.

One of the primary advantages to developing a partnership between Marquette University, UW-Milwaukee, Northwestern University, University of Cincinnati, and LCOOCC and Richard Daley College with UW-Madison as the lead institution is the consolidation of ongoing, and perhaps, duplicative research efforts. By building these sorts of partnership arrangements, expertise in these areas can be aggregated, rather than potentially having several smaller, less cohesive options. The geographic distribution of the partner institutions allows the Center to have several places to reach DOT personnel for distance learning courses and symposiums as well. The partnership is a real asset to the region, allows the several states in the Region to gain significantly in the areas of research, education, and technology transfer and makes the likelihood of useful research results more likely.

### **III.E. Matching Funds**

The following sources outlined in Table I2 have been identified as potential contributors of matching funds for the UTC program. The University will most likely obtain its matching funds from state SP&R monies, state DOT direct donations, partner institution donations, and monies from within the University.

The Executive Committee will establish criteria upon which funding determinations can be made. It will ultimately be the principal investigator's responsibility to find and attract matching funds for their proposed projects. Each consortium institution will be responsible for providing matching funds for its educational programs. We expect the most common matches for these educational programs will come from state DOTs.

The consortium overall budget will be maintained on a project by project and program by program basis. By doing so, the UTC should have ample matching funds.

**Table I2.** Sources of UTC Matching Funds

<b>Name of Potential Contributor</b> (1)	<b>Estimated Amount (\$)</b> (2)
Research Project Match from state DOTs (IL, IN, MI, MN, OH, WI)	383,400
WisDOT	200,000
UW-Madison	131,600
Other Schools	175,000

**Appendix A: Baseline Measures**

**1. Education**

**1a.**

A. UW-Madison offers:

1. Civil and Environmental Engineering Courses:

<b>Undergraduate</b>	<b>Undergraduate/Graduate Credit</b>	<b>Graduate</b>
Materials for Constructed Facilities	Transportation Engineering	City Planning
	Environmental Impact of Transportation Systems	Highway Engineering
	Urban Transportation Planning	Special Topics in Transportation and City Planning
	Geometric Design of Transport Facilities	Infrastructure Management
	Traffic Control	Advanced Bituminous Material
	Advanced Highway Materials and Construction	Testing and Construction
	Advanced Highway Design	Advanced Asphalt Rheology
	Seminar-Transportation Engineering	Special Topics in Transportation
	Transit Systems Planning	Engineering and City Planning
		Land Use and Communication Systems Planning (crosslisted with Urban and Regional Planning)
		Workshop in Land Use and Communication Systems Planning (crosslisted with Urban and Regional Planning)

2. Transportation and Public Utilities Courses (in School of Business):

<b>Undergraduate</b>	<b>Undergraduate/Graduate Credit</b>	<b>Graduate</b>
Economics of Transportation	Public Utilities (crosslisted with Economics)	Carrier Management Principles
Transportation and Business Logistics	Energy Economics (crosslisted with Environmental Studies, Agriculture and Applied Economics, Economics, and Urban and Regional Planning)	Logistics Strategies
Transportation in Economic Development		Urban Transport Economics (crosslisted with Economics)
		Public Utility Problems (crosslisted with Economics)

B. Northwestern University offers:

a. Management and Strategy Department

<b>Undergraduate</b>	<b>Undergrad/Grad Credit</b>	<b>Graduate</b>
Technology Management		Transportation Economics and Strategy
Public Policy and Management Strategy: Energy and Environment		

b. Finance Department

<b>Graduate</b>
Financial Management in Transportation

c. Marketing Department

<b>Graduate</b>
Transportation Marketing

d. Operations Department

<b>Graduate</b>
Logistics: Location, Transportation and Allocation Aspects

e. Economics Department

<b>Undergraduate</b>	<b>Undergrad/Grad Credit</b>	<b>Graduate</b>
Elements of Public Finance	Economics of State and Local Governments	Issues in Urban Economics
Transportation Economics and Public Policy		Urban and Regional Economics
Industrial Economics		

f. History Department

<b>Undergrad/Grad Credit</b>
Development of the Modern American City

g. Sociology Department

<b>Undergraduate</b>
The City: Urbanization and Urbanism

h. Civil Engineering Department

<b>Undergraduate</b>	<b>Undergrad/Grad Credit</b>	<b>Graduate</b>
Microstructure of Cement-Based C20	Public Infrastructure Management	Inelastic Analysis of Structures
Materials Structural Analysis	Transportation System Design and Analysis	Stability of Structures
Properties of Concrete		Transportation Systems Analysis I
Matrix Analysis of Structures		Transportation Systems Analysis II
Transportation system Operations		Computers in Engineering Design, Management and Decision Making
		Transportation Systems Planning and Management
		Travel Demand Analysis and Forecasting I
		Travel Demand Analysis and Forecasting II
		Evaluation and Decision Making for Infrastructure Systems

i. Industrial Engineering Department

<b>Undergraduate</b>	<b>Graduate</b>
Deterministic Models in	Introduction to Technology Management

Operations Research	
Operations Research	Information Systems and Telecommunications Management
Location Analysis and Spatial Planning	Mathematical Programming I
	Stochastic Models I
	Factory Physics I, II
	Factory Physics II
	Manufacturing Distribution Strategy
	Production and Economics I
	Production Scheduling
	Inventory and Distribution Systems

j. Interdepartmental Transportation Program

<b>Graduate</b>
Transportation Systems Seminar

C. UW-Milwaukee offers:

1. Civil Engineering and Mechanics Courses:

<b>Graduate</b>
Transportation Engineering
Environmental Impact Assessment
Traffic Control
Physical Planning and Municipal Engineering

D. Marquette University Offers:

1. Civil Engineering Courses

<b>Undergraduate</b>	<b>Undergrad/Grad Credit</b>	<b>Graduate</b>
Introduction to Transportation	Bridge Design	Bituminous Materials
	Highway Planning and Design	Urban Street Design
	Traffic Characteristics and Design	Airport Design
	Construction Costs and Economic Analysis	Pavement Design
	Computer Applications in Construction	Highway Interchange Design
	Urban Planning for Civil Engineers	Advanced Traffic Engineering
	Construction Seminars	Advanced Traffic Management
		Environmental Impacts of Transportation

		Construction Decisions under Uncertainty
		Public Works Administration 1
		Public Works Administration 2

2. Business School Course

<b>Graduate</b>
Management Information Systems

3. Math Course

<b>Undergrad/Grad Credit</b>
Analysis of Variance and Covariance

D. University of Cincinnati offers:

1. Transportation Courses:

<b>Undergraduate</b>	<b>Graduate</b>
Transportation Engineering	Highway Engineering
	Transportation Demand Forecasting I
	Traffic Engineering
	Pavement Design
	Computer Methods in Transportation
	Computer Aided Pavement Design
	Asphalt Pavement Technology
	Transportation Demand Forecasting II
	Mass Transit Engineering and Operations
	Transportation Systems Evaluation
	Traffic Signal Design
	Mechanistic Principles of Pavement Design
	Artificial Intelligence Techniques in Civil and Environmental Engineering
	Intelligent Traffic Management Systems
	Transportation Facilities Design
	Transportation Systems Design
	Methods of Transportation Analysis
	Traffic Planning and Operations
	Topic in Transportation

2. Urban Planning Courses:

<b>Graduate</b>
Introduction to Geographic Information Systems

Using Geographic Information Systems
Applied Projects in Geographic Information Systems

**1b.**

<b>Transportation Education</b>	<b>Undergraduate</b>	<b>Graduate</b>	<b>Total</b>
1b.1 Number of Courses Offered	20	38	58
1b.2 Number of Academic Departments Offering Them	21	18	24
1b.3 Number of Students Completing Above Courses	1,350	652	2,002
1b.4 Number of Students Involved in Transportation Research Projects	15	124	139

**2. Human Resources**

**2a.**

- A. UW Madison offers:
  - M.S. Civil and Environmental Engineering
  - PhD Civil and Environmental Engineering
  - Master of Business Administration (MBA)
  - M.S. in Urban and Regional Planning
  - PhD in Urban and Regional Planning
  - Master of Public Administration (MPA)
- B. Northwestern University offers:
  - MEM Engineering Management
  - MM(T) Management, Transportation Major
  - MMM Management in Manufacturing
  - MSCE Civil Engineering
  - MSIE Industrial Engineering
  - MST Transportation
- C. UW-Milwaukee offers
  - MS Engineering (Civil Engineering)
  - PhD Engineering (Civil Engineering)
  - MUP (Urban Planning) / MS (Engineering) Dual Degree
- D. Marquette offers:
  - M.S. Civil and Environmental Engineering
  - Ph.D. Civil and Environmental Engineering
- E. The University of Cincinnati offers:
  - MS Civil Engineering
  - PhD Civil Engineering

**2b.**

For the degrees listed as Baseline 2a, the following data is provided.

Advanced Transportation Students	Transportation-Related Degree Programs		
	Masters	Doctorate	Total
2b.1 Number of Students Enrolled	148	46	194
2b.2 Number of Students Receiving Degrees	61	17	78

### 3. Diversity

Diversity of Those Receiving Advanced Degrees	Transportation-Related Advanced Degrees Only		All Advanced Degrees	
	#	%	#	%

3.1 Non-Hispanic White	43	55	3,424	84
3.2 Hispanic	6	8	102	3
3.3 African-American	4	5	144	4
3.4 Asian/Pacific Islander	24	31	283	7
3.5 Native American	0	0	15	0
3.6 Other	1	1	95	2
<b>Total</b>	<b>78</b>	<b>100</b>	<b>4,063</b>	<b>100</b>

3.7 Male	63	81	2,136	53
3.8 Female	15	19	1,927	47
<b>Total</b>	<b>78</b>	<b>100</b>	<b>4,063</b>	<b>100</b>

3.9 U.S. Citizens and Permanent Residents	46	59	3,399	84
3.10 Non-U.S. Citizens	32	41	664	16
<b>Total</b>	<b>78</b>	<b>100</b>	<b>4,063</b>	<b>100</b>

\*This number must match the total number provided as Baseline 2b.2.

### 4. Research Selection

<b>Transportation Research Selection</b>
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4.1 Number of Transportation Research Projects Conducted	98
4.2 Total Budgeted Costs for Those Projects	9,362,540
4.3 Number of Individuals Listed as Principal Investigators in Those Projects	48

## 5. Research Performance

<b>Transportation Research Performance</b>	
5.1 Number of Peer-Reviewed Transportation Research Reports and Books Published	74
5.2 Number of Transportation Research Papers Accepted for Presentation at Academic / Professional Meetings	53
5.3 Number of External Awards Received for Transportation Research	6

## 6. Technology Transfer

<b>Transportation Technology Transfer and Outreach</b>	
6.1 Number of Visitors to Transportation Center Website (if you do not have a transportation website, show "0")	1,200
6.2 Number of Peer-Reviewed Transportation Research Publications Available on Website (if you do not have a transportation website, show "0")	12
6.3 Number of Transportation Outreach Events Conducted for Pre-College Students	8
6.4 Number of Pre-College Students Participating in Those Events	970
6.5 Number of Transportation Seminars, Symposia, Distance Learning Classes, etc., Conducted for Practicing Professionals	201
6.6 Number of Practicing Professionals Participating in Those Events	2,443
6.7 Number of Transportation Center Newsletters and Other Transportation Periodicals Published	5
6.8 Number of Issues Produced	11
6.9 Total Circulation	10,000
6.10 Number of Transportation Technology Products Deployed	5