STRATEGIC PLAN

THE UNIVERSITY TRANSPORTATION CENTER FOR WORK ZONE SAFETY AND EFFICIENCY:

"Working to Save Lives"

Prepared For

The University Transportation Centers Program
Research and Innovation Technology (RITA)
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SECTION I - PROGRAM OVERVIEW

This strategic plan will serve as a guide for proposed activities, and outlines a development path for the Transportation Center at Cleveland State University during its initial four year period of operation. The Center was established by the SAFETEA-LU legislation.

I. A. - Glossary

The following terms and acronyms are used throughout this plan.

ARTBA	American Road and Transportation Builders Association
ATSSA	American Traffic Safety Services Association
CDC	Center for Disease Control
CVE	Civil & Environmental Engineering Course Designation
FTE	Full Time Equivalent
FHWA	Federal Highway Administration
INE	Industrial and Manufacturing Engineering Course Designation
LECET	Laborers-Employers Cooperative Education Trust
NIOSH	National Institute for Occupational Safety and Health
NSBE	National Society of Black Engineers
NSF	National Science Foundation
ODOT	Ohio Department of Transportation
OTEC	Ohio Transportation Engineering Conference
RFP	Request for Proposals
SAFETEA-LU	Safe, Accountable, Flexible, Efficient Transportation Equity Act – a Legacy for Users
SWE	Society of Women Engineers
TEA 21	Transportation Equity Act for the 21st Century
USDOT	United States Department of Transportation
UTC-WZSE	University Transportation Center for Work Zone Safety and Efficiency

I. B. - Center Theme

The theme of this Center is "Highway Work Zone Safety and Efficiency." The overall safety of America's highways has steadily improved over the years after construction upgrades, supported under various federal transportation equity acts, have been completed. However, these same segments of the highway system that offer up improvements in safety *after* construction is completed are yielding disturbing safety trends *during* construction phases. In fact, deaths per year in work zones have an increased 37.5% since 1995. Due to increased investment levels by state and federal transportation agencies, thousands of new construction sites will be created in the upcoming years. Recent estimates by the American Road and Transportation Builders Association (ARTBA) point to an increased number of highway projects such that construction work zones are likely to appear as frequently as every 30 to 40 miles on the interstate highway

system. Only a limited number of construction zones lend themselves to traffic diversion, i.e., routing traffic around construction zones. So when highway work zones are present motorists must share the road with construction equipment and personnel. These work zones are particularly hazardous and as we repair our nation's highway infrastructure, motorists and construction personnel, as well as public maintenance personnel are be placed at greater risk, as evidenced in Figure 1.

Figure 1. Work Zone Accident: I-71, ODoT Project #239-00

For the heavy highway industry, safety along roadway construction sites has always been a priority. However, since the year 2000, over 1000 people have been killed in work zones on an annual basis (see trends in Figure 2) and on average, over 37,000 are injured every year. To a limited extent, historical data on work zone crashes and configurations has been used to identify particularly hazardous features at work zones that have led to recommendation of enhanced traffic control strategies. The effort dedicated to collecting work zone crash data typically attempts to identify or classify the causal factors and then

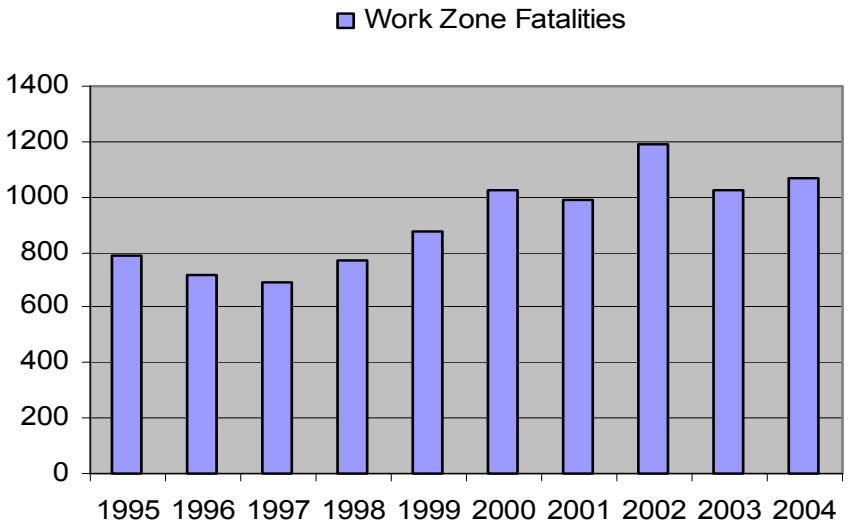


Figure 2: Trends in Work Zone Fatalities

develop appropriate and effective countermeasures. However, most of the work zone crash data simply describes the type of crash or pre-crash activity, but does not answer the question "what factors (e.g., driver, vehicle, organization, environment, or otherwise) increase crashes on roadways where a work zone is present?" Driver behaviors prior to the crash have historically been analyzed based on subjective information from drivers and observers. Surveys have been conducted and narratives from police reports and insurance claims have been studied. However, the usefulness of this information is limited by several factors. First, subjective data is unreliable. Drivers are often unwilling to reveal the true cause of the accident or admit fault to avoid further personal liability. In addition, eyewitness testimony is notoriously inaccurate. Therefore, a critical proportion of work zone crash data is largely unavailable for analysis. Second, databases and police forms often contain incomplete data. Data on near crashes and incidents is not available in databases simply because the data is never reported to police or insurance companies, and thus is not available for analysis. Due to the limitations of existing work zone crash data as well as the complexity involved in producing effective countermeasures based on incomplete or inaccurate data, it is not surprising that work zone safety is still a critical issue.

In addition to human factors associated with work zone safety, it can be argued that construction project management and construction operations are significant links in the safety equation. Work zones lead to congestion, and congestion has been rightfully viewed as an anchor on economic prosperity. For the transportation industry in general this issue is cross-cutting – including congestion at the entrance to construction work zones, delays due to rush hour traffic, downtown congestion, freight rail bottlenecks as well as air traffic delays. Even though the regional impact from a highway work zone project is on balance economically beneficial, the traveling public is particularly sensitive to and resentful of congestion related to work zone activities. Highway project managers are particularly aware of the growing public frustration. Thus time serves as a financial penalty for the construction industry, and under most current bid practices, the intent is to limit the public exposure to work zones. Contractors have inherent incentives to get work done as quickly as possible. Along with time compression, work zones are being compressed in size, and night time construction periods have been encouraged which reduce visibility and motorist alertness. Motorists tend to maintain normal traffic speeds within work zones, and it is readily apparent that all the aforementioned issues degrade safety within construction work zones. Thus a number of financial and project management constraints tend to be counterproductive relative to safety in highway work zones.

It is not enough to merely repair our nation's infrastructure. In the process of reconstructing our highway system to its optimal condition, engineering designs must be implemented to allow for future maintenance with minimal disruption to traffic flow. This must be accomplished with a corresponding minimum number of safety hazards. It is noted here that work zone safety has not been widely incorporated into the transportation engineering curricula, so design engineers are not presently cognizant enough of safety issues. Through the direction and work of researchers and educators in at CSU, it is hoped that understanding of driving behaviors and motivations, along with establishing work zone traffic control best practices and design protocols will ultimately saves lives. Research personnel at the CSU Transportation Center have adopted the philosophy that congestion and reduced safety are not natural outgrowths of rehabilitating the nation's infrastructure. New transportation technologies will be developed in conjunction with

government agencies and the private sector, including the heavy highway industry, equipment manufacturers, insurance companies, and regional government agencies to develop and implement long term design policies and protocols and proactively share best practices/policies. Hopefully this will lead to low cost operational improvements in work zones. These viewpoints dovetail with the 2006 "National Strategy to Reduce Congestion on America's Transportation Network."

The Work Zone Safety and Congestion Center at CSU will support the national research, development and technology priorities of the US DOT and its Operating Administrations. These priorities are identified in the "Department of Transportation Strategic Plan" and in the 2006 update of the "U.S. Department of Transportation Research, Development, and Technology Plan." Moreover, the Center at CSU will support and align activities to the greatest extent possible with the research priorities outlined in a report authored by the National Highway Research and Technology Partnership entitled "Highway Research and Technology: The Need for Greater Investment" as well as the programs of the National Research and Technology Program of the Federal Transit Administration which are outlined in "Delivering Solutions that Improve Public Transportation."

I. C. - Director's Summary.

At the end of the current grant period (four years; September 2010) we anticipate that the Transportation Center at CSU will have grown in size and capability such that the Center will at the least compete for a Tier I University Transportation Center designation. This assumes that the anticipated changes that occur at CSU will propel the Center to a position where it is nationally recognized for excellence in work zone safety research, congestion abatement, education, and technology transfer. As outlined below, the Civil Engineering program at CSU is growing both in capability and accomplishments. Since the research efforts at the Center will be multi-disciplinary, other programs (e.g., industrial engineering, education, etc.) will be impacted in a positive fashion. The technology transfer efforts as well as the educational outreach endeavors will demand and receive resources similar to the resources planned for research efforts. This strategic plan is the blueprint to guide the requisite transformation.

Current Situation: Over the last two years, Cleveland State University has been laying the foundation for the development of a research, education, and training effort targeting transportation engineering, highway construction, and in particular, construction safety and congestion abatement issues. In **December of 2003**, the University hired a transportation specialist (Dr. Norb Delatte) in order to complement the skills of existing faculty with transportation engineering related skills (Dr. Stephen Duffy, Dr. Lutful Khan, Dr. Paul Bosela, Dr. Phil DeGroot, and Dr. Chin Kuo). In **September 2005**, the Industrial and Manufacturing Engineering Department hired an additional faculty member, Dr. Nancy Grugle, whose expertise in human factors research dovetails with transportation work zone safety issues. At this point the transportation program at CSU is beginning a maturation process with various areas of expertise now available within the program, including scholars who focus on the design of concrete pavements; human factors engineering; bridge deck rehabilitation and durability; hydraulics and

hydrology; geomechanics; work zone safety and safety education; and roller compacted and pervious concrete pavements.

In **May 2004**, a new Transportation Specialization within the Masters of Science in Civil Engineering was approved by the faculty, with one new course in Highway Engineering and two substantially revised courses. During that time, the faculty also approved a new Civil Engineering Graduate Seminar, with topics presented in the first academic year that included "Work Zone Crash Analysis and Traffic Management in Work Zones – The ODOT MOT Process[1]" and "Work Zone Safety – Research and Modeling Techniques."[2]

By **June 2004**, an important step was taken to further strengthen the institution's position in the transportation field. Cleveland State University received a grant from the U.S. Department of Education for curriculum development in the area of work zone safety. Specifically, the funding supported three activities: the establishment of a safety curriculum at the university level (with the first course being taught in academic year 2006 -2007); the establishment of a training curriculum for construction personnel (discussion with the Ohio Contractors Association and ATSSA have established basic benchmarks and needs); and the creation of a summer intern research program at the undergraduate level. The funding from the U.S. Department of Education led to the creation of the Transportation Work Zone Safety and Efficiency Center at CSU.

The results of these initial investments into our academic activities have substantially impacted the transportation program at CSU. There has been an increase of student interest focused on the new transportation specialization. In the area of student and workforce development, the following has occurred in a relatively short period of time:

- A transportation safety engineer at ODOT District 12 graduated from the CSU Civil Engineering Master's program in May 2006 (representing our first outreach to ODOT).
- Two Doctoral students and three Master's students attended the TRB annual meeting in Washington, DC, January 2005.
- Student papers were presented at the 2004 and 2005 TRB annual meeting, and two papers have been submitted for January 2007 TRB annual meeting.
- There has been increased student participation at the Ohio Transportation Engineering Conference (OTEC) in 2004 and 2005.
- There has been an increase in the number of available undergraduate scholarships and graduate assistantships with transportation engineering sub-specialties.
- Three students graduated in Spring 2006 with Masters degrees in Civil Engineering with a transportation subspecialty, the first of the new program.
- One Doctoral level student and two Masters level students are currently enrolled in the transportation speciality area and are working full time on research projects through the summer of 2006 (an additional 11 students are also enrolled and working on research projects during the academic year).

[1] Presented by Dave Holstein, ODOT Office of Traffic Engineering
[2] Presented by Dr. Steve Jones, Department of Civil and Environmental Engineering, University of Alabama at Birmingham

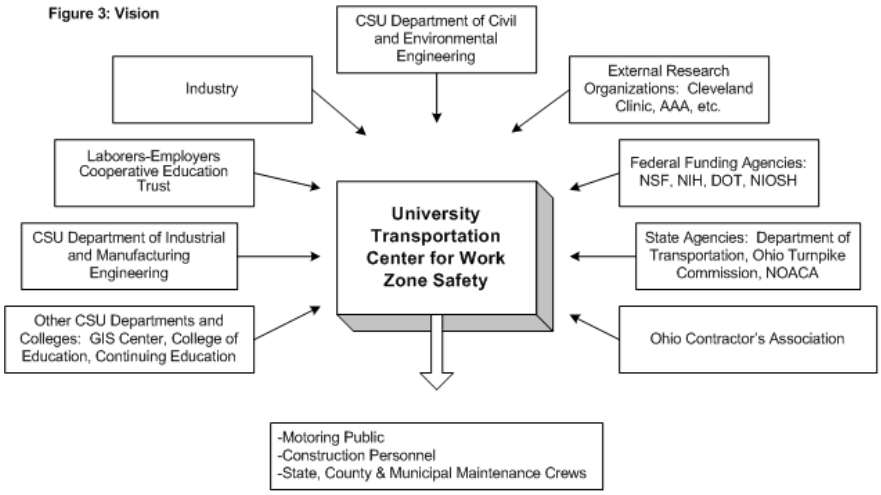
We note that prior to 2002 there had been no activity in transportation engineering at the graduate level, and one course was offered at the undergraduate level. So what is outlined herein represents substantial academic progress in a very short period of time. The University has also seen an increase in research grant and contract activity – and like the efforts cited above, much of this activity has occurred over the last two years:

- "Curriculum Development: Work Zone Safety," $248,000, U.S. Department of Education, June 2004, Principal Investigator: Stephen F. Duffy.
- "Evaluation of High Absorptive Materials to Improve Internal Curing of Low Permeability Concrete," State Job No. 134227, Federal Contract Number 20809, $98,702.79, Ohio Department of Transportation, April 2005, 24 months, Principal Investigator: Norbert Delatte
- "Demonstration of Innovative Techniques for Highway Safety Data Analysis," $70,388, Ohio Department of Transportation, July 2006, Principal Investigator: Nancy Grugle.
- "Effect of Partial Layer Bonding on Design of Layered RCC Pavements," $20,000, Portland Cement Association Education Foundation Fellowship, awarded May 2005, Principal Investigator: Norbert Delatte.
- "Laboratory Evaluation of Thin Bonded Overlays on Roller-Compacted Concrete Pavements," $20,000, Portland Cement Association Education Foundation Fellowship, awarded June 2004, Principal Investigator: Norbert Delatte.
- "Consultant to Federal Highway Administration Concrete Pavement Technology Program," Task 65(03), Technology Transfer, Deployment and Delivery for the Concrete Pavement Technology Program (CPTP), consultant to Construction Technology Laboratories, September 2003 – September 2005, Principal Investigator: Shiraz Tayabji, CSU Co-Investigator: Norbert Delatte.
- "Innovative Pavement Research Foundation, Practices for Accelerated Airfield Concrete Pavement Rehabilitation and Reconstruction (Planning, Design, Execution)," Contract awarded July 17, 2003, Subcontractor APTech, Principal Investigator: David Peshkin, total contract amount $200,000 (CSU subcontract amount $ 30,000) CSU Principal Investigator: Norbert Delatte.
- "Portland Cement Pervious Concrete Pavement: Field Performance Investigation on Parking Lot and Roadway Pavements," $100,000, National Ready Mix Concrete Association (NRMCA) Research Foundation, January 1, 2006 – August 31, 2007, Principal Investigator: Norbert Delatte
- "Acquisition of Driving Simulator," $107,051, National Science Foundation, August 15, 2006-August 14, 2007 Principal Investigator: Nancy Grugle

With the successes and achievements cited above occurring in the area of transportation engineering and work zone safety at Cleveland State University, it was a natural progression for CSU to be designated as a Tier II University Transportation Center during the current federal transportation budget cycle.

***Vision of the Future**:* Drawing on the existing expertise housed within Cleveland State University (Civil and Environmental Engineering; Industrial and Manufacturing Engineering; the College of Education and Human Services; the Division of Continuing Education; etc.) as well as partners off-campus (government, industry, and non-profit organizations), the UTC-WZSE envisions an organization that takes a multi-disciplinary approach to solving problems associated with highway construction safety. Whether the problem is how to modify work zone geometries, abate congestion, or how to divert motorists safely around construction work zones, the Center will be able to pull together the appropriate talent and expertise to provide timely and appropriate solutions. For example, reducing crashes in work zones requires the input of law enforcement to reduce speed, civil engineering to develop safer work zone geometry, human factors engineering to develop countermeasures to address unsafe driving behaviors, and public education to convey the importance of work zone safety to the driving public. The Center will, when fully operational, aid the heavy highway construction industry to increase safety without sacrificing efficiency within construction work zones across the nation. To diversify the capabilities of the Center at CSU, transportation-related research projects not specifically targeted towards work zone safety will be supported and encouraged. Transportation human factors issues such as distracted and impaired driving as well as older driver safety are issues of critical importance in the transportation field that can be addressed by the UTC.

Figure 3: Vision



Collaborative research, education, and training for the purpose of saving lives in highway work zones.

A unique component of the UTC-WZSE is its vision of relationships with industry, government (local, state, and federal), and industry-related non-profit organizations (e.g., Laborers Union, Iron Workers Union, and the Operating Engineers Union). The work of the UTC is about the public and about individuals, whether those individuals are inside the work zone perimeter, or outside the perimeter. Typically, academic research efforts tend to result in scholarly publications such as journal articles, conference proceedings, and conference presentations that rightfully contribute to advancing the knowledge base. While this type of work will occur at the UTC-WZSE, the core vision for the Center is the belief that safety and congestion abatement research conducted at the UTC-WZSE will immediately benefit those individuals occupying the work zone—the construction laborer, the equipment operator, the contractor, government employees, and the driving public (commercial and private). Applicability of the research knowledge generated and its attending technology transfer for the public good are expected to be trademarks of the UTC-WZSE. For example, working with the CSU Division of Continuing Education, the UTC-WZSE will offer continuing education courses such as OSHA's "10-Hour

Training Exclusively for the Roadway Construction Industry" and the "OSHA 30-Hour Training Exclusively for the Roadway Construction Industry." We intend to provide appropriate training for transportation professionals to maintain the credentials deemed necessary by the Ohio Department of Transportation as well as the Federal Highway Administration. The motivation for this stems from the fact that Cleveland State University's retooling of the transportation program was driven by industry reaching out to academia looking for training and education relative to work zone safety. While peer-reviewed research will occur in association with this Center, the practical side of the UTC-WZSE will be as important as the day-to-day activities of operating the UTC unfold.

We also intend to work hard at increasing the number of engineers specializing in transportation. This work will focus on reaching out to the K-12 educators on a regional basis. An important aspect is that these educators will help define the direction of this effort. The UTC-WZSE will explore the possibility of partnering with the CSU College of Education and Human Services to offer graduate courses for K-12 educators willing to incorporate engineering and technology applications in their math and science curriculums– at all levels of a child's education. This is being approached with the thought that at its core, engineering is all about applied mathematics and applied science. There also are plans to add an engineering teaching certification program for high school teachers and to pursue accredited undergraduate degrees in interdisciplinary pre-engineering education. In addition, the UTC-WZSE will develop and/or expand engineering graduate certificate programs focused on the transportation industry, with the expectation that professionals will enroll in these courses and eventually move into graduate programs.

Over the next four years, the UTC-WZSE expects to achieve a number of accomplishments, ranging from the development of training programs, recruitment/development of transportation professionals, to participation in multi-disciplinary research projects. It is expected that establishing itself as a premier center focused on safety and efficiency in work zones will help position the Center to successfully compete for a Tier I Center designation. The following six-point plan summarizes what the Center hopes to accomplish over the next four years (see Section II for more details):

1. **Research Selection Process Based on Impact and Ease of Implementation:** A research selection process will be designed to offer maximum opportunities to faculty for developing multi-disciplinary approaches to problems related to work zone safety. Each year, a Research Committee will help develop a research agenda that is consistent with the needs of industry and public safety advocates. A pool of research dollars will be available along with stringent research criteria that will help guide the selection of the most appropriate and applicable research submitted.

2. **Increased Research Performance:** Through various support mechanisms including the availability of graduate assistants, grant writers, and research administrators, all faculty and research personnel associated with the UTC-WZSE will be encouraged and expected to contribute to the body of knowledge associated with work zone safety and congestion abatement. A network of multi-disciplinary research faculty and transportation specialists will be recruited to help increase the likelihood of new and collaborative research activities. While some CSU departments and subspecialties have traditionally

been linked to transportation research (e.g., civil engineering, and human factors engineering), other University departments offer significant research capabilities that can contribute faculty expertise and resources to address multi-disciplinary research problems within the transportation field such as psychology, GIS, and industrial health and safety. Moreover, human factors engineering is inherently multi-disciplinary in nature and offers a unique opportunity to bring transportation work into fields and disciplines outside the engineering college.

3. **Improvements in Education of Transportation Safety Issues:** Increases in both undergraduate and graduate student enrollments will be a paramount objective of the transportation program. This includes increases in both the Civil and Environmental Engineering, and the Industrial and Manufacturing Engineering programs. Additional courses will be developed that will be focused on the needs of the transportation industry, and multi-disciplinary research programs targeted toward student involvement will be enhanced. Examples of educational programs to be offered include student internships with highway construction companies and the development of a joint certificate program between civil and industrial engineering in transportation safety. All curricula will be offered with the intent to meet technical and safety needs identified in collaboration with the Ohio Department of Transportation. In addition, the Center will also identify one outstanding student each academic year to receive the Student of the Year Award.

4. **Increased Recruitment of Professionals into Transportation-Related Jobs:** With the advent of the new transportation specialty in the Civil Engineering Department and the growth of new courses and programs in related departments (i.e. Industrial and Manufacturing Engineering), activities will be focused on active recruitment and increasing enrollment in the transportation program. Additionally, students from other departments and colleges (e.g., psychology, education, urban studies) will be encouraged to take advantage of the multi-disciplinary nature of the program by taking transportation-related courses. For example, industrial engineering students with an interest in human factors will be encouraged to take transportation courses such as the new transportation human factors course and the construction safety course.

   Due to the new program focus, first steps include basic marketing and recruiting activities, from the design of brochures and websites to setting up recruitment tables at area high schools, community colleges, and even the common areas at Cleveland State. In addition, various K-12 outreach programs will be instituted to develop a larger pipeline of potential students for the program. These are discussed in more detail later in the plan.

5. **Improved Diversity in the Transportation Field:** With an ever-increasing number of minorities working at highway construction sites, it has become equally important to increase the number of transportation professionals from underrepresented minorities. To this end, the UTC-WZSE will draw from the success of Cleveland State University's ability to educate and graduate a large percentage of minority students (20%, the highest percentage of any non-HBCU in Ohio), integrating the Center's recruitment and retention activities into existing University programs. This includes collaborating with offices such as the Focus Center (helps teach study skills and other college-readiness techniques)

as well as programs such as STARS (recruits minority students into graduate programs) to educate and graduate a truly representative transportation-trained workforce. Furthermore, by diversifying the transportation education plans to include students from outside the Civil Engineering Department, the base of students will increase and will potentially attract a more diverse student body than is traditionally seen in an engineering department (i.e., more women and minorities). The base of students will be augmented by the K-12 outreach activities as well.

6. **Implementing Focused Outreach Programs to Stakeholders through Technology Transfer**: There is a great deal of room for the UTC-WZSE to grow in this area by collaborating internally with the University's Division of Continuing Education and collaborating externally with organizations such as the Ohio Contractors Association and ASCE. This includes developing a website and newsletter as well as increasing the number of seminars and symposia offered. We have found that the heavy highway construction industry and the engineering design consultants are quite receptive to sending their employees to appropriate training seminars, which helps these stakeholders adapt to technological changes. A variety of programs related to safety issues are under consideration and discussed in more detail in a later section.

SECTION II - PROGRAM ACTIVITIES

UTC-WZSE has developed a four-year plan to continue down the road toward becoming a center of excellence in work zone safety. The objectives set forth for the Center are directly related to the vision for the UTC-WZSE as just reported.

With the majority of the UTC-WZSE's first year focused on start-up and organization, first year objectives have been established to allow formative measurement of progress rather than summative change. The overall goals and objectives are reproduced in total in Appendix A. Unless otherwise noted, each fourth-year objective represents cumulative accomplishments since the origination of the UTC-WZSE.

Goal II.A – Research Selection

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

1. Baseline Measures: Baseline measures for research selection include the following: 1) Number of projects selected for funding, and 2) Budgeted costs for selected projects. Currently, these numbers are -0- until the first project is selected.

2. Research Selection Program Outcome: Research will be selected based on whether the proposed work supports the CSU UTC program goals, and if it is consistent with the theme of *Highway Work Zone Safety and Efficiency*. In regards to the selection criteria, research projects must as a minimum:

- be responsive to national transportation strategies/priorities;
- demonstrate a level and certainty of matching support from non-federal sources.
- have objectives that advance the state of knowledge and practice in transportation; and
- have a quality research team as determined by the research committee.

In addition, research proposals that:

- are responsive to the critical needs, challenges and opportunities in our region;
- to some extent involve academic, government and/or industrial partners other than the principle investigator's colleagues at his/her institution; and
- have some type of linkage of the research team to education and/or technology transfer projects/objectives of the UTC

will receive preferential consideration.

Budget will serve as a constraint to the development of a comprehensive safety research program. While the US DOT support is substantial, every UTC is required to achieve six objectives. Each objective has an equally substantial "charge" to fulfill. To address these

objectives, the CSU Center will develop programs not only in research, but also in education, outreach and technology transfer. To assure that the Center will be able to make substantive contributions it is essential that projects are multi-disciplinary, with an attempt to collaborate with non-university partners and involve things such as

- the use of labs, products and equipment,
- employment of students and faculty,
- the applicability of research to educational programs, and
- a clear financial contribution of projects.

The involvement of non-university partners will tend to support the achievement of the required one-to-one matching of federal monies, which, in itself represents a significant constraint as well as an opportunity.

The Research Selection Program will include input from members of the Research Committee, which is a sub-committee of the Advisory Board. The Advisory Board will be composed of members from transportation-related industries and government organizations (See Appendix B for roster of members). The Research Committee will be composed of three to five individuals with knowledge and expertise in the transportation, work zone safety, and human factors areas. The Center Director and Associate Directors will be given voting status on the Research Committee. The individual members of the Research Committee may or may not be the same as the Advisory Board. The intent is that the Research Committee must have the technical expertise to judge the merits of the white papers as well as proposals, and/or be able to identify appropriate peers for external reviews. The UTC research selection process is described graphically as follows:

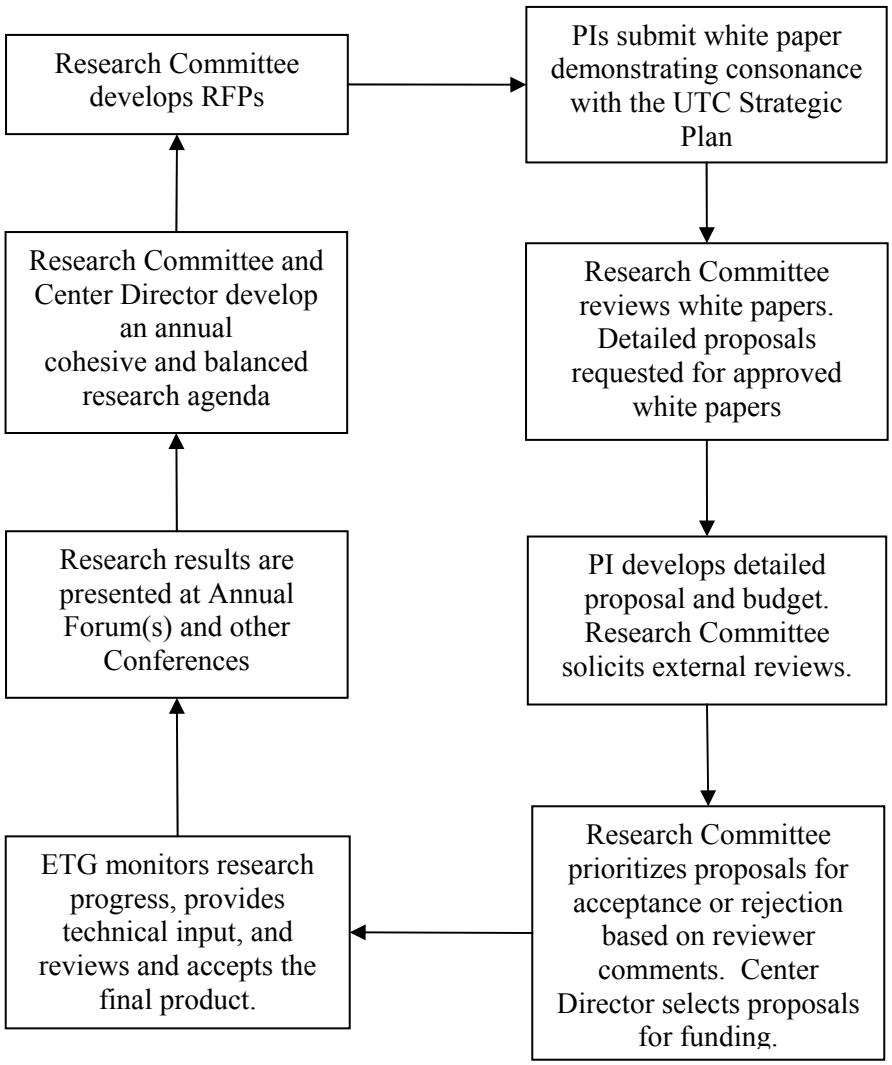


Figure 4. Research Program Feedback Loop

The Center Director in consultation with the Research Committee will determine and publish program goals, prioritize research areas, and an annual research agenda. This consultation effort will develop and publish requests for proposals (RFPs) annually. RFPs will be based on priority research areas and the annual research agenda.

Two-page white papers written in response to RFPs will be accepted from faculty and reviewed by the Research Committee members. The Research Committee will select those white papers that are most consonant with the Center's themes and goals and request detailed proposals from the Principal Investigator(s). The Research Committee will forward these to at least one technical reviewer. All reviewers must be recognized in the discipline area represented by the white paper. External reviews will be conducted based on whether a proposal meets the minimum set of criteria stipulated above.

Proposals will returned to the PI with the reviewers' comments and recommendations. The PI may then address any deficiencies and resubmit the proposal. The Research Committee will rank all peer-reviewed proposals based on their level of consonance with the Center's research priorities. The Center Director will then either accept or reject a proposal based on the Research Committee's ranking and the available funding.

After the Center has become operational, a process will be implemented that when the proposals are approved for funding, the Research Committee will assign each research project to an Expert Task Group (ETG) comprised of at least three members, who will track the progress of the project, provide technical input, and review and accept the final product. The ETG Chair will be a member of the Research Committee.

It is anticipated that three to five projects will be funded annually. Principal investigators must be full-time faculty from any CSU. Proposed research projects will be expected to request $30,000 to $70,000 for a one to two year period (*note: this targeted dollar amount may be adjusted based on annual research needs of the faculty conducting research*).

3. Planned Activities: A variety of activities are expected to support the research selection process. These include:

- Identification of a Research Committee chairperson and members, including one USDOT member.
- Development and approval of research proposal selection criteria.
- An annual workshop for CSU faculty and potential collaborators to describe the program goals, research agenda, proposal requirements, and proposal selection procedures. The workshop will look for feedback on the research selection process from participants.
- Networking and social events for both internal and external researchers and industry members (e.g., ODOT, FHWA, etc.) to help stimulate ideas for future related research areas and agendas.
- Development of a web site that includes the following: a, personnel directory for the Center, a CSU UTC program description to include the theme, program goals and strategic plan, the annual research agenda, proposal writing and submission requirements, proposal selection criteria, descriptions of ongoing UTC-funded research, completed project reports, and a schedule of workshop and networking events as well as proposal deadlines.

4. Performance Indicators: All data required to track the progress of Performance Indicator 1 ("projects selected for funding") and Performance Indicator 2 ("total budgeted costs") will be obtained from the Research Committee after each review cycle. A database will be maintained by Center support staff with the appropriate information.

Goal II.B – 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. As indicated in Appendix A, Table 2 of the baseline measures, a limited amount of activity is occurring in the transportation research area. To date, two peer-reviewed books/reports have been published and four research papers have been accepted for presentation at academic meetings. As new faculty and an increased focus on transportation research occurs, it is expected that these numbers will climb significantly.

2. Research Performance Program Outcome. Objectives the Center hopes to meet to show an increase in research performance include:

- Increase the number of peer reviewed books, book chapters, and articles from the current level of two to six per year.
- Increase the number of conference presentations from four to nine per year.

3. Planned Activities. A variety of activities will support the research performance goal, but the overarching set of actions is the development of the UTC-WZSE - the more prominence it achieves, the more research activity will occur. In support of this are the following activities:

- Using University resources, hire one new transportation faculty member, with the ability to develop new courses as well implement an active transportation research agenda
- Organize an annual or biannual UTC Symposium that will occur every February or March. This activity will be coordinated by the Associate Director for Research Activities. This event should be coordinated with the four UTCs located in the State of Ohio and the UTC at the University of Detroit-Mercy.
- Institute an internal grant program (see Research Selection goal), with a research agenda identified by the Advisory Board and implemented by the Research Committee.
- Identify both federal and non-federal sources of research support to fund those projects and initiatives of the faculty. This may include federal groups such as the NSF, FHA, FAA, FTA and non-federal groups such as the Ohio Department of Transportation and non-profit organizations interested in highway safety.
- Establish cooperative research initiatives across CSU departments and colleges.
- Increase the number of grant proposals submitted to and funded by external federal and non-federal agencies.
- Provide grant writing support through the Office of Sponsored Programs and Research for faculty teams that are seeking external funding (e.g. NSF, USDOT, NIH), based on complexity of partnerships and topics.
- Target the Title 23 Section 503-505 dollars to help broaden scope of Center, thus helping the Center prepare to become a Tier I status institution.

4. Performance Indicators. Program progress will be compared to the baseline measures shown in Table 2 in Appendix A. All faculty associated with the Center will be required to file annual reports of peer reviewed scholarly activity. This information will in turn be compiled by a staff assistant and will be processed and included in the required annual reports.

Goal II.C – Education

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

1. Baseline Measures. Table 3 in Appendix A provides the baseline measures for the UTC-WZSE's education program. These figures were compiled from information available for the 2005-2006 academic year. The course baseline measures include six courses that are listed as undergraduate and 11 graduate level courses, i.e:

Undergraduate

- CVE 404 Civil Engineering Systems Analysis
- CVE 415 Reliability
- CVE 421 Behavior and Properties of Concrete
- CVE 424 Non-Destructive Evaluation
- CVE 446 Transportation Engineering
- CVE 447 Highway Engineering

Graduate

- CVE 504 Civil Engineering Systems Analysis
- CVE 505 Reliability
- CVE 521 Behavior and Properties of Concrete
- CVE 524 Non-Destructive Evaluation
- CVE 546 Transportation Engineering
- CVE 547 Highway Engineering
- IME 505 Human Factors Engineering
- IME 520 Experimental Design
- UST 642 Introduction to GIS
- UST 643 Advanced GIS
- UST 644 GIS Capstone Seminar (certificate in GIS)

The baseline measure for student involvement in transportation research includes 13 Master's students and one doctoral student in transportation or transportation structures.

2. Education Program Outcome. In order to ensure growth in the undergraduate and graduate programs in transportation, the UTC-WZSE has set forth a number of objectives, including the following:

- Increase the number of students enrolled in transportation courses by 25% at the undergraduate level and 100% at the masters and doctoral level.
- Increase the number of transportation-related courses offered at both the undergraduate and graduate level.
- Increase the number of academic departments participating in the delivery of transportation courses, such as industrial engineering, psychology, education, and the urban studies/GIS department.

- Increase the number of graduate students participating in the transportation research program from the current level of 14 to at least 31 (or more) by the end of the grant period.
- Identify a "Student of the Year" based on research productivity and service to industry.

3. Planned Activities. Meeting these objectives will require a number of activities targeted specifically toward transportation-related issues. This includes the following:

- Institute a formalized recruitment plan at the undergraduate and graduate levels targeting the transportation specialty. This will include offering scholarship dollars to undergraduate students as well as initiating dialogues with curriculum directors at regional school systems. These dialogues can lead to activities such as hosting several "transportation days" at area high schools that will encourage attendance at Cleveland State. In addition, to reach additional Cleveland State students, there will be increased coordination with the undergraduate recruitment efforts with the Fenn Academy (a recruitment program in the College of Engineering) as well as with the Office of Enrollment Services at the university.
- Teach a semester course on Construction Safety Engineering spring semester 2007 (on a two year reoccurrence schedule). The Division of Continuing Education at CSU has also scheduled an OSHA 10 hour and 40 hour training seminars during spring break 2007. Anyone enrolled in the semester Construction Safety course will be cross-enrolled with the OSHA training seminar, paid for by the Center. Students enrolled in the regular semester course will have an opportunity to obtain their OSHA training card.
- Hire one new transportation faculty member, with the ability to develop new courses as well as to lead new research initiatives.
- Develop two new courses per year on topics such as logistics, and encourage cross-disciplinary listings among other departments at the University, e.g., transportation human factors engineering.
- Develop a 12 credit hour graduate certificate in transportation safety that will serve as a precursor to the transportation graduate degree. This certificate will target transportation professionals who may then move into graduate education.
- Reserve a total of at least five positions per year for graduate research assistantships in the Masters and Doctorate programs for those students specializing in transportation.
- At the undergraduate level, develop at least five new cooperative study/internships focused on transportation research and applications. Two of these scholarships will be made available to awardees of the Ohio Contractors Association Hall of Fame Scholarships. The OCA scholarships are targeted for students attending Ohio community colleges who are enrolled in construction technology and construction management.
- Provide support for graduate student participation in the annual Transportation Research Board meeting as well as the Ohio Transportation Engineering Conference annual meetings.
- Develop and submit a proposal to the NSF's Research Experiences for Undergraduates program to further support research activities for the students.
- Develop annual selection process for "Student of the Year" and provide support to attend the award ceremony in Washington, DC.

4. Performance Indicators. Program progress will be compared to the baseline measures shown in Table 3 in Appendix A. Faculty mentors and advisors will be required to submit research activities with students on an annual basis. Coursework information will be compiled by a staff assistant and will be processed and included in the required annual reports.

Goal II.D – 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. In the 2005-2006 academic year, Table 4 in Appendix A shows the number of students enrolled in the two advanced transportation-related degree programs (Doctor of Engineering, Department of Civil and Environmental Engineering, Transportation Specialization; and Master of Science in Civil Engineering, Transportation Specialization), with two graduates in Spring 2006. As described earlier, the transportation specialty is new in the College.

2. Human Resources Program Outcome. Several objectives have been set to help increase the number of professionals in the transportation field. This includes the following:

- Over a four year period, increase the number of students enrolled in the masters program from 13 to 26 (or more), with at least a 95% graduation rate.
- Over a four year period, increase the number of students pursuing a DRE with a specialization in transportation from 1 to 5 (or more), with a 100% graduation rate.
- Impact the oscillatory behavior of freshman enrollment in the Civil Engineering program. Over the recent past undergraduate Civil Engineering class sizes consistently vary from below 10 to above 20.

3. Planned Activities. Activities associated with the development of Human Resources target two levels: higher education and K-12 education. In the higher education realm, the Center will coordinate recruitment activities throughout Cleveland State University, specifically with the Chair of the Civil Engineering Department, the Chair of the Industrial and Manufacturing Engineering Department, the Director of the Fenn Academy (the Engineering College recruitment arm), the Dean of the College of Engineering, and the various Deans from other colleges of the University (Education, Science, Urban, etc.). In addition, area community colleges will also be targeted for recruitment. The planned activities to spur growth at the university level include:

- Increase the availability of graduate assistantship dollars by increasing the number of funded grants with graduate assistantships, and through fund raising.
- Increase the availability of undergraduate scholarships through fund raising.
- Provide shadowing opportunities for the undergraduates and increase their involvement in faculty research projects.

- Offer five scholarships via the UTC-WZSE for undergraduate students, with partial support coming from industrial sponsors.
- Apply for an NSF based research experience for undergraduates (NSF-REU) grant focused on transportation research.
- Increase graduate student marketing through print and television media available through the public relations office.
- Continue to enlarge the pipeline of students into the undergraduate program through sponsorship of transportation activities in the Fenn Academy (a recruitment program).
- Work with the Director of the Ohio Contractors Association (OCA) and the Business Manager of the Laborers District Council of Ohio to promote careers in the transportation industry at all levels.

The Center will put considerable effort into building and then expanding the pipeline of freshman engineers by initiating a comprehensive dialogue with K-12 educators in the region. The Center Director has become, and will continue to be, engaged with regional primary and secondary school systems. The intent is to pursue partnerships with local school systems so that engineering and technology can be implemented at various grade levels where teaching advocates can be identified. The goal is a seamless transition from high school to engineering programs in college – a transition that is as seamless as, for example, advancement from 11^{th} to 12^{th} grade. If the recent past is prologue, then an open dialogue with enthusiastic teaching professionals can lead to some very interesting programs that will impact the shortage of civil engineers occurring in Ohio. Planned activities to help achieve this goal include:

- Creation of a regional K-16 engineering education council which would bring together transportation engineering faculty, K-12 educators, district curriculum directors, motivated school principals from all levels, and transportation industry leaders.
- Development of programs with the College of Education and Human Services based on needs identified by front line teachers. This could include devising courses for certification credit where secondary math and science teachers participate in beginning engineering course lectures (e.g., Statics, Dynamics, Fluid Mechanics) and extract application examples of basic math and science principles. These introductory engineering courses abound in simple every day examples where physics and math concepts are put to use.
- Support the participation of principals, guidance councilors, and motivated teachers in activities such as Contractor for a Day, and Engineer for a Day. These efforts would be coordinated with the Ohio Contractors Association and the Cleveland Engineering Society.
- Initiation of various pre-college outreach programs (again with the College of Education and Human Services) for area children including the possibility of transportation summer camps. This could be done in partnership with other Ohio universities such as Ohio State.
- The Center at CSU will explore the concept of becoming a contributor to Project Lead the Way, a national a not-for-profit organization that partners with the public schools, organizations in the private sector, and higher engineering/engineering technology institutions to promote pre-engineering courses in the nation's high schools and an integrated math, science, technology curriculum in the middle schools.

4. Performance Indicators. Program progress will be compared to the baseline measures shown in Table 4 Appendix A. Needed information will be compiled by a staff assistant with the assistance of the registrar's office and will be processed and included in the required annual reports.

Goal II.E – Diversity

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

1. Baseline Measures. No baseline measures are required by the USDOT due to privacy concerns.

2. Diversity Program Outcome. The objective of the UTC-WZSE for increasing diversity in the transportation work force includes the following:

- Without excluding non-minorities and men from Center programming, increase from 0% to 10% the number of underrepresented students with advanced degrees in transportation-related engineering over a four-year period.

3. Planned Activities. A variety of activities will occur to help improve the diversity of the transportation specialty of the UTC-WZSE:

- Increasing the presence of the transportation specialty focus in existing minority-focused programs of the College of Engineering. This includes working with the CSU student chapter of the National Society of Black Engineers (NSBE); collaborating with the LINK Program, a cooperative program that targets minority student participation in Engineering; and working with the CSU chapter of the Society of Women Engineers (SWE) as well as the National Association of Women in Construction (NAWIC).
- Working with the Fenn Academy - a program that provides outreach activities to local high school students to encourage entry into Engineering programs - the UTC-WZSE will visit area high schools with high populations of Hispanic and African American students, particularly those within the Cleveland Municipal School District.
- The Center is currently exploring initiatives that would fit within the Garrett A. Morgan Technology and Transportation Education Program to improve the preparation of students, particularly women and minorities, in science, technology, engineering, and mathematics through curriculum development.

4. Performance Indicators. Not required due to privacy concerns.

Goal II.F – Technology Transfer

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

1. Baseline Measures: With the UTC-WZSE a new entity at the University, little formal infrastructure has been created in support of technology transfer activities. As indicated in Table 5 in Appendix A, the only activity in this area has dealt with delivery of seminars and symposia—a total of 4—that reached over 200 transportation professionals.

2. Technology Transfer Program Outcome: With a strong interest in moving the expertise of the UTC-WZSE into the public realm, a stringent plan of technology transfer objectives have been set. They include the following:

- Develop a website that will average annual hits of 5,000, accessible by both the public as well as the transportation industry.
- Increase the number of seminars and symposia offered to practicing professionals from the current level of 4 to at least 20 over a four year period, reaching at least 1000 professionals. This outcome will be coordinated with the Division of Continuing Education at CSU
- Coordinate Center training activities with the Director of the Ohio Laborers Council Apprenticeship program.
- Produce a UTC-WZSE newsletter with an annual circulation of 500.

3. Planned Activities: In support of these objectives, a variety of activities have been planned:

- The Research Director will present annually at the Ohio Transportation Engineering Conference.
- The Center Director will work with the Director of the Ohio Laborers Council Apprenticeship program and coordinate/create specialty courses that can be included in the new apprenticeship program. The intent is that these courses would count for college credit.
- Develop a program of short courses for practicing professionals (building off the work supported by the U.S. Department of Education) using the expertise of the CSU Division of Continuing Education.
- Host continuing education short courses on work zone related topics from the OCA, ASCE, NHI, NTI and ATSSA.
- Hire a webmaster to fully develop an interactive UTC-WZSE web site, including links to research publications, industry groups, and government agencies. The site will include detailed information about work zone safety practices.
- Develop an outside speaker's series, offering four seminars per year. This will be coordinated with the graduate student seminar implemented several years ago. A variety of training program topics will be selected that will transfer a knowledge of current best practices about safety issues and other topics relevant to individuals employed in the heavy highway construction industry.

4. Performance Indicators Program progress will be compared to the baseline measures shown in Table 6 in Appendix A. Data from all seminars, symposia, etc. will be sent to support staff on a quarterly basis. Additional information will be compiled by a staff assistant and will be processed and included in the required annual reports.

SECTION III - MANAGEMENT APPROACH

From an organizational standpoint, management of the UTC-WZSE will reside in the University's College of Engineering. The Director and Associate Director will formulate the operating policies and administrative procedures that will then be approved by the Advisory Board. It will also be the role of the Director to serve as the liaison between all internal and external partners of the UTC-WZSE.

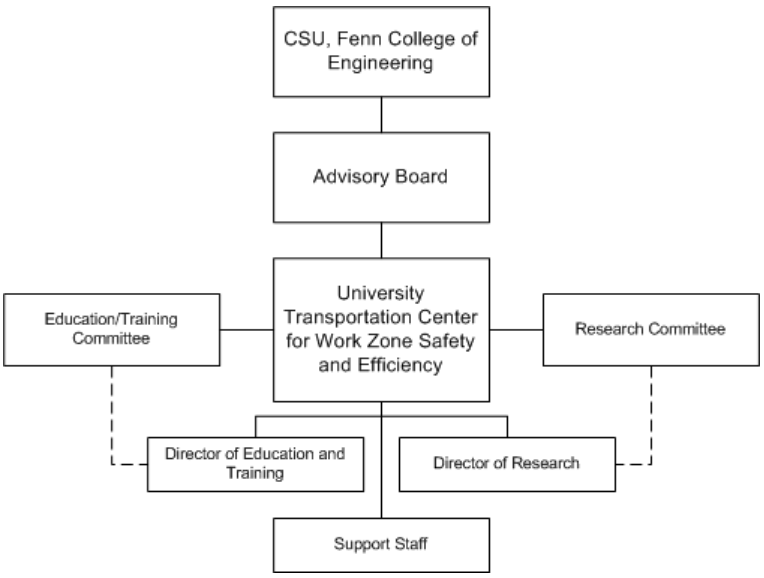


Figure 5 Management Structure

The Advisory Board will play a key role in guiding UTC-WZSE and in selecting projects. Representative leaders in the transportation field have already agreed to serve on the Board, as shown by the roster in Appendix B. They will help guide the Center in terms of applicability of efforts and technology transfer. The primary role of the Board will be to ensure that the UTC-WZSE remains relevant to the heavy highway construction industry and its workers.

A secondary panel, called the Research Committee, will consist of three to five individuals including both academic and industrial representatives as well as someone from the U.S. Department of Transportation. The Center Associate Director will initially serve as the Director of Research. The role of the Research Committee will be to prepare guidelines for an annual research program, participate in proposal review, and serve as the evaluation group to track progress in the research projects.

Finally, the Education/Training Committee will be comprised of members from the Education Committee of the Cleveland Section of ASCE. The Center Director is a member of the board of directors of the Cleveland Section of ASCE and chairs the Education Committee. Members of the ASCE committee have been asked to serve dual roles and all have agreed. In addition, one representative from the Division of Continuing Education at CSU will serve on this committee. The role of this committee will be to advise the Center Director on scheduling short courses and training seminars as well as help with the K-12 outreach efforts. Initially, the Center director will serve as the Director of Education and Training.

III-A. Institutional Resources.

A. Research and Training Facilities. The Fenn College of Engineering maintains a wide variety of research and training facilities. The first two descriptions focus on facilities that specifically

target the transportation field, with the following facilities representing general civil engineering laboratories that may be used by the transportation students for both research and education.

Transportation-Related Facilities:

1. Computer Laboratory: There are 16 Micron CVT-503 Clientpro computer stations for students in the Department of Civil and Environmental Engineering's computer laboratory. Also available for student use is an IPM-2000 Interactive Presentation Manager, a Panasonic PT-L711XULCD Projector, a Toshiba VCR, a HP LaserJet 2200 DSE Printer, and a Techronics Phaser 750 Color Laser Printer.

The computers are equipped with Microsoft office, Richardson's Estimating System, Primavera Suretrack Scheduling Software, AutoCad, Microstation, Eagle Point, West Point Bridge Design module. The AutoCad, Microstation and Eagle Point software are used in the surveying and transportation related courses. Richardson's Estimating System and Primavera Suretrack are used in the construction planning and estimating course. The West Point Bridge design software is used in the introduction to design course.

Other software available that is specific for the transportation engineering specialty includes ArcSoft GIS, HCS 2000 (Highway Capacity Software), IDAS-ITS Deployment Analysis System (to design traffic diversions), pavement design and analysis programs, and Traffic Software Integrated System v 5.1 (a traffic simulator from the FHA).

2. Vehicle Simulator: In addition to the various transportation software programs available in the Civil Engineering computer laboratory, the University invested $50,000 in a desktop driving simulator in December, 2005. The DriveSafety DS-100c Desktop Research Simulator is a "high performance, high fidelity driving simulation system designed for use in ground vehicle research and training applications" and is located in the Industrial and Manufacturing Engineering Department.

Recently funded grants from the Ohio Department of Transportation and NSF will upgrade the desktop simulator to the DriveSafety DS-600c Research Simulator. The DS-600c is a fully integrated, high performance, high fidelity driving simulation system. The DS-600c system upgrade is primarily hardware-oriented and includes multi-channel audio/visual systems, a 180° wraparound display (9 feet tall), full-width automobile cab (Ford Focus) including windshield, driver and passenger seats, center console, dash and instrumentation, and real-time vehicle motion simulation on the Q-motion platform. The software includes a HyperDrive authoring suite for "drag and drop" scenario generation as well as Vection real-time simulation software for simulating an advanced vehicle dynamics model, traffic, environmental conditions, and other features that provide a realistic driving experience. There are 53 standard data collection variables and the user can add up to 25 more user-defined variables.

This simulator will be used for work zone safety research and for other driving-related transportation research. For example, it will be utilized in the pre-construction analysis of the effectiveness of work zone safety countermeasures, the investigation of the effects of driver distraction on work zone driving behaviors, and the study of impaired driving (e.g., drowsy driving). In addition, the simulator will be used as part of undergraduate and graduate courses as

well as for work zone safety training seminars at the professional level.

General Laboratories:

1. Environmental Laboratory Complex: An Environmental Engineering Lab Plan as well as an Environmental Engineering Equipment Plan were developed and adopted in 1998. Much of the equipment is focused on real-time environmental monitoring, pollution prevention and sustainable engineering supported by the NASA Glenn Research Center. For research projects dealing with airborne toxins, environmental safety and worker health this lab would be available.

2. Hydraulics Laboratory: The hydraulics laboratory is utilized primarily by the junior level hydraulic engineering students. The facility includes a Venturi Meter and Variable Speed Power Supply; a H-6985 Water Hammer Trainer; an H-6645 Series/Parallel Pump Unit and H-6648 Data Logging Module; a H-6526 Ground Water Flow Unit; a Pipe Flow; an Open Channel Flow; an H-6980 Series/Parallel Pump Test Demonstrator; and an H-6925 Fluid Circuit Demonstrator.

3. Geotechnical Engineering Laboratory: The geotechnical engineering laboratory has capabilities consistent with the routine soil evaluation experiments required by contemporary engineering design. Among these instruments are:

a. Ovens, conventional and infra-red
b. Pycnometers
c. Automated Atterberg limit devices
d. Fall cone instrument for liquid and plastic limits determination
e. ASTM sieve stacks
f. Hydrometers and accessory equipments
g. Constant head, falling head and triaxial permeability apparatus
h. Consolidometers
i. Unconfined compression molds, spring loaded hammer and loading machine
j. Compaction molds and hammers
k. Triaxial compression machine

In addition, the lab includes a manual soil sampling kit capable of collecting sample to a depth of 10 feet; a wheel mounted direct push GEOPROBE soil sampling rig - 100 ft capacity; and an impedance analyzer for porous material (soil, rocks and concrete) evaluation. Finally, research equipment for conducting bench scale electro-kinetic decontamination and "Coupled Hydraulic-Electric Gradient Decontamination" (developed at CSU) have been fabricated in-house.

4. Strength of Materials Lab: Three Instron machines are the primary instructional testing machines. Two of the machines (which were 30+ years old) were updated from vacuum tube to full digital controls. Since 1992, a new Instron testing machine was also added, as well as a new Rockwell hardness testing machine. A new extensometer was also purchased, and existing extensometers were refurbished to make them compatible with the new machine. Computerized data acquisition was added to some of the lab experiments. An educational shake table was also purchased from Quanser. Balsa wood bridges built by the students are subjected to various static and earthquake loads. There is a model of a two-story building which was purchased with the

shake table, and a model of a water tank built by college machinist which are used for demonstrations.

5. Surveying Lab: The surveying lab is equipped with the following:

4 - Electronic Distance Measuring Instruments
4 - Data collectors
1 - Transits
4 – Engineers Levels
4 - Rods
3 - Steel Tapes

A Z-Xtreme Survey System was recently purchased from Thales Navigation. It includes a rugged, weather-proof dual-frequency GPS receiver with centimeter accurate real-time positioning.

6. Experimental Mechanics Laboratory: Equipment available in this laboratory includes 3 ft by 15 ft structural load frame with 2-20 kip actuators; ultrasonic scanning immersion system; 50 channel digital strain gage system; thermography system for stress analysis and NDE inspection of structures; Schmidt hammer; German Instruments Dockter Impact-Echo Test equipment; Sensors and Software Noggin Ground Penetrating Radar; Olson Instruments SASW-S Spectral Analysis of Surface Waves structures version, including data acquisition pc; UPV-1 Ultrasonic Pulse Velocity; SE/IR-1 Slab Impulse Response; and SASW-G4 Spectral Analysis of Surface Waves.

7. Construction Materials Lab: Basic equipment is available for mixing, forming, and curing concrete samples. This lab includes hydraulic testing machines for compression testing as well as a Gilson HM-224 Portable concrete mixer, 9.7 cu. ft. drum capacity, high speed towing tupe, 115V/60HZ; a Maturity Meter; and a Pine Instrument Co. Portable Gyratory Roller Compactor (FHWA Superpave compliant- for asphalt & concrete pavement).

B. Human resources In addition to the primary faculty focused on transportation issues - Drs. Duffy and Delatte - a variety of other scholars and experts are on hand to provide support for the new UTC-WZSE. This includes Dr. Nancy Grugle, an expert in transportation human factors; Dr. Paul Bosela, an expert in engineering mechanics and structural engineering; Dr. Saini Yang, an expert in transportation engineering and safety; and Dr. Lutful Khan, an expert in geotechnical and geo-environmental engineering. There will also be significant efforts associated with reaching out into other colleges and disciplines to engage researchers in the transportation area.

C. Physical facilities: The physical home of the UTC-WZSE will be in the University's Fenn College of Engineering's Stillwell Hall. Stillwell Hall is located between two main arteries in the Cleveland region, Interstate I-90, which runs directly through downtown as well as Euclid Avenue, a city street that carries a significant amount of traffic daily. The significance of this location is the scheduled construction projects on these roads, including the transit reconstruction

of the Euclid Corridor. As such, the City of Cleveland provides a close, relevant, and real-time laboratory setting for the transportation students.

D. Institutional support capabilities: All of the functions of the UTC-WZSE will be supported by standard academic resources. Space, communications, printing, computational, technical support, and staff support are available through the Fenn College of Engineering as well as general university offices. The Library is available to provide support to students needing to obtain publications in transportation and civil engineering. In addition, the Library has access to several special collections focused the development of Cleveland and the region, thus providing resources on the transportation systems of the region. The Offices of Sponsored Programs and Research will be charged with facilitating the handling and processing of research and training grants. In addition, this Office will provide support for grant identification as well as grant writing in order to continue obtaining appropriate external support for projects.

III-B. Center Director.

Stephen F. Duffy PhD, PE, F. ASCE

Professor Duffy has been employed continuously at Cleveland State University since September 1985. He is chair of ASTM Sub-Committee C 28.02 Design and Evaluation. He also chairs ISO Working Group 11 (Fine Ceramics). Professor Duffy has published numerous technical papers and book chapters in the area of structural reliability, viscoplasticity, and how these topics relate to monolithic ceramics, CMCs, MMCs, and metal alloys. Recently he has been appointed to serve on the executive committee of the American Society of Civil Engineers (ASCE) national Transportation Security Committee, and he serves on an American Society of Mechanical Engineers (ASME) Nuclear Code Committee on graphite components. Professor Duffy is a Fellow of the American Society of Civil Engineers.

Professor Duffy has over 17 years experience in the area of designing components fabricated from ceramic materials. He has been associated with the Life Prediction Branch at NASA Glenn Research Center since 1987. Research efforts supported by NASA have focused on developing reliability based design algorithms for monolithic and ceramic matrix composites. This work has led to the development of the NASA C/CARES computer code (Composite Ceramic Analysis and Reliability Evaluation of Structures) as well as various parameter estimation software algorithms.

Professor Duffy has been supported by the DoD (Army Research Lab - *ARL*) as well as the DoE through Oak Ridge National Laboratory (*ORNL*) and Lawrence Livermore National Laboratory (*LLNL*). DoE efforts have focused on providing industry partners with help in designing ceramic based components used at elevated service temperatures. He was under contract with *ARL* to develop design protocols and conduct design studies relative to ceramic gun barrels, as well as ceramic armor.

As Center Director, Dr. Duffy will not only provide leadership for the Center, but he will also represent the Center at external meetings and will participate in up to two annual meetings held by DOT with the directors of all of the University Transportation Centers.

III-C. Center Faculty and Staff.

Norbert J. Delatte PhD, PE – Associate Director
Professor Delatte has recently been appointed to Associate Professor of Civil Engineering at Cleveland State University. Previous appointments include the University of Alabama at Birmingham (Associate Professor, October 2002 – December 2003; Assistant Professor, September 1997-September 2002), the United States Military Academy (Assistant Professor; June 1996-August 1997), and the United States Army Corps of Engineers (Officer; 1986-1997).

Professor Delatte served as Principal Investigator for the University Alabama at Birmingham (UAB) Research Experiences for Undergraduates (REU) Site in Structural Engineering, 1999 – 2003. As part of this project six different undergraduate students have worked on failure case studies so far, with three ASCE journal papers published or pending publication. An ASCE journal paper describing the site has been published in the ASCE Journal of Professional Issues in Engineering Education and Practice. He has been awarded the American Concrete Institute (ACI) Walter P. Moore, Jr., Faculty Achievement Award for work with the REU site.
With Dr. Harold Kincaid, he developed the ethics seminar series that has been an integral part of the UAB REU site. The seminars address basic concepts in ethics, fraud, ethical issues in research, and ethical issues in engineering practice.

Professor Delatte developed the UAB Honors Program in Civil and Environmental Engineering. This undergraduate honors program requires 9 hours of seminars and individual research. He served as the advisor to the first two students from the program - one working in failure case studies. Case study research has been an excellent complement to undergraduate research.

Professor Delatte has served as secretary and was selected to chair the ASCE TCFE Executive Committee. Working in close collaboration with this committee has been an excellent way to develop oversight and input for the case studies project, and has given the committee an important and worthwhile mission. Currently he serves as the editor of the ASCE Journal of Professional Issues in Engineering Education and Practice.

Nancy L. Grugle PhD – Faculty Researcher

Dr. Nancy Grugle received a B.S. degree in Industrial and Manufacturing Systems Engineering from Ohio University in 1999. She went on to Virginia Polytechnic Institute and State University where she received an M.S. in Industrial and Systems Engineering and worked as an industrial engineer for the Army Research Laboratory during the summer of 2000. After completing her M.S. in 2001, Dr. Grugle worked as a Human Factors Engineer for Lockheed Martin Systems Integration in Oswego, New York. In 2002, she returned to Virginia Polytechnic Institute and State University to pursue her Ph.D. in Industrial and Systems Engineering. Dr. Grugle conducted her dissertation research with Walter Reed Army Institute of Research on the effects of sleep deprivation on executive function and situation awareness. She graduated with her doctorate in May, 2005 and began work as an assistant professor of Industrial and Manufacturing Engineering at Cleveland State University in July, 2005.

Dr. Grugle is currently supervising one M.S. and one DRE graduate student focused on transportation human factors. She recently received a presidential appointment to the University Patent Committee and also serves as a member of the Library Committee. Dr. Grugle became the faculty advisor to the student chapter of the Institute of Industrial Engineers in the Spring of 2006.

III-D. Matching Funds.

It is anticipated that matching funds will be obtained through various sources such as corporations, foundations, non-profit entities, the State of Ohio, and the University. To underscore the breadth of external financial support for Center operations, the Laborers-Employers Cooperative Education Trust (LECET) has committed to donating $100,000to the Center in its first year of operation and the Area Wide Protective company has donated $5,000, examples of only a few organizations that are expected to provide long-term support to the Center. In addition, matching funds are being provided by the Ohio Department of Transportation for research and education in human factors and transportation, by the Cleveland State College of Engineering for faculty release time, and by the Cleveland State College of Graduate Studies for graduate assistantships. By the end of the four year grant period, the Center expects to have the majority of its match (over 60%) from the Northeast Ohio-based transportation industry.

At the time this plan was written, current matching dollars that the Center has secured are as follows for the first budget year:

Table 1 - Sources of Budget Match

CSU	$230,326
Ohio Department of Transportation	$ 41,846
Area Wide Protective - Corporate Donations	$ 5,000
LECET	$ 31,199
Unspecified Corporate Donations	$ 15,000
Student co-op salaries	$ 25,039
Uncommitted research funds	$ 35,600
Ready Mix Association	$ 26,280
Portland Cement Association	$ 19,710
	$430,000

SECTION IV – BUDGET DETAILS

IV-A. Grant Year

The UTC-WZSE anticipates using a grant year that begins on July 1 and concludes on June 30 each year. This corresponds to the State of Ohio fiscal year and will minimize record keeping issues. The funds from the USDOT will be used for a variety of purposes, from the payment of faculty and staff salaries, to support of research projects and new curriculum, to the development

of outreach programs and training. In the first year of funding, these dollars will be used for the following:

Table 2 - University Transportation Center Budget Plan				
Categories	**Explanation**	**DOT - Federal**	**Matching**	**Total**
Center Director Salary				
Steve Duffy	AY 06-07: 55.7% level of effort	$24,690	$26,667	$51,357
	Summer 07: 100% level of effort	$27,200		$27,200
Faculty Salaries				
Norb Delatte	AY 06-07: 65% level of effort	$32,147	$37,371	$59,518
	Summer 04: 0%			$0
Faculty 1	AY 06-07: 70.8% level of effort	$21,667	$21,667	$43,334
		$23,118		$23,118
Administrative Staff Salaries				
To Be Hired	Part time	$0		$0
Other Staff Salaries				$0
Student Salaries				$0
Undergraduate - 6	Non-work study, (OPREP) - $10/hour	$ 6,000		$ 6,000
Graduate - 6	Five students, $4,000 stipend per semester, two semesters	$40,000	$49,250	$89,250
Sub-Total Salaries		**$174,822**	**$124,995**	**$299,776**
Duffy Benefits	AY: 31.15%	$ 7,691	$ 8,307	$15,998
	Summer: 18.25%	$ 4,964	$0	$ 4,964
Delatte Benefits	AY: 31.15%	$10,014	$ 8,526	$18,540
	Summer: 18.25%	$0	$0	$0
Faculty 1 Benefits	AY: 31.15%	$ 6,749	$ 6,749	$13,498
	Summer: 18.25%	$ 4,219	$0	$ 4,219
Administrative	AY: 31.15%	$0	$0	$0
Undergraduate	5.25%	$ 315	$0	$ 315
Graduate	5.25%	$ 2,100	$ 2,586	$ 4,686
Sub-Total Benefits		**$36,052**	**$26,168**	**$62,219**
Total Salaries and Benefits		**$210,873**	**$151,122**	**$361,996**

Table 2 - University Transportation Center Budget Plan (continued)				
Categories	**Explanation**	**DOT - Federal**	**Matching**	**Total**
Scholarships/Tuition				
Undergraduate	Five at $3,960, two semesters	$29,600	$10,000	$39,600
Graduate	Two in state at $3,728 for two semesters; three out of state at $7,067 for two semesters		$57,317	$57,317
Permanent Equipment				$0
Expendable Property, Supplies, and Services	laboratory supplies		$0	$0
Domestic Travel		$15,299		$15,299
Foreign Travel				
Other Direct Costs (Specify)				
Contract Services (OPREP)		$36,923	$36,000	$72,923
Research Projects	uncommitted	$35,600	$35,600	$71,200
Co-op salaries - graduate			$ 4,020	$ 4,020
Co-op salaries - undergraduate			$21,019	$21,019
Human Resources (K-12 outreach)	Unspecified Corporate Donation		$10,000	$10,000
Human Resources (Continuing Ed)	LECET Donation		$31,199	$31,199
	Includes salaries and benefits	**$328,295**	**$356,277**	**$684,573**
F&A (Indirect Costs)	**59% of sub-total salaries**	**$101,705**	**$73,723**	**$175,428**
Total Costs		**$430,000**	**$430,000**	**$860,000**

IV-B Salaries

Salaries for each staff member, along with their corresponding percent of time or effort in relation to total their professional activities are given in Table 2 above. In computing estimated salary charges, an individual's base salary represents the total authorized annual compensation that Cleveland State University would be prepared to pay for a specified work period. The base salary for purposes of computing charges to this grant excludes income that an individual may earn outside full-time duties at Cleveland State University. Currently all staff members have full-time appointments at CSU. Amounts requested for the Center Director, the Center Associate Director, Co-Investigators and other personnel for summer salaries and/or academic year salaries are clearly indicated in Table 2. Summer salaries for faculty are computed based on one third of their corresponding nine month salary.

IV-C Scholarships

Grant funds will be used to help provide a minimum of five undergraduate student scholarships, i.e., financial assistance which is not compensation for labor. The Center Director is actively soliciting donations from regional consulting firms and industrial partners (e.g., Area Wide Protective) to increase the number of scholarships to eight. The Director is concurrently seeking external donations to cover dorm fees for the undergraduate students who receive scholarships and want to live on campus. The intent is the creation of a "transportation engineering dorm floor" at the newly renovated Fenn Tower dorm facility. This dorm facility is a half city block from Stilwell Hall – the campus building that houses the Fenn College of Engineering and the CSU Work Zone Safety & Efficiency Center.

Dorm facility fees will be strictly paid with external donations. The University's Master Plan has incorporated the renovated Fenn Tower as the anchor of a student-oriented residential neighborhood. The University administration has focused on the issue that that students who live on campus become more engaged with the University and that they are more likely to persist toward their degrees.

IV-D Equipment

A written (hard copy or e-mail) request will be submitted to RITA for approval prior to the purchase of "permanent equipment" that has a unit acquisition cost of $5,000 or more. Unless otherwise requested by the Grantee, all legal rights to equipment purchased with UTC funds shall vest in the Grantee upon acquisition. The Center recognizes that permission is not required for the purchase of "Expendable Property, Supplies, and Services" which is a category that includes such tangible items as expendable office and laboratory supplies and services such as telecommunications.

IV-E Foreign Travel

The Center Director will obtain written permission from RITA, per section III.4 of the "General Provisions Of Grants For University Transportation Centers" prior to a trip taken to any destination outside of the United States and its territories. The value gained by the CSU Transportation Center will be clearly demonstrated in the request. Requests for approval shall: include a written justification that states the name and relationship of the traveler to the CSU Center; describe how the travel will further the goals of the Center Program; provide a detailed itinerary and breakdown of planned expenses; carry the endorsement of the Center Director.

IV-F Other Direct Costs

Other direct costs currently include $35,000 of uncommitted funds reserved for research projects/grants in academic year 2005/2006. This will support the internal grant program mentioned in section II.B above.

It also includes $36,923 in support of the OPREP research grant obtained from the Ohio Department of Transportation mentioned earlier. For this grant a partnership has been established with Virginia Tech Transportation Institute (VTTI) and the Center at CSU. VTTI will provide reduced data from the "100-Car Naturalistic Driving Study" database to the CSU Center for further data analysis. All data analysis and subsequent reports based on this analysis will be completed and authored by Cleveland State University. The budget for acquiring the reduced naturalistic data can be provided to RITA on request.

IV-G Facilities & Administrative (Indirect) Costs

Cleveland State University has negotiated with the United States Government a rate for recovering facilities and administrative (F&A) costs. This negotiated rate is currently 59% of total salary costs. With the current proposed budget this cost is $101,705.

APPENDIX A
BASELINE MEASURES

1. Research Selection: The following information tracks transportation research at Cleveland State University for academic year 2005/2006:

Research Selection		
1.1	Number of Transportation Research Projects Funded • Number of those projects that are basic research • Number of those projects that are advanced research • Number of those projects that are applied research	0 0 0 0
1.2	Total Budgeted Costs for Those Projects	$ 0

2. Research Performance: The following information tracks transportation research performance at Cleveland State University for academic year 2005/2006:

Research Performance		
2.1	Number of Transportation Research Reports Published	2
2.2	Number of Transportation Research Papers Presented at Academic / Professional Meetings	4

3. Education: The following information tracks transportation education at Cleveland State University for academic year 2005/2006.

Education		
3.1	Number of courses offered that are part of a the CSU transportation curriculum. Courses reported appear in the university course catalog, whether or not they were conducted during academic year 2005/2006. • Undergraduate • Graduate	 6 courses 11 courses
3.2	Number of students participating in transportation research projects. One student participating in two research projects counts as one student. • Undergraduate • Graduate	 0 undergraduate 14 graduate

4. Human Resources: The following information tracks human resources data for academic year 2005/2006.

Advanced Transportation Students	Transportation-Related Degree Programs		
	Masters	Doctorate	Total
4.1 Number of advanced degree programs offered that are transportation-related	1	1	2
4.2 Number of students enrolled in transportation-related advanced degree programs.	13	1	14
4.3 Number of students who received degrees through transportation-related advanced degree programs	2	0	2

5. Technology Transfer: The following information tracks information specific to technology transfer and outreach activities at Cleveland State University for academic year 2005/2006:

Transportation Technology Transfer and Outreach	
5.1 Number of transportation seminars, symposia, distance learning classes, etc. conducted for transportation professionals	4
5.2 Number of transportation professionals participating in those events	200

APPENDIX B – Advisory Board

Purpose: The External Advisory Board's mission consists of

- helping the CSU Transportation Center define and address problems and issues that are of importance to Northeast Ohio and are consistent with national and state initiatives in the areas of work zone safety and efficiency;

- providing contacts and liaison with governmental agencies, the private sector, nonprofit organizations, and the public that would facilitate the Transportation Center to work creatively and cooperatively with all interested stakeholders concerned;

- serving as contacts to personnel and experts who will be willing to work on interdisciplinary teams to carry out research on significant safety and efficiency issues;

- facilitating mutual understanding and delineate the constraints which will define workable solutions to safety issues which affect work zones and the heavy highway industry; and

- serving as a review board for proposed plans and policies developed by the Center Director and Staff on the operation and management of the Center;

Structure: The External Advisory Board members will be invited to serve by the Center Director after consultation with the Provost and existing External Advisory Board members. The Board will consist of no more than 10 representatives from a broad spectrum of governmental agencies, the private sector, and nonprofit organizations.

Individuals will serve for a term of two years beginning in July, and may be re-appointed. The initial Board members will decide which individuals shall serve an initial term of one year to allow terms to be staggered.

Board Function: Meetings of the Advisory Board shall be chaired by a member elected from the External Advisory Board. Discussions within the Board shall be informal. In instances when draft proposals are being discussed, all information and discussion shall be held as confidential unless specifically stated otherwise. Meetings shall be arranged by the elected Board chair, but shall not exceed 3 times per year (October to October).

Initial Roster of Advisory Board Members

George Palko PE (board chair)
The Great Lakes Construction Company
2608 Great Lakes Way
Hinckley, Ohio 44233

Bruce Owens
Plastic Safety Systems
2444 Baldwin Road
Cleveland, Ohio 44104
(ATSSA National Board Member)

Mark Potnick
Director, Labor Relations & Safety Affairs
Ohio Contractors Association
1313 Dublin Road
Columbus, Ohio 43215

Tracy Scriba*
Work Zone Mobility and Safety Team
Federal Highway Administration
Office of Transportation Operations
HOTO-1, Room 3408
400 Seventh Street, SW
Washington, DC 20590

William A Fink
President, Area Wide Protective
2641 South Arlington Road
Akron, Ohio 44319

Anthony D. Liberatore, Jr.
Business Manager/Secretary Treasurer
Laborers Local 860
4220 Prospect Avenue
Cleveland, Ohio 44103

Dennis O'Neil
Ohio Department of Transportation
District 12
5500 Transportation Blvd.
Garfield Heights, Ohio 44125

**Representative - US DOT*