

APPROVED STRATEGIC PLAN

University Transportation Center for Materials in Sustainable Transportation Infrastructure



Prepared For

**The University Transportation Center Program
Research & Innovative Technologies Administration
U.S. Department of Transportation
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Submitted By

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Section I PROGRAM OVERVIEW

A. Glossary

Acronyms

AASHTO	American Association of State Highway and Transportation Officials
ARC	Aggregate Research Center
ASTM	American Society for Testing and Materials
CEE	Civil & Environmental Engineering
CSD	Center for Structural Durability
ETG	Education Task Group
FAA	Federal Aviation Administration
FHWA	Federal Highway Administration
FTA	Federal Transit Administration
HMA	Hot-Mix Asphalt
ISR	Institute for Snow Research
LTAP	Local Technical Assistance Program
MDOT	Michigan Department of Transportation
MiSTI	Materials in Sustainable Transportation Infrastructure
MNDOT	Minnesota Department of Transportation
MTTI	Michigan Tech Transportation Institute
MTU	Michigan Technological University
PCC	Portland Cement Concrete
PDCM	Pavement Design, Construction, and Materials Enterprise
PI	Principle Investigator
RTG	Research Task Group
RFP	Request for Proposal
RFA	Request for Application
RITA	Research and Innovative Technology Administration
SAFETEA-LU	Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users
SDDOT	South Dakota Department of Transportation
SFI	Sustainable Futures Institute
STG	Steering Task Group
T2	Technology Transfer
TAC	Technical Advisory Council
TDG	Technology Development Group
TMRC	Transportation Materials Research Center
TRB	Transportation Research Board
TTAP	Tribal Technical Assistance Program
USDOT	United States Department of Transportation
UTC	University Transportation Center
WisDOT	Wisconsin Department of Transportation
WISE	Women in Science and Engineering
WMA	Warm-Mix Asphalt

Definitions

Enterprise is an undergraduate program developed at Michigan Tech offering students team-oriented, multidisciplinary research opportunities. Projects are proposed and funded by industrial or governmental sponsors and represent real-world problems or research opportunities. Students gain valuable project management skills, leadership and professionalism while working on actual projects for real clients. Students participate in Enterprise for college credit. Enterprise programs have been established across campus with a variety of themes or focus areas. The Enterprise program being referenced in this report is the PDCM. The PDCM has traditionally focused on asphalt materials. As a result of the award of the UTC to Michigan Tech, the PDCM will be expanded to include other transportation materials.

Sustainability is the consideration of economic, societal, and environmental factors through life cycle analysis.

Transportation Infrastructure is built systems used to move goods and people.

Transportation Materials are conventional and innovative materials used in the construction, maintenance and repair of transportation infrastructure.

B. Center Theme

The theme of the University Transportation Center at Michigan Tech is **Materials in Sustainable Transportation Infrastructure**, and is hereby acknowledged as **MiSTI**. This theme was selected to join new resources with strengths that already exist at Michigan Tech into a center that will assist transportation agencies in using sustainable solutions for the repair, rehabilitation, and replacement of an aging transportation infrastructure. Society demands a safe transportation system that offers ease and accessibility in mobility. Overseeing agencies are haunted by congestion and the need to maintain the system, inhibiting their ability to provide safe, efficient, and secure methods of transporting people and freight necessary to facilitate global connectivity and provide for national defense. To construct and maintain this improved transportation system, federal, state, and local governments must understand and embrace the concept of sustainability and begin implementing solutions for more sustainable infrastructure through better use of construction materials and processes. MiSTI researchers will seek more sustainable alternatives to conventional infrastructure materials and develop new methods of using conventional materials in a more sustainable manner. Likewise, through MiSTI's technology transfer activities, sustainable solutions to address today's transportation infrastructure needs will be communicated to stakeholders. Through its educational initiatives, the Center will promote transportation related areas of study, providing a more educated and diverse workforce to meet the industry's growing human resource demands.

C. Center Director's Summary

State of the Industry

National reports, including the *USDOT Strategic Plan*, *USDOT Research, Development, and Technology Plan*, and the *Highway Research and Technology: The Need for Greater Investment*, all call for improved environmental stewardship in planning, constructing, and maintaining the nation's transportation system. As the current transportation infrastructure continues to age and demands on the system increase as population and freight loads increase, the development of strategies to maintain, repair, and replace the existing infrastructure in a more sustainable manner becomes more critical. Identifying more sustainable approaches to the selection and use of materials will play an important role in maintaining and developing a viable transportation system. With growing concern over the depletion of natural resources, the consumption of energy, and the production of greenhouse gases, more environmentally conscious alternatives in material selection and processing are necessary. Coupled with the development of these sustainable material use strategies is the need for an educated workforce with particular knowledge of new and emerging materials, processes, and designs to construct future infrastructure in the most sustainable fashion while repairing and maintaining the existing systems.

To address sustainability in creating more economical and longer lasting infrastructure, the Center's activities will focus on the role materials play in transportation infrastructure. There will be an emphasis on exploring multi-modal transportation infrastructure issues including highway, rail, air, transit, and port as they relate to the built environment. New research conducted at the Center will develop methods of applying sustainability to existing and conventional materials including aggregates, HMA, and PCC as well as exploring innovative materials, yet to be discovered. The results of MiSTI's research efforts will be disseminated through a variety of educational and technology transfer activities to assist in the adoption of sustainability concepts in the use of materials and processes in transportation infrastructure construction, repair, and maintenance.

Environmental stewardship often advocates the philosophy of "cradle to grave," where the environmental impact of the material used in a specific structure is considered over the life-cycle of the structure. This analysis includes the cost of materials, construction, maintenance and repair of the structure, culminating in the disposition of the material at the end of the structure's service life. Sustainability, as adopted by MiSTI, takes this one step further advocating a "cradle to cradle" approach in which materials are specifically selected for use in infrastructure with consideration of economic, environmental, and societal impacts even beyond the life of the structure. For a given structure, this approach will result in a longer service life, less waste, less energy consumed before, during, and after construction, and a reduction in the need for producing more materials.

As energy costs escalate, there is an increasing need to use materials that minimize the energy required in their production. The use of recycled HMA pavement in a

new pavement is an existing process that illustrates this concept. Existing pavement is removed, recycled, and combined with raw materials into a new HMA pavement. Some variations of this process recycle the pavement in-place, eliminating the need for transportation to re-processing plants, resulting in additional energy and time savings. Another example of a product showing a potential for increased life-cycle and performance, while consuming less energy during production, is WMA.

The partial replacement of portland cement in PCC with industrial byproducts such as coal fly ash, produced from burning pulverized coal to produce electricity, or blast furnace slag that results from the production of pig iron demonstrates a more sustainable approach to a material. The production of portland cement is an energy consumptive process that is also responsible for approximately 8 percent of the anthropogenic CO₂ produced globally, thus strategies to minimize portland cement usage will have a measurable positive environmental impact.

Energy consumption, natural resource depletion, waste disposal expenses, and maintenance and replacement issues are all factors that must be considered in maintenance and construction of transportation infrastructure. Reduction in the energy needed to construct and maintain transportation infrastructure is being addressed by adopting sustainability concepts that consider the full advantages offered by materials and processes like WMA, cold-mix, recycled HMA and concrete, and industrial byproducts. As naturally occurring resources are depleted, the need to identify alternative materials to conserve natural resources is critically important. Conservation may be addressed through research into new materials, recycled materials, and industrial byproducts thereby reducing the use of naturally occurring materials in future transportation infrastructure. The practice of landfilling waste materials from demolished infrastructure needs to be addressed to improve the sustainability of the transportation system. And, future infrastructure projects need to incorporate preventative maintenance materials and practices as components in building a more sustainable infrastructure.

Environmental considerations may also positively impact the economic factors of constructing and maintaining transportation infrastructure. Materials such as cold-mix and WMA minimize emissions creating a healthier and safer work environment on the transportation infrastructure job site. Moreover, the reduction of emissions at a WMA plant minimizes the societal impacts of the plant by creating a less objectionable presence, and may lead to a broader acceptance of such plants allowing placement nearer job sites which reduces the consumption of fuel used in hauling WMA.

Congestion caused by infrastructure construction, repair, and maintenance needs to be considered in the long-term life cycle of transportation planning. New materials and processes must account for ease in mobility while maintaining global connectivity. In addition, new materials and processes must offer solutions to improve capital and operating efficiencies throughout the material's life cycle.

An advanced transportation infrastructure that rapidly moves goods and people is demanded by society with little consideration of the long-term environmental, economic, or other societal impacts of these demands. Through research, education, and outreach, the adoption of sustainability concepts will help balance society's short-term and long-term needs. Smoother, faster, and more convenient has to be considered in conjunction with the environmental, economic, and societal impacts that the construction, maintenance, and repair of infrastructure entails. The modern engineer must consider all these factors when selecting materials for use in existing, and future, transportation infrastructure.

Building a Foundation for Success

Michigan Tech has many successful programs from which MiSTI will leverage resources to establish itself as a leader in materials research for a more sustainable transportation infrastructure and education within the transportation community. MiSTI will benefit from expertise in research, education, and T2 to ensure success in formulating sound scientific exploration, innovative and engaging educational activities, and dissemination and distribution of research results to the transportation community. Industry will be engaged to support, promote, and foster the activities and initiatives of MiSTI through the development of a formal Partners Program. Opportunities to support MiSTI activities will be identified and promoted to the transportation community for sponsorship. This support has the potential to provide a significant portion of the cost share match required by the USDOT and offers a mechanism for industry to establish buy-in regarding the use of materials in sustainable transportation infrastructure and foster their relationship to the research, education, and T2 initiatives of the Center. Together these partners in the greater transportation community will usher in the discovery, adoption, and implementation of strategies leading to a more sustainable transportation infrastructure.

MiSTI has the vision of creating the transportation infrastructure of the future through the sustainable use of materials. Progress towards this vision will be made by engaging people of all ages and educational backgrounds through shared knowledge and research. MiSTI will serve the transportation needs of future generations through innovative research, distinctive educational programs, and engagement with industry by successfully achieving the following goals:

1. Conducting innovative materials research to improve the sustainability of transportation infrastructure
2. Delivering distinctive educational programs and opportunities to prepare students to embrace sustainability in the construction, maintenance, and repair of transportation infrastructure
3. Advancing the understanding of use of materials in sustainable transportation infrastructure through T2

4. Becoming a self-sustaining Center that continues to advance the use of materials in sustainable transportation infrastructure beyond the initial four-year federal grant.

Over the next four years, MiSTI will establish itself as a leader in the transportation community for increasing sustainability in transportation infrastructure through improved materials use and innovation. The Center will expand Michigan Tech's already nationally and internationally recognized materials research group with new members. Our undergraduate enrollment will increase with a greater interest by students to understand and pursue transportation related careers. Our graduating students will be highly sought by companies and become leaders in shaping the future of transportation. Our graduate program will produce future educators and researchers who will achieve international recognition for their contributions to sustainability and transportation.

MiSTI will promote its theme by increasing awareness of the importance of sustainability in the choices made by individuals, organizations, and industry through multiple outreach activities and partnerships. These activities will include K-12 education initiatives developed in collaboration with the Western U.P. Center for Science, Mathematics and Environmental Education. Activities will engage teachers and students in the necessity to understand the need for a more sustainable transportation infrastructure. Through presentation, exposure, interaction, and representation in industry organizations, MiSTI will take an active role in engaging individuals and organizations to consider sustainability as it pertains to materials use in transportation infrastructure.

The Center will facilitate the outreach and T2 of the materials research group at Michigan Tech advancing the understanding of sustainability within the transportation community while assisting transportation stakeholders in the adoption of materials and processes that increase sustainability in the construction, maintenance, and repair of the transportation system. These efforts will provide greater knowledge transfer at all levels of understanding within the industry. MiSTI will work closely with Michigan's LTAP to coordinate and deliver meaningful information to transportation professionals through existing and new channels. Through MTTI, MiSTI will reach out to the university community to engage a broader constituency to advance research initiatives on campus that support and strengthen sustainability in transportation research and education. This will increase the Center's ability to leverage additional university resources and foster a greater transportation initiative on campus.

The relationships, partnerships, and initiatives of MiSTI will support the sustainability of the UTC at Michigan Tech beyond the initial four-year federal funding as the Center strategically positions itself for long term existence. The first step in establishing the Center has been the development of the Center's strategic plan. Eighteen transportation faculty, researchers, and staff were engaged in developing the initial plan and budget which sets the stage for broad buy-in across the Michigan

Tech campus. This plan will be revisited annually with additional input from the Center's TAC. The Center is being housed in Dillman Hall on the Michigan Tech campus in the same area as the Civil Engineering transportation faculty offices, materials laboratories, and PDCM student lab. Close proximity will foster greater communication with faculty and students and provide strong visibility for establishing and maintaining campus support.

Within the first year of Center operations, the Center staff and faculty will develop and establish a number of initiatives to support research, educational, and T2 activities in the future. The following is a timeline of tasks to be completed within the first year and progress made towards accomplishing those tasks as of the writing of this strategic plan.

Table 1 Timeline of initial tasks to establish Center operations

TASK	TIMELINE/DEADLINE	ACCOMPLISHED
Identify Center Theme	Jul-06	yes
Identify Center Director	Jul-06	yes
Develop Corporate Identity	Aug-06	yes
Hire Center Coordinator	Sep-06	yes
Establish Center Office	Sep-06	yes
Begin Center Outreach/Marketing	Sep-06	yes
Conduct Strategic Planning	Sep-06 to Feb-07	yes
Develop Student Outreach Material	Nov-06	in development
Submit Strategic Plan to RITA	Mar-07	yes
Establish Campus Transportation Initiative	Mar-07	in development
Develop Web Presence	Apr-07	in development
Identify TAC Members	Apr-07	in development
Identify Task Group Members	Apr-07	in development

Section II PROGRAM ACTIVITIES

MiSTI will plan and conduct activities that promote the theme of the Center and further the mission and goals of the USDOT's University Transportation Center program.

UTC Program Mission: To advance U.S. technology and expertise in the many disciplines comprising transportation through the mechanisms of education, research and technology transfer at university-based centers of excellence.

UTC Program Vision: Internationally recognized centers of excellence, fully integrated within institutions of higher learning, that serve as a vital source of leaders who are prepared to meet the nation's need for safe, efficient and environmentally sound movement of people and goods.

UTC Program Activities include:

- *Research Selection*
- *Research Performance*
- *Education*
- *Human Resources*
- *Technology Transfer*
- *Diversity*

In this section, the proposed Center activities designed to support the USDOT's vision and mission for UTCs are described.

A. Research Selection

The funding level of the Tier II UTC at Michigan Tech does not permit the direct funding of entire research projects; thus the development of a research selection process that entails a separate call for research, the submittal and rating of competing proposals, and the awarding of research projects is not warranted. Instead, MiSTI will provide developmental support to research being conducted in the focus area of the Center's theme through a number of initiatives including pre-proposal, proposal, and project support. In this section, a modification to the Research Selection Goal set forth by USDOT is presented to address how research proposals being submitted to MiSTI are selected for developmental support.

Research Selection Goal: *An objective process for selecting and reviewing research that balances multiple objectives of the program. Specifically as it relates to the strategic plan for MiSTI, an objective process for selecting new research*

initiatives to receive developmental support from MiSTI must be followed that balances the multiple objectives of the Center. MiSTI will develop an objective process for identifying and reviewing the success of its new research selection activities. This process will support multiple UTC initiatives, enhancing research on materials used to create a more sustainable transportation infrastructure.

1. Research Selection Program Outcome: MiSTI's developmental support selection process for research in the area of materials in sustainable transportation infrastructure is designed to provide support elements in the pre-proposal, proposal generation and funded research support stages. MiSTI will not be soliciting and selecting research projects for funding through the UTC due to limitations of the current level of funding. However, MiSTI will support new research initiatives that are seeking research funding through other internal and external sources. Support may be in the form of pre-proposal activities such as RFP review and team building, proposal preparation including organization, editing, and budgeting, and direct project support including undergraduate and graduate student support, supplies and report preparation. In addition, developmental support services for results dissemination and distribution will also be provided. New research initiatives supported by MiSTI will be consistent with the Center's theme and focus area, expanding upon a foundation of conventional applied research. In order to be considered for developmental support, proposed new research initiatives will be required to meet a set of defined criteria through a formal selection process that includes review by the RTG (described in next section). The RTG will establish the criteria for distinguishing between current conventional applied research activities and the identification of new research activities of the Center. This process will include recommendations from the TAC (described in section 2a).

MiSTI has outlined a method for leveraging the resources provided by SAFETEA-LU through university and other cost share sources to provide technical assistance and research support in pursuing and securing new research initiatives consistent with the theme of the Center. This process will promote quality research while maintaining fairness and objectivity. The process includes peer review and recommendation through the RTG and industry review through the Center's TAC. The long term outcome of this developmental support is to expand the portfolio of research being done on materials at the University to include basic materials research and research specifically addressing sustainability in materials used in transportation infrastructure. This will provide a return on the research investment to the Center to support the required cost share match and the organization's long term existence.

With the addition of developmental support, it is anticipated that the research program will grow to support additional student researchers, staff, and faculty pursuing innovations for materials use and processing to create a more sustainable transportation infrastructure. Current research efforts have maintained a strong contract base with federal and state transportation agencies as well as private industry. These research initiatives have offered practical solutions to critical needs.

With developmental support, new research initiatives and larger proposals that offer opportunities for innovative research will be pursued to increase the research activities of the materials research group while providing a balanced portfolio of applied and theoretical investigations.

2. Planned Research Selection Activities: MiSTI will develop and implement a process by which externally funded research proposals will receive developmental support from the Center. This process will include:

a. Technical Advisory Council (TAC): MiSTI will form a TAC to oversee compliance with the research selection criteria, provide a link between industry needs and research objectives, and assist in identifying potential external research collaborators and funding sources. The TAC will include representatives from state and federal agencies, industry, and research organizations, with specialization in transportation infrastructure, materials, and/or sustainability. The TAC will be comprised of the following representatives:

- 2-Asphalt or HMA Industry (minimum of 1 from Michigan)
- 2-Portland cement or PCC Industry (minimum of 1 from Michigan)
- 1-Aggregate Industry
- 2-DOT (1-MDOT and one other which may include WisDOT, MNDOT, SDDOT)
- 1-USDOT or FHWA
- 1-University Faculty from a University other than Michigan Tech
- 1-Sustainability/Environmental Industry or University
- 1-Multi-modal Federal Agency (FAA, FTA, FRA)

In order to maintain an unbiased and objective role, TAC members will not be listed as collaborators or subcontractors on proposed research; however to encourage participation as a TAC member, their representing organization may collaborate in research activities. It is anticipated that the TAC will convene biannually to discuss current initiatives, monitor progress and address industry trends and issues. The meetings will offer the TAC members an opportunity to see research being conducted, interact with undergraduate and graduate students, and faculty, and meet with university research and administrative personnel to review the Center's progress.

To provide campus connection and continuity within the Center, four Center task groups will be formed with faculty from the greater campus community to review TAC feedback and comments and develop recommendations for action to the Center Director. The Center Director will have final authority. These Center task groups will be comprised of a minimum of three active members. The proposed task groups and initial responsibilities are as follows:

Research Task Group (RTG) will provide review of TAC feedback on developmental support services and provide recommendations to the Center Director. Additionally,

they will provide on-campus guidance in the area of Center research activities and baseline reporting.

T2 Task Group (TTG) will provide guidance in the dissemination and distribution of research results to the transportation community and will advise the Center Director in addressing the emerging national need for workforce development.

Education Task Group (ETG) will provide curriculum development activities as well as K-12 program involvement, making recommendations to the Center Director as needed. Additionally, they will provide guidance in the area of Center outreach activities and baseline reporting.

Steering Task Group (STG) will provide administrative recommendations to the Center Director and will be responsible for developing and maintaining a Center Charter and Bylaws. Additionally, they will provide on-campus guidance in the area of Center-University relationships and monitor Center reporting and budgeting.

b. Developmental Support Process and Selection Criteria: MiSTI will support and promote new research initiatives consistent with the Center's theme. In order to be considered, proposed research initiatives will be required to address a set of guidelines to be developed by the RTG, the TAC, and Center staff. The following is an example of possible criteria:

Required

- Conforms to the focus area of the Center's theme.
- Shows support of national (including but not limited to the USDOT, FTA, FHWA, FRA and/or FAA) and state (MDOT or other state DOT) identified industry needs.
- Provides an applied application or demonstration for future application.
- Involves graduate students in research activities.
- Provides an opportunity for the results to be subject to peer review.
- Provide additional research revenue and support from non-federal sources to offer cost share opportunities for the Center.
- Improves multiple baseline measures being monitored through this grant.
- Provides a possible solution to a current problem or offers innovations that may lead to solving current problems.
- Expands the materials research portfolio of the university by proposing basic or advanced materials research, pursues new funding sources, proposes new collaborations, or specifically addresses sustainability.

Desired

- Enhances industry relationships and strategic partnerships.
- Provides likelihood of deployment or adoption.
- Offers multidisciplinary collaboration to solve the problem.
- Offers multimodal applications.

- Encourages undergraduate involvement in research activities.
- Supports the University's research goals.

A full disclosure announcement detailing the application process and selection criteria for developmental support will be made available to researchers through electronic mailings, Center publications, and on the Center's Web site. As proposed research opportunities arise a maximum one-page summary and draft budget of the proposed research activity will be developed by the proposing PI and delivered to each RTG and TAC member by the Center coordinator for review and comment. The summary will include the research being proposed, show relevance to the required and desired selection criteria, list the potential collaborators and funding resources being sought, and address the involvement of undergraduate and graduate students in the project. Each TAC member will be notified by e-mail when a new request is made. A link in the e-mail will grant the TAC member access to the one-page summary and draft budget on a secured Web page, and a short review form will be available to facilitate TAC review. TAC members will be given a reasonable period in which to respond to facilitate progress in responding to the request. The reviews will be used by the RTG as they make a formal recommendation to the Center Director for authorization to provide support. In addition, each TAC member will be provided with all one-page summaries and budgets, as well as the RTG recommendations for each proposed new research initiative, prior to the biannual meetings so that the recommendations can be reviewed, progress may be monitored and required changes made to enhance the process.

A number of considerations will be made in the final decision to provide developmental support. These may include the availability of staff time, previous funding commitments, PI's ability to work effectively with the staff, critical thrust areas of the US and state DOTs, the availability of other resources to the PI, and the perceived likelihood of success in securing the funds being sought. If a proposal is not selected for developmental support, the Center Director, based on recommendations of the RTG, may advise the proposing PI to make modifications for resubmission.

c. Developmental Support Services

MiSTI will engage in the support of new research initiatives meeting the selection criteria and process adherence, based on RTG recommendation and TAC review. This support will include the following:

- Seeking RFP/RFA announcements for new research opportunities.
- Technical writing support for faculty and research staff.
- Submission assistance including, document preparation, assembly and mailing, electronic submission, and securing letters of reference and other supporting material as required by the granting agency.
- Enhanced recruiting of undergraduate and graduate students interested in research initiatives conforming to the focus theme of this Center.

- Promotion of research being conducted in the focus theme of this Center.
- Securing additional research support from non-federal sources.
- Support on presentations, papers and journal articles reporting the finding of the research being conducted.
- Support in attracting and securing industry match.
- Liaison between the faculty and research staff and the Office of Sponsored Programs and Research at the University.

The developmental support outlined above will be carried out by a full-time Center Coordinator (in-part) and a 0.5 FTE Technical Writer funded by the Center and hired during year two. It is anticipated that an increase in research funding, as a result of the initial Center support, will provide additional indirect cost recovery and an opportunity for the Technical Writer to be hired full-time, contributing to additional in-kind cost share for the Center. Figure 1 on page 16 shows the process flow for the developmental support solicitation process, review, and final recommendation.

3. Performance Indicators for Research Selection Activities: MiSTI will monitor its progress using performance indicators 1 and 2 in Exhibit A of the *Reporting Requirements for University Transportation Centers (3/06)*. Baseline data for these performance indicators is provided in Appendix B. Annual tracking of the performance indicators will utilize information provided through university required annual faculty activity updates, objective reporting questionnaires, and data collected from the Office of Sponsored Programs and Research at Michigan Tech. The data will be reported in the Center's annual report.

The Center is seeking an increase in the number of proposals being submitted by faculty for external funding specifically related to the research theme of the Center, an expansion of the current research portfolio to include basic and or advanced materials research, and an increase in the total funded research revenue being generated.

B. Research Performance

The success of the research activities of the Center will be judged in part on the quality of the research being conducted, the distribution of research findings, and the Center's success in supporting research consistent with the focus theme of the Center. Success will be measured by the Center's ability to increase the funding level of research being conducted, the ability to quickly and accurately share research knowledge with industry professionals, and our ability to provide transportation infrastructure material solutions that provide for the sustainable construction, maintenance, and repair of the transportation system.

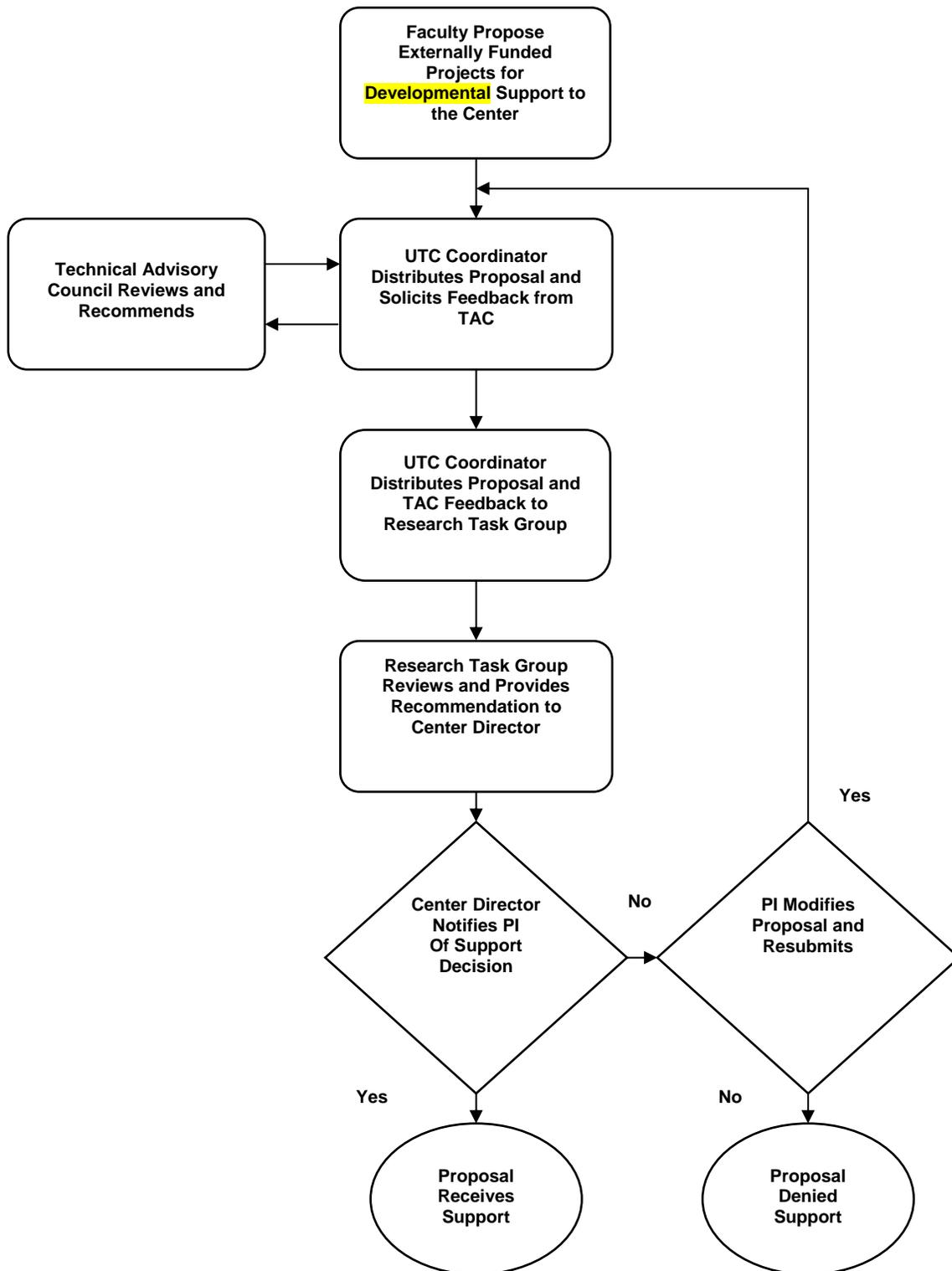


Figure 1 Process for selecting projects to receive developmental support

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.* MiSTI will develop a new program of basic and applied research to be judged by peer review and other experts in the field to advance the role of materials in sustainable transportation infrastructure.

1. Research Performance Program Outcomes: MiSTI will enhance the research initiatives of the University and assist industry through an increased effort and focus on initiatives related to the theme of the Center. Research participants will not be limited to faculty or research staff. Undergraduate and graduate students will be encouraged to engage in research that supports the UTC mission and the goals of this Center. MiSTI's research performance program will draw upon peer review, industry outreach, and education. Emphasis will be placed in the following areas:

- a. Industry outreach activities that increase awareness of the University's research capabilities, initiatives, and results, consistent with the focus theme of this Center, will provide opportunities to serve industry through research and exchange information.
- b. Professional development activities will be identified that connect researchers to industry for the purpose of determining industry needs, and the opportunity to explore opportunities for applied and theoretical research along with information exchange.
- c. Knowledge distribution through Center sponsored activities will enhance research impact.

Research activities promoted and measured by the Center will be consistent with the theme of the Center. These focus areas may include, but are not limited to, the following:

- Materials-based research, including aggregates, HMA and PCC.
- Multi-modal transportation infrastructure including highway, rail, air, and port facilities as they relate to the built environment.
- Sustainability through reuse of existing infrastructure, extension of service life using existing materials and modified processes, and the development of new materials that reduce waste, conserve raw materials and energy, and increase longevity.
- Sustainability initiatives related to transportation infrastructure and materials that consider the economic, environmental, and societal aspects of activities and decisions.

2. Planned Research Performance Activities: Research initiatives will involve undergraduate, graduate, faculty, and research staff. All research activities will be subject to peer review and will be disseminated through traditional modes including journals, papers, reports, and presentations. MiSTI will further promote the

dissemination of research by developing direct and innovative mechanisms for reaching a broader audience. To accomplish the research performance goal and achieve the described outcomes, MiSTI will support a number of research performance activities.

a. Peer & Industry Outreach: The quality of research being conducted, the research findings, and the Center's efforts to support research consistent with the focus theme of this Center will be subject to review. Success will be based on an increased submission and acceptance in peer reviewed publications and journals, and through guest speaker invitations and presentations at annual conferences, symposiums, and seminars where research consistent with the focus theme of this Center is being presented. MiSTI will actively seek opportunities to provide developmental support and coordinate schedules for faculty and research staff to present results and studies in professional and educational venues. Additionally, with developmental support, research briefs and white papers will be developed and submitted to trade publications.

MiSTI will maintain a list of industry organizations and associations, and coordinate strategic involvement of faculty and research staff within those organizations. This coordination effort will ensure representation and attendance at annual meetings and conferences providing a continuous presence and enhanced awareness of capabilities and industry needs. These events and affiliations also offer opportunities for outreach and awareness of the Center's many activities, positioning the Center for leadership within the transportation community.

MiSTI will support faculty efforts to assume leadership roles in ASTM, AASHTO, TRB and other transportation-related industry organizations by showcasing involvement on the Center's Web site and in Center publications. MiSTI will seek opportunities for faculty to assume leadership roles within industry and will support faculty outreach through adjunct appointments with peer institutions. The professional development of our faculty will be a key component in developing a strong self-sustaining research program.

Equally important to the development of a strong research program is the collaboration with external professionals on research initiatives. MiSTI will seek opportunities to support recognized partners from other institutions serving as adjunct faculty, as collaborators on research projects, and as external graduate committee members.

b. Program Development: The growth of the Center's research activities relies on human resources to facilitate research activities and improve the efficiency of the mechanisms in which research is being conducted. MiSTI will enhance the transportation research program by augmenting current methods through which research is identified, planned for, conducted and disseminated to industry. The Center will also leverage university and industry resources to increase the number of people engaged in research activities. This activity is strongly correlated to the

Human Resource goals and activities prescribed by the USDOT's UTC Program and will be further discussed in the Section II D.

c. Program Growth: MiSTI will increase the amount of research being conducted in the area of materials in sustainable transportation infrastructure and expand the current portfolio of applied research to include basic and advanced research initiatives. The measurement of our success will be an increase in the value of research awards related to the theme of the Center through the following activities:

- a. Engage industry, government and non-governmental organizations, individuals, associations and other universities to support research by developing a research partners program and actively promoting it through increased outreach and marketing.
- b. Leverage internal university resources to support research initiatives and activities.
- c. Increase the number and value of research proposal submissions by providing staff support to seek proposal opportunities and provide technical assistance in proposal preparation and submission.
- d. Provide support for research laboratories and facilities by developing and maintaining accreditations, equipment acquisitions, and upgrades.

The research performance of the Center will be measured by the Center's ability to meet the research performance goal through enhanced peer and industry outreach, program development, and growth.

3. Performance Indicators for Research Performance Activities: MiSTI will monitor its progress using performance indicators 3 and 4 in Exhibit A of the *Reporting Requirements for University Transportation Centers (3/06)*. Baseline data for these performance indicators is provided in Appendix B. Annual tracking of the performance indicators will utilize information provided through annual faculty activity updates, objective reporting questionnaires, and data collected from the Office of Sponsored Programs and Research at Michigan Tech. The data will be reported in the Center's annual report.

C. Education

Education ensures the prosperity of future generations. The PDCM is an example of a unique undergraduate research initiative at Michigan Tech that supports experiential learning, the development of critical thinking skills, and leadership, as well as engagement in research activities addressing real needs. Additionally, Michigan Tech has experience and success in engaging K-12 students and teachers in developing classroom modules for learning at an introductory level.

Even well educated people struggle with incorporating the concept of sustainability into actions. Often, sustainability is treated simply as a check box that we "must" address instead of subconsciously permeating our decision-making process. This is not limited to a select age or generation, and in order to expedite the acceptance of

sustainability, the concept must be introduced at an early age. Equally, for youth to consider transportation as a potential career field, we need to introduce the opportunities available in the transportation industry at an early age.

For the purposes of this strategic plan, initiatives and activities addressed in the following Education section are limited to K-12, undergraduate and graduate students. Professional development is addressed in Section F describing technology development.

Education Goal: *A multidisciplinary program of coursework and experiential learning that reinforces the transportation theme of the Center.* MiSTI will develop a multidisciplinary program of coursework and experiential learning that reinforces the exploration, consideration, and understanding of materials in creating a more sustainable transportation infrastructure.

1. Education Program Outcomes: MiSTI will raise awareness of the importance of sustainability in the use of materials in transportation infrastructure by delivering distinctive educational programs to prepare students to embrace these concepts.

The supporting activities will help position Michigan Tech as the premier institution for education, research, technologies and knowledge pertaining to materials in sustainable transportation infrastructure. Graduates from the program will be highly sought by industry for the workforce of the future, achieving leadership roles within industry as well as becoming future educators in the area of transportation infrastructure. The Center will work towards achieving the educational goal through the enhancement of existing programs, the introduction of sustainability into the current curriculum and the development of new courses leading to the development of a graduate program within Civil Engineering for sustainable transportation infrastructure.

2. Education Program Activities: MiSTI will develop or enhance a number of educational initiatives to increase awareness of transportation as a career field and to instill sustainability concepts, especially as they relate to the theme of the Center.

a. Student of the Year MiSTI will develop the criteria and application process to select a *Student of the Year*. This student will receive a travel stipend and cash award for travel to the annual meeting of TRB. Both the TAC and the ETG will be engaged to develop the selection criteria which may include:

Required:

- Completion of a formal application including a written narrative, and letters of recommendation.
- Acceptance of a peer reviewed publication.
- Development of a professional poster design.
- Oral interview.
- Technical presentation.

- Industry leadership.
- High academic standards.
- U.S. citizenship or permanent resident status.

Desired:

- Research closely related to the theme of the Center.
- Awards or recognition in the form of fellowships.
- Industry internship or co-op experience.
- Student leadership.

b. Curriculum Enrichment MiSTI will work to encourage faculty to include sustainability concepts as they relate to the theme of this Center into current curriculum at the undergraduate and graduate levels. This will not be limited to the civil engineering curriculum, but rather promoted across campus to broaden the availability of sustainable transportation-related subjects to engineering and non-engineering majors alike. This will expand the courses available to civil engineering-transportation focused students, offering them the opportunities to explore sustainable transportation-related studies within business, social science, communication etc., exposing students of many backgrounds to transportation related subjects. Faculty release time to develop new course curriculum will be supported by the Center. Over the initial four years, a goal of six (6) new courses is being sought.

c. On-line Learning Initiative The Center will explore the development of a distance or on-line learning program to offer courses to students at other universities to promote the theme of this Center and advance the state-of-understanding of materials in sustainable transportation infrastructure.

d. Teacher Modules MiSTI will develop a program through the Western U.P. Center for Science, Mathematics and Environmental Education to work with K-12 teachers to develop in-class and field modules that expose K-12 students to issues and concepts related to sustainability and transportation. The program recently conducted a maritime modular development course with K-12 teachers. This model will be used to engage K-12 teachers in learning about transportation needs and challenges for the development of learning modules that will be distributed to teachers nationwide for classroom education.

e. Career & Science Fairs MiSTI will promote opportunities to introduce junior high students to transportation related careers and education. This may include involvement in the Michigan Tech YES Expo, the LTAP Construction Career Days, and WISE (Women in Science and Engineering) events for middle school age young women. MiSTI will also explore the opportunity to present transportation related awards at High School Science Fairs, at local and state levels, to increase awareness of the field of transportation in youth.

f. Industry Engagement The Center will develop a series of field opportunities, in collaboration with industry, for students to gain experience with materials in transportation infrastructure especially where sustainability concepts are being explored. These trips will expose students to current transportation infrastructure related needs and how sustainability is being addressed, as well as providing first hand exposure to sustainable material applications.

The Center will support, with joint industry sponsorship, student involvement in national competitions. Furthermore, the Center will advocate the development of sustainable concepts and competitive classes within existing competitions. An example of a successful introduction in an existing competition is the snowmobile manufacturing industries addition of an electric sled class in the Society of Automotive Engineer's Clean Snowmobile Challenge competition. This type of industry recognition and challenge will be pursued by the Center.

g. Student Research Initiatives Current student programs will be enhanced to expand the transportation-related educational and research learning opportunities for students. PDCM will be expanded to cover additional materials used in transportation infrastructure and sustainability research initiatives for the PDCM will be sought and secured from industry. Center scholarships will be offered to encourage students to pursue these new initiatives. The Center will fund (using developmental support) hourly students on selected research projects, providing research opportunities and engaging more students in research activities related to the theme of the Center.

h. Workforce Recruitment MiSTI will lead the recruiting efforts for the various Michigan Tech transportation centers and institutes to attract undergraduate students to pursue transportation related graduate studies. The Center will also identify potential graduate students with interest in research consistent with the theme of the Center. This Center will fund at least four (4) graduate students over the life of the grant to specifically pursue research initiatives supporting the theme of the Center and to support new research initiatives selected for developmental support. These positions will be used to leverage additional positions from the university and industry.

3. Performance Indicators for Education Activities: MiSTI will monitor its progress using performance indicators 5 and 6 in Exhibit A of the *Reporting Requirements for University transportation Centers (3/06)*. Baseline data for these performance indicators is provided in Appendix B. Annual tracking of the education indicators will utilize information provided through annual faculty activity updates, objective reporting questionnaires, and data collected from the academic departments at Michigan Tech. The data will be reported in the Center's annual report.

The Center will lead the enhancement of the current curriculum to incorporate sustainability concepts and develop new course(s) to support materials in sustainable transportation infrastructure, which may include on-line learning. In

addition, the Center is seeking to increase the number of students participating in research related to the theme of the Center at all educational levels.

D. Human Resources

People are the critical element to the success of the Center. Advancement towards a more sustainable transportation infrastructure through research and applied implementation and the positioning of the US as a global economic leader depends on the students, educators, researchers and industry professionals of today. The Center will strive to engage all constituencies in transportation education and research while building the workforce of tomorrow.

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.* MiSTI will (1) increase the number of students, faculty, and staff engaged in education and research related to the theme of the Center; (2) will increase the opportunity for transportation workforce development by engaging students at all levels to explore career opportunities related to transportation; and (3) increase the transportation industry's involvement in education, workforce development, and research related to the theme of the Center.

1. Human Resources Program Outcomes: Over the next four years, MiSTI's activities will engage students, faculty, and industry to participate in programs designed to increase the awareness of the role materials play in a more sustainable transportation infrastructure. Dynamic programs will provide education, awareness of careers, and research, pertaining to transportation, sustainability, and materials. These will include:

- An increase in technical staff and faculty dedicated to pursuing, securing and supporting research related to the theme of the Center.
- An increase in students engaged in educational activities related to the theme of the Center, through K-12 outreach, curriculum development, and recruitment.
- An increase in industry involvement in supporting education, research, and outreach activities of the Center.
- An increase in the number of industry professionals being engaged through T2 activities.

2. Human Resources Planned Activities: Through various programs and activities, MiSTI will increase the number of students, faculty, staff, and industry workers engaged in materials in sustainable transportation infrastructure through awareness and outreach, education, research, and T2.

a. K-12 Outreach MiSTI will support the development of K-12 instruction modules and activities for students and teachers that promote awareness of transportation issues and the opportunities for careers in the transportation field. The Center will participate in events that provide opportunities for outreach to K-12 students to

ensure that transportation is represented as a viable and desirable career and educational choice.

b. Enhanced Graduate and Undergraduate Recruitment MiSTI, in partnership with various Michigan Tech departments including Civil and Environmental Engineering, Admissions, and the Graduate Student Office, will develop promotional materials and actively recruit students at all levels to pursue degrees supporting the transportation industry. MiSTI will work closely with these entities to develop a strategic recruitment plan that will lead to a bolstering of the workforce of the future, prepare future educators, and support the research needs of the industry. At the undergraduate level, students will be encouraged to participate in transportation initiatives in all disciplines. At the graduate level, students will be recruited to pursue advanced degrees with a focus in transportation materials. At both the undergraduate and graduate levels, students will be engaged in research related to the theme of the Center.

c. Curriculum Development and On-line Learning to other Universities MiSTI will support the development of curriculum promoting the theme of the Center and also the distribution of this curriculum to students at Michigan Tech and at other universities through on-line learning methods. In addition, current courses at Michigan Tech will be enhanced by including topics related to materials in sustainable transportation infrastructure, to promote the needs of transportation to all students. Examples include incorporating transportation topics in business logistics and economic courses, policy planning, social and cultural curriculums, and in all fields of engineering and sciences.

d. Partnership with Industry MiSTI will seek substantial involvement from industry partners to develop, establish and support education and research programs that promote sustainable use of transportation materials. Industry will be asked to financially support the Center's activities, collaborate on educational activities including site visits and field trips, and fund research projects and undergraduate research initiatives like the PDCM. Through a well coordinated and executed program, the Center will increase support and participation by industry in the education and research at the university.

e. Research Partnership Expansion MiSTI will strategically pursue an expansion of the research partnerships on the Michigan Tech campus, at other universities, and with outside research organizations. A transportation forum will be held in year one of the Center on the Michigan Tech campus to create awareness of the opportunities for multidisciplinary research and external funding opportunities. By expanding research to other departments across campus, a greater number of people will be engaged to support the transportation industry. Efforts will also be made to pursue an increase in the number of off campus collaborations involving research projects with external experts. The core faculty team will be engaged and supported by the Center to present research results and capabilities at other

universities in an attempt to increase awareness of transportation research and the opportunities for research partnerships.

f. T2 Activities MiSTI will increase the T2 activities of the research initiatives at the university. This increase will be in the amount of instructional material being made available and in the number of industry professionals being reached.

3. Performance Indicators for Human Resources Activities: MiSTI will monitor its progress using performance indicators 7, 8, and 9 in Exhibit A of the *Reporting Requirements for University transportation Centers (3/06)*. Baseline data for these performance indicators is provided in Appendix B. Annual tracking of the human resource indicators will utilize information provided through annual faculty activity updates, objective reporting questionnaires, and data collected from the universities academic departments. The data will be reported in the Center's annual report.

The Center is seeking to increase at all levels, the number of people involved in transportation education and research related to materials in sustainable transportation infrastructure. Enhanced T2 efforts will increase the number of industry professionals being made aware of the research findings leading to broader acceptance and adoption.

E. 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.* MiSTI will promote diversity in all activities and programs of the Center to encourage participation by under-represented students, faculty, and staff in the U.S. workforce within the transportation industry.

1. Diversity Program Outcomes: Through increased awareness of the need for a more diverse transportation workforce, MiSTI will emphasis diversity in all activities and programs providing equal opportunity. This outcome will also address a national need to encourage women and minorities to consider careers in fields including math, science, technology and engineering.

2. Diversity Planned Activities: Through continual efforts, MiSTI will seek out opportunities to engage under-represented groups in transportation education, research and outreach and when possible, specifically target audiences and events where these groups can be reached. Planned activities will include:

a. K-12 Outreach MiSTI will support and participate in events such as the Michigan Tech YES Expo, a youth engineering and sciences expo held in Detroit Michigan annually. In 2006, the YES Expo attracted more than 20,000 middle school students from southeast Michigan. Nearly 100 companies, educational institutions and organizations introduced students to possible careers and educations in science and engineering. MDOT represented the transportation industry with interactive activities, brochures and career related material. The university did not offer a

transportation related discovery booth. This is something that the Center will pursue for 2007.

In 2009, the Michigan LTAP and the MDOT will hold the first Construction Career Days in the Detroit area. This event is targeting under-represented students of middle- through high- school age to expose them to opportunities for education and careers in transportation construction fields. MiSTI will play take a lead role in the event with an anticipated participation by 3,000 students and more than 100 educators.

WISE events are hosted annually on the Michigan Tech campus, offering young women an opportunity to learn more about careers in science and engineering. MiSTI educators and researchers will participate in these activities and events to ensure transportation careers and fields are represented and promoted.

b. Targeted Graduate Recruiting MiSTI will take a prominent role in the recruitment activities of the CEE Department to increase the number of graduate students pursuing programs in transportation materials. There are currently no dedicated personnel to recruit graduate students for the department. These duties fall to one campus-wide recruiter targeting events where multiple departments' interests can be met. New efforts will focus on faculty visits to other universities, targeting venues where a large number of civil engineering undergraduates are in attendance, and hosting on and off campus graduate informational events. A strategic marketing campaign will be developed including promotional material that specifically addresses graduate education with a strong research component in transportation materials. Additionally, the Center will monitor other recruiting initiatives, events, and activities on campus to ensure that transportation, and specifically transportation materials, is represented in all university recruiting activities.

c. Speakers MiSTI will host speakers from multimodal areas of transportation and materials including visiting faculty, graduate students, and industry leaders, with an emphasis on under-represented role models. These presentations will be free and open to the entire campus community. Other university resources will be leveraged to support and promote these engagements.

3. Performance Indicators for Diversity Activities: RITA no longer requires the collection and reporting of performance or baseline measurements related to diversity. MiSTI will internally monitor its success in attracting and reaching a greater number of under-represented groups through its activities and programs to maintain awareness of the challenges and its success in addressing diversity.

F. Technology Transfer

T2 provides a critical link between research and solving the transportation infrastructure problems of today. The cycle of T2 requires the engagement of industry in identifying research needs, which are translated to research initiatives

that in turn produce results to address the problem. This process is built on a relationship between industry and the research community where in partnership, the exchange of needs and solutions moves everyone towards a desired outcome. MiSTI will work diligently to establish this type of relationship with its industry partners through sound scientific research and the delivery of practical information utilizing a variety of technology transfer mechanisms.

Technology Transfer Goal: *Availability of research results to potential users in a form that can be directly implemented, utilized or otherwise applied.* MiSTI will develop programs to efficiently deliver research results to students, faculty, staff, and industry professionals for implementation in meeting the needs of the transportation community to ensure a sustainable transportation infrastructure.

1. Technology Transfer Program Outcomes: The Center, in cooperation with the Michigan LTAP, will work closely to tailor and enhance the LTAP's successful T2 programs, delivering pertinent research results to the transportation industry at all levels. This symbiotic relationship will play a critical role in the success and longevity of the Center. Traditionally, the academic environment relies on journals, conferences, presentations, and reports to convey research findings. Often these are delivered to academic peers, not the industry audience where the results could see more immediate implementation. Additionally, the level of presentation in the academic environment is often inappropriate for the level of understanding needed by the industry audience. Research results need to convey pertinent information in a usable and understandable language for the end user. MiSTI will utilize a technical writer to ensure that the information being conveyed is disseminated properly for accurate interpretation and use by targeted users ensuring implementation.

2. Technology Transfer Planned Activities: MiSTI will develop or implement a number of tools to ensure quick and efficient transfer of knowledge to industry personnel.

a. Technical Writer MiSTI will fund a 0.5 FTE Technical Writer to assist researchers in generating and presenting useful results for a variety of audiences. It's anticipated that externally funded research will provide the other half of the funding necessary to support this position on a full-time basis. This person will also be available to assist with other T2 activities identified in this section. This role will commence in year two of the Center operations.

b. Web site The Center will develop and maintain a Web site where all activities, reports, research projects, and programs will be made available to the transportation community. The use of this site will be monitored to maintain a strategic position through Web search engines. Copies of all reports, newsletters, annual reports, and the strategic plan will be available on the site.

c. Publications The Center will publish a semi-annual newsletter and an annual report to be distributed through the LTAP network, the National UTC network, industry contacts, to Center affiliates, and industry partners. Additionally, the Technical Writer will assist in preparing and submitting research findings to a variety of journal, trade publications, and technical briefs.

d. Contact Management System The Center will develop, with the assistance of the Michigan LTAP, a contact management software program to manage T2 information distribution. Industry partners, contacts, and other people with whom the Center will engage in research, education, T2 or other partnerships, will be tracked.

e. On-line Seminars MiSTI will support the development of an on-line Webinar series offering knowledge transfer to transportation professionals. In year one, one seminar will be developed and distributed. Years 2-4 will see the development of two additional Webinars each year. These on-line seminars will be available live from any Internet connection and will also be archived and made available for future viewing. The technology to deliver this type of knowledge transfer already exists on the Michigan Tech campus. Faculty and researchers will be engaged to develop and deliver the material.

f. Professional Services MiSTI will coordinate and strategically position faculty on key committees of professional organizations and associations including ASTM, TRB, and ACI. Additionally, MiSTI will coordinate representation at major industry conferences and meetings to ensure that the research initiatives and capabilities of the team at Michigan Tech are being conveyed to the industry community.

g. Transportation Summit MiSTI will host two conferences in years three and four to bring together researchers and transportation professionals to explore research needs, develop future partnerships, discuss research results, and research implementation.

h. Transportation Forum MiSTI, in collaboration with MTTI, will coordinate and present an annual transportation forum on the Michigan Tech campus to explore multidisciplinary research opportunities that benefit the transportation industry. Centers, institutes, and faculty from across campus will be encouraged to collaborate on transportation research projects, bringing additional expertise to address research problems while increasing the number of active researchers pursuing transportation projects.

3. Performance Indicators for Technology Transfer Activities: MiSTI will monitor its progress using performance indicators 10 and 11 in Exhibit A of the *Reporting Requirements for University transportation Centers* (3/06). Baseline data for these performance indicators is provided in Appendix B. Annual tracking of the T2 indicators will utilize information provided through annual faculty activity updates, objective reporting questionnaires, and data collected by the Center through Web

tracking software, and distribution lists. The data will be reported in the Center's annual report.

Section III MANAGEMENT APPROACH

A. Institutional Resources

Michigan Tech offers a variety of institutional resources that the Center will be able to draw upon to ensure success in meeting its outlined goals. MTTI is a multidisciplinary organization, supported by faculty and staff, offering connections to a network of industry associations and cost share opportunities for the Center. This group has engineering and educational expertise in areas that include geotechnical, structural, construction, modeling, life-cycle analysis, pavement design, management, transportation materials, and railroads. The initial faculty members of the Center, used in the baseline measurements-Appendix B, are all active researchers within the MTTI organization.

In addition to the broad transportation focus of MTTI, the TMRC conducts research on transportation materials, including HMA, PCC, aggregates, and soils. The CSD provides similar research on transportation structures including materials research on ultra high performance concrete and pre-stressed concrete. Both of these centers are directly supported by MDOT. In the area of geotechnical research, the ARC, funded by FHWA, offers expertise in geotechnical engineering, aggregates, and soils.

Educational initiatives of the Center will include partnering with the PDCM. Through an expansion of this program, the Center will have an opportunity to engage more students in undergraduate transportation materials related research and provide additional access to potential industry partnerships and relationships. The SFI will provide opportunities for joint projects in engineering educational initiatives, industry partnerships, and student recruiting.

Expertise in the area of T2 will be available from the Michigan LTAP, which has developed a vast network of communication channels and tools for reaching local, regional, and national transportation audiences. Their contact management approach will be modeled to ensure swift and efficient T2. Their technical staff will provide added human resources as needed to carry out the activities of the Center. Similarly, the TTAP will be utilized to reach regional and national tribal municipalities.

TDG and the ISR both offer expertise in transferring and supporting emerging transportation related technologies into commercialized products or applications. And finally, the Western U.P. Center for Science, Mathematics, and Environmental Education offers opportunities for collaborations with the Center to educate K-12 teachers and students through the development of transportation modules for classroom and field instruction.

Michigan Tech is actively seeking additional centers that build on its strengths and compliment the mission of MiSTI. The broad network of centers that comprise MTTI have the ability to leverage resources and share technologies to swiftly and efficiently perform research, education, and technology transfer activities and deliver broader and larger initiatives in sustainability and transportation.

B. Center Staff

It is the view of the interim Executive Committee that the Center's federal resources should be leveraged to attract additional research to the university, engage students in research activities, develop educational programs, and support T2 for professionals in the transportation community. On an as needed basis staff support may be secured from other centers, institutes, and across the university to carry out the activities of the Center, minimizing the need to hire permanent staff through the Center. The Center will be staffed by two full-time employees, a Center Coordinator funded primarily through federal resources and a technical writer, hired during year two using 50% federal resources and 50% cost share secured through external research projects. The Executive Director will contribute 50% time towards Center activities and will be funded 50% by federal funds and 50% by cost share match provided by the university. Faculty will contribute significantly towards supporting Center activities, but will receive no additional compensation for their efforts during the academic year. Center funds will be allocated for faculty summer support for the development of curriculum. Their efforts during the academic year are viewed as normal to their positions as faculty researchers and educators. Research Scientists will be supported 20% by federal sources and 80% by funded research of which a minimum of 20% will contribute to cost share match for the Center. In order to support the anticipated increase in research being conducted, current part-time research scientists will be hired full-time and supported 20% by the Center and 80% by external research projects. Table 2 provides a Center staff overview.

Table 2 Center staff effort towards Center operations and funding sources

Number	Position	%Effort	%Federal	%Match	Match Source
1	Director	50%	50%	50%	Release time funded by the University
1	Coordinator	100%	75%	25%	MTTI match
1	Technical Writer	100%	50%	50%	External research funding
4	Research Scientist	100%	25%	75%	External research funding

In addition to the Center operational staff, a number of students will receive developmental support by the Center to assist with research initiatives selected through the formal research selection process. Up to \$50,000 per year will be used to engage students in hourly and scholarship supported research activities related to the theme of the Center. This initiative is expected to match industry funds at a rate of 1(federal \$):2(industry \$). The leveraged matching funds will be considered cost share match for the Center.

The Center will focus recruiting efforts on attracting high quality PhD students, leveraging federal funds to create a large pool of PhD students pursuing advanced degrees and conducting research in the area of materials in sustainable transportation infrastructure. This effort is outlined in Table 3.

Table 3 Plan for funding PhD students

Funding Source	Year 1	Year 2	Year 3	Year 4
MTU-CEE Department	2	2	2	2
UTC Federal Funds		1	2	2
External Research-Cost Share		1	2	2
Total PhD slots Funded	2	4	6	6

Over the initial four years of the Center operations, 2 Post Doctoral, 1-year appointments will be considered to enhance the research and T2 efforts of the Center. These combined positions will be funded 50% by University cost share, 37.5% by external research projects and 12.5% through federal funding for the Center.

As of the writing of this strategic plan, the Center Director and Coordinator have been identified. Dr. Thomas J. Van Dam, PhD, P.E. (Michigan and Illinois), will serve as the Center's Executive Director. Dr. Van Dam is an Associate Professor at Michigan Technological University specializing in pavement materials, evaluation, design and performance. He is the Director of the Transportation Materials Research Center, and the Co-Director of the *NC/VP Materials Characterization Facility*. During the past ten years, Dr. Van Dam has participated in projects for various clients including the FHWA, Innovative Pavement Research Foundation, NCHRP and private industry, investigating concrete durability and performance. Dr. Van Dam is the Chair of TRB Committee AFN30, *Durability of Concrete* and an active member of ACI Committee 201, *Durability of Concrete*, where he Chairs Subcommittee 201.1R, *Condition Assessment*. In the last five years, he has authored or co-authored 23 refereed journal and proceeding publications, 12 technical reports, and participated in \$3.55 million in funded transportation materials research projects.

Elizabeth Hoy will serve as the Center's full-time Coordinator. She holds a BS in Scientific and Technical Communication with a technical emphasis in business management and marketing from Michigan Technological University. Before joining the UTC at Michigan Tech, Ms. Hoy worked as a project specialist for an integrated marketing communication firm assisting high-tech, start-up businesses through the Michigan Economic Development Council's SmartZone initiative.

C. Multiparty Arrangements

Currently, there are no multiparty arrangements necessary for Center operations. Michigan Technological University has formally established relationships with a number of universities, governmental agencies, and private industries through

executed Memorandums of Understanding, Memorandums of Agreement, and other legal contracts. Should the need arise for the UTC to enter into a multiparty arrangement; university representatives will be enlisted to draft the necessary legal documents. These documents will be presented to RITA for prior approval.

D. Matching Funds

A variety of sources will contribute to the matching funds required by FHWA. These sources include state DOTs, Michigan's LTAP program, Michigan Tech, MTTI, and private industry. Matching fund use will conform to the OMB Circular A-110, 503, 504 (b), or 505 of Title 23 USC. Section IV Budget Detail, F. Cost Sharing provides a breakdown by source of anticipated cost share opportunities. Appendix A provides the first year combined Center budget including anticipated cost share expenditures by category.

Section IV BUDGET DETAIL

This section of the strategic plan provides additional detail for the Budget provided in Appendix A.

A. Salaries

Table 4 outlines average salaries and/or hourly rates for staffing expenditures associated with the operation of the Center.

Table 4 Average hourly rate or salary for Center staff

Total Hours Per Year	Position	Annual Salary	Distribution
5,000 per year	Undergraduate		Students will be paid hourly to support research projects selected for developmental support. Rate of \$10.00 per hour.
Full-time	PhD Students	\$20,500	Plus Tuition and F&A
1 FTE	Post Doctoral	\$40,000	Plus F&A
1 FTE	Research Scientist	\$45,000	Average, plus F&A
1 FTE	Coordinator	\$40,520	Plus F&A
.5 FTE	Executive Director	\$85,000	Plus F&A (9 month)

The total cost of salaries for year one of Center operations is \$387,335; Staff salaries of \$55, 440 for the Director, \$21,000 for summer faculty support for the development of curriculum and on-line learning programs, \$40,520 for the Center Coordinator, \$72,000 for technical staff support, and \$26,000 for summer faculty support from externally funded research; \$2,000 for technical writing and graphic design assistance; and student support of \$81,000 for undergraduates and \$89,375 for graduate students.

B. Fringe Benefits

Staff benefits are applied at an approved rate negotiated with the Office of Naval Research. Currently the fringe benefit rate for all full time employees is 42.4%, 7.5% for graduate students, and 20.2% for faculty for the academic summer semester. There is no fringe rate associated with hourly student employees. Total budget expenditures for fringe benefits for year one are \$79,803.

C. Travel

The combined Center travel budget for the first year is \$57,000, of which \$20,000 is provided by the Center's federal funds. The remaining travel budget includes MTTI travel funds available to faculty, staff and students for Center specific travel and as cost share match for the Center; TAC travel for annual Center meetings, contributing additional in-kind cost share towards the Center's required match; University travel resources and faculty incentive account travel for Center related business; and other industry sponsored travel. Hard and in-kind cost share match accounts for \$37,000 of the travel budget. Travel to destinations outside the U.S. and its territories are considered "foreign travel." Written permission will be obtained from RITA prior to the initiation of such travel.

D. Other Direct Costs

Other Direct Costs associated with the Center's Budget Plan in Appendix A include equipment, expendable property and scholarships/tuition. Twenty thousand dollars (\$20,000) has been allocated for laboratory facility special purpose equipment upgrades to provide resources to conduct externally funded research providing cost share match for the Center. Prior approval for equipment purchases will be secured from RITA. Expendable property includes publications, services and Center specific supplies in the amount of \$67,333.

The Center will offer scholarships in the amount of \$25,000 annually to undergraduates who are engaged in PDCM Enterprise projects. These scholarships will leverage additional funds in the amount of \$50,000 in industry match for the Center through student research initiatives in transportation materials. Additionally, the CEE Department will fund two graduate students including a stipend and tuition in the amount of \$31,734, counted as cost share for Center funded graduate student positions.

E. Facilities and Administration Costs

Facilities and Administration Costs (F&A) are applied at an approved rate negotiated with the Office of Naval Research. The current F&A rate is 56% of the Total Direct Costs on the federal portion of the Center Budget less equipment, scholarships/tuition.

F. Cost Sharing

The required cost share match of 100% will be met by a number of identified and unidentified sources. This match is generally identified as hard and soft. Hard match sources include indirect costs in the amount of \$60,000 being returned to the

Center by the University. MTTI has committed to supporting 25% of the Coordinator's Salary in the amount of \$10,130 plus benefits for each of the four years. In addition, MTTI travel funds and an initial start-up contribution totals approximately \$15,000 in funds available to the Center. The CEE Department has offered two months release time for the Director's position for each of the four years, amounting to \$18,720 in the first year in hard match (hard meaning actual dollars are transferred to a physical account). Other sources of hard match include external research funding with a minimum estimate of a 1:1 match for the 20% of the four technical staff salaries, the Industry Partners Program, and other university resources including graduate lines (carrying stipend, benefits and tuition) from the CE Department.

Soft match will be provided by other University resources in the form of effort towards Center programs and activities. In-kind contributions include office space, equipment, and internet and phone access, all being supported by the CEE Department. Industry will also provide soft match through negotiated waived conference and seminar fees, industry expenses associated with field demonstrations and site visits for students, and other non-monetary donations where value can be assessed. Time donated by the TAC members and associated travel expenses to attend annual Center meetings will be included as in-kind match.

It is the intention of the Center management to generate more match than the required 100% of federal funds. Over match will be used to provide additional services and support through the Center and to enhance Center programs and activities.

APPENDIX A

**University Transportation Center for Materials in Sustainable Transportation
Infrastructure Budget Plan**

Grantee: Michigan Technological University Fiscal Year: July 1, 2006-June 30, 2007

CATEGORIES	CENTER BUDGET	EXPLANATORY NOTES
Salaries		
Director-Academic	\$37,440	4 months academic release time
Director-Summer	\$18,000	2 months of summer salary
Faculty-Summer	\$47,000	Summer salaries for faculty to develop curriculum, distance education program, match contribution from externally funded projects
Coordinator	\$40,520	Full time position to oversee Center operations
Other Salaries	\$2,000	Graphic Design and Technical Writing Assistance
Technical Staff (4)	\$72,000	20% Center Support and 20% Industry match from externally funded research projects
Undergraduate	\$81,000	Hourly support for undergraduate student research positions, Center work study support
Graduate	\$89,375	2 graduate line stipends from CE and hourly support on externally funded Center research
Total Salaries	\$387,335	
Benefits	\$79,803	
TOTAL SALARIES & BENEFITS	\$467,138	
Permanent Equipment	\$20,000	Special Purpose Equipment Purchases
Domestic Travel	\$57,000	\$20,000 from federal funds
Expendable Property, Supplies and Services	\$67,333	Publications, services, and program specific supplies
Scholarships/Tuition	\$106,734	Year 1, tuition for two graduate lines and undergraduate research scholarships
TOTAL DIRECT COSTS	\$718,205	
TOTAL F & A	\$141,795	56% of Total Direct Costs less Equipment, Scholarships/Tuition on federal dollars
TOTAL BUDGET	\$860,000	Includes \$430,000 federal and \$430,000 matching cost share amounts

APPENDIX B

Baseline Measures**University Transportation Center for Materials in Sustainable Transportation
Infrastructure at Michigan technological University****Academic Year:** 2006 **Beginning:** Summer 2005 **Ending:** Spring 2006

Data represented in this baseline assessment is for the most recent academic year's activity by the following key transportation materials faculty.

Dr. Theresa Ahlborn, Associate Professor, Structural Engineering
 Dr. George Dewey, Associate Professor, Structural Engineering
 Dr. Ralph Hodek, Professor, Geotechnical Engineering
 Dr. Lawrence Sutter, Adjunct Professor, Pavement Materials
 Dr. Thomas Van Dam, Associate Professor, Pavement Materials
 Dr. Stanley Vitton, Professor, Geotechnical Engineering
 Dr. You Li, Assistant Professor, Structural Engineering
 Dr. Zhanping You, Assistant Professor, Pavement Engineering

Research Selection

1. Number of transportation research projects selected for funding:
 - a. Number Considered Basic research: **0**
 - b. Number Considered Advanced research: **0**
 - c. Number Considered Applied research: **14**
2. Total budgeted costs for projects reported in question 1: **\$2,610,988**

Research Performance

3. Number of transportation research reports published: **17**
4. Number of transportation research papers presented at academic/professional meetings: **9**

Education

5. Number of courses offered that you consider being part of a transportation curriculum (report courses shown in the university course catalog as being offered, whether or not they were conducted during the academic year being reported):
 - a. Undergraduate: **7**
 - b. Graduate: **11**

6. Number of students participating in transportation research projects (count individual students-one student participating in two research projects counts as one student): **22**

Human Resources

7. Number of advanced degree programs offered that you consider being transportation related.
 - a. Master's Level: **1**
 - b. Doctoral Level: **1**
8. Number of students enrolled in those transportation-related advanced degree programs.
 - a. Master's Level: **13**
 - b. Doctoral Level: **4**
9. Number of students who received degrees through transportation-related advanced degree programs.
 - a. Master's Level: **5**
 - b. Doctoral Level: **0**

Technology Transfer

10. Number of transportation seminars, symposia, distance learning classes, etc. conducted for transportation professionals: **1**
11. Number of transportation professionals participating in those events: **75**