2017

Michigan Tech Transportation Institute 2016 Annual Report

Michigan Tech Transportation Institute, Michigan Technological University

2016 ANNUAL REPORT

Michigan Technological University

Michigan Tech Transportation Institute

BY THE NUMBERS

70 *faculty and staff members were involved in active research through MTTI*

60 youth supported for on-campus summer educational activities in transportation

proposals submitted **63**

$4,211,320 in research funding was awarded to MTTI investigators

76% of MTTI membership funding was spent on Major and Minor Initiative Support

2016 funding partners

- Cambridge Systematics, Inc.
- EQUOS Research Co., LTD
- Hawaii County DPW
- MI Department of Environmental Quality
- Michigan Department of Transportation
- Minnesota Department of Transportation
- National Science Foundation
- Nine Sigma, Inc.
- University of Chicago
- University of Illinois Urbana Champaign
- University of Wisconsin Madison
- US Department of Transportation

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THE YEAR IN REVIEW

The role of the Michigan Tech Transportation Institute (MTTI) is to create a collaborative environment on Michigan Tech's campus to bring together centers, programs and principal investigators that conduct transportation research within focus areas and to provide leadership in developing transportation activities. Support is provided to the MTTI membership through funding of initiatives, graduate student and faculty travel stipends, invited guest speakers, leadership in transportation organizations, funding of student activities and pre-award proposal preparation.

Future plans, as stated in the 2015 annual report to the Vice President of Research, included:

OPERATIONAL

- A strategic plan for future use of MTTI funds will be developed in conjunction with the Executive Committee.
- New goals will be researched for the next fiscal year including financing of new major initiatives.
- Cross disciplinary relationships will continue to be executed and partnerships with other Michigan Tech centers and institutes increased.

OUTREACH

- Plans for a potential speaker series with invited guests will be discussed.
- MTTI will extend their network email list to include external sources for potential collaboration and networking.
- MTTI will examine other external memberships to fund for showcase and collaboration of MTTI researchers.
- Increase involvement with the National Road Research Alliance (NRRA) and the Council of University Transportation Centers (CUTC).

TECH TRANSFER

- With the inclusion of additional researchers, departments, and facilities by new MTTI members, an update of the website is a necessity.
- Promotional material will be more of a priority for the institute.

MISSION

"The Michigan Tech Transportation Institute will provide the operating structure, resources, recognition and leadership, in a collaborative environment, that supports research, education and outreach leading to sustainable solutions for transportation"

The Director and Executive Committee continued to develop a future path for MTTI in 2016 supporting the mission of MTTI set in the Charter and Bylaws. The highlights of FY16 activities included:

- MTTI organized and led a collaboration of cross campus researchers in the quest for a five year master contract as a pre-approved vendor with the Minnesota Department of Transportation (MnDOT) for their "Research Services Academic Research Program". Partnering with the MnDOT Academic Research Program enables MTTI to provide MnDOT with a large pool of university faculty and technical staff members not normally available within MnDOT along with specialized support equipment to be used in solving MnDOT's tasks. **Fifty** multi-disciplinary MTU PIs provided an overview of their expertise and facilities available to MnDOT in the areas of; multimodal, bridges and structures, traffic and safety, maintenance operations and security, policy and planning, environmental and administrative. The application for this contract was approved by MnDOT with **Ralph Hodek** (CEE) serving as Principal Investigator for the University. Request for Proposals (RFPs) were released for projects in 2016 which will be awarded in FY17. MTTI submitted four proposals in response to the RFPs, three of which have been selected for presentation to the MnDOT research review board.

- Michigan Tech submitted five proposals to the USDOT in response to their request for proposal for their University Transportation Centers (UTC). The centers are scheduled for six year terms with funding amounts up to $1.5 million annually. MTTI supported five UTC proposals administratively and financially, by providing cost share funding as a required match by the USDOT to two proposals.

- MTTI funded a portion of the renovation of Dillman Hall for use by CTT in their need of additional workspace in response to the award of the Environmental Protection Agency (EPA) Environmental Center. Because the sponsorship by MTTI was large and the maximum set aside by the Director and the Executive Committee for commitment each year, no additional major initiatives were sought in FY2016.

- Continuation of invited guest speakers to the University by MTTI included Terry Stepanski of MDOT. A monthly speaker series is being investigated for 2017 in which each month, MTTI will bring in leaders of the transportation industry for presentations to the campus and to meet students with interests in transportation industry careers.

- MTTI also contracted with the National Road Research Alliance (NRRA) in a pooled fund collaboration with these state departments of transportation; CalTrans, Illinois DOT, Michigan DOT, Minnesota DOT, Missouri DOT and Wisconsin DOT.

- Outreach activities were continued and supported by MTTI through sponsored membership fees and travel to annual CUTC and NRRA meetings by MTTI staff.

In review, the goals set forth to the Vice President of Research Office in FY2016 have been realized by MTTI through leadership of Director **Ralph Hodek** and the Executive Committee. Executive committee elections for two principals and one affiliate member will be held in FY17 to replace members with expiring positions. The three year director term has also concluded and a member election will be held in FY17. FY2016 committee members included:

Principal Members – Colin Brooks (MTRI)**, Pasi Lautala** (CEE), **Amlan Mukherjee** (CEE)

Affiliate Members – Chris Gilbertson (CTT), **Andrew Swartz** (CEE)

USE OF IRAD FUNDS

Issued Institutional Research and Development (IRAD) funds by the Office of the Vice President of Research, MTTI utilizes the funds to satisfy MTTI operating expenses and for expanding the external funding opportunities for transportation related activities. MTTI IRAD returns (Figure 1), MTTI expenditures (Figure 2) and MTTI IRAD balances (Figure 3) are shown for the five year period FY12-FY16.

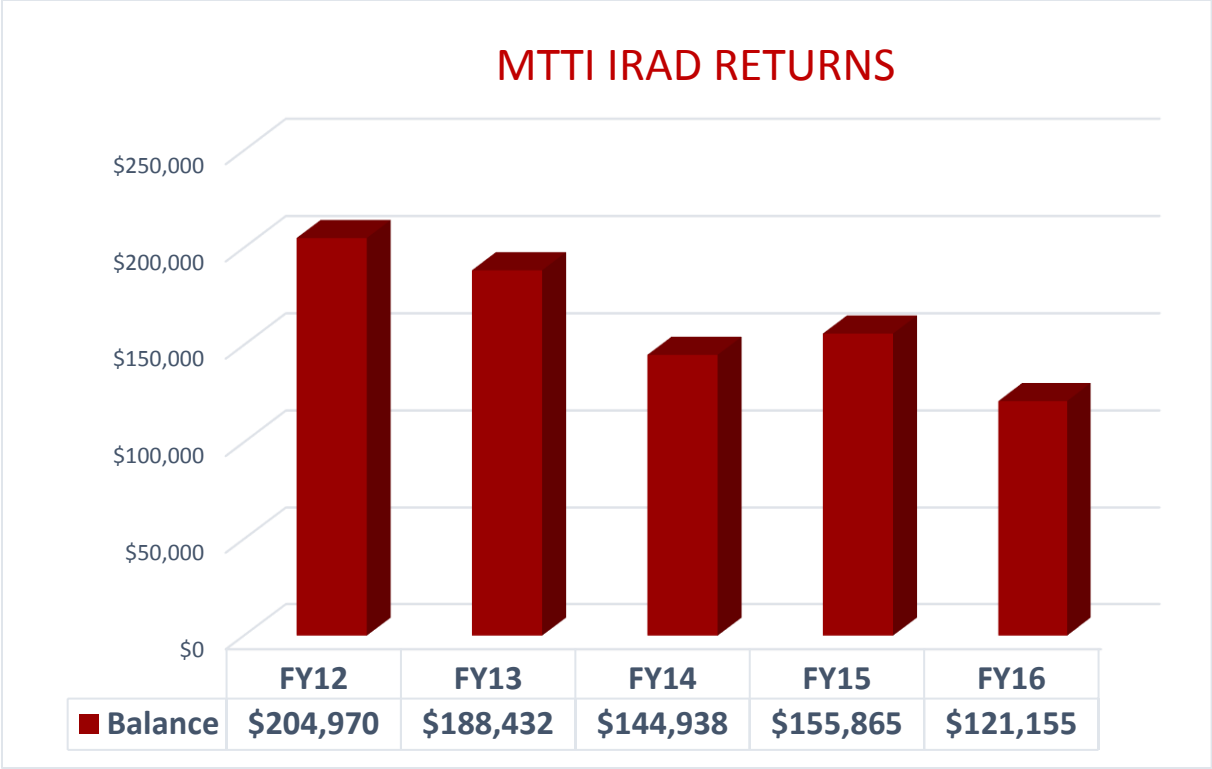


Figure 1: MTTI IRAD RETURNS

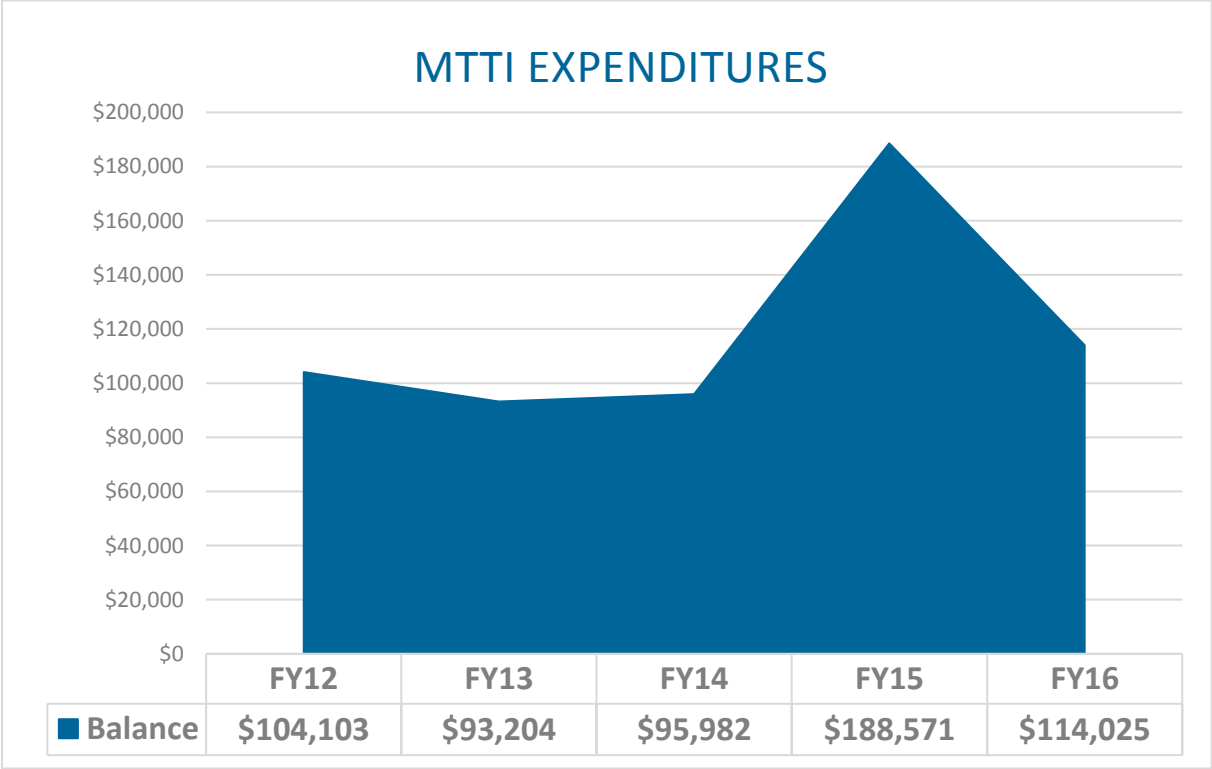


Figure 2: MTTI EXPENDITURES

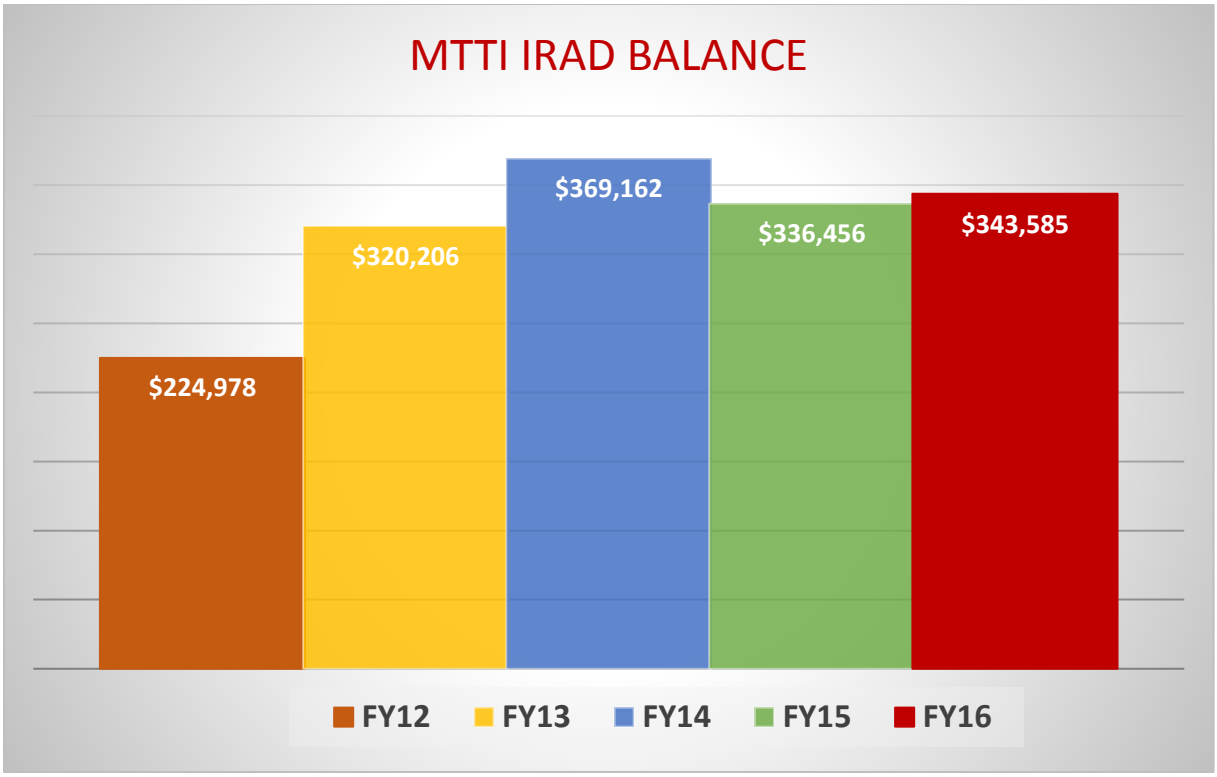


Figure 3: MTTI IRAD BALANCE

RETURN ON INVESTMENT

The principal approach to investment of IRAD funds is in support of membership through initiatives. MTTI allocates funding annually for items such as internal major and minor initiative research projects, data collection, proof-of-concept studies, equipment purchase, member travel, external speaker expenses and required cost share. 76% of MTTI membership funding was offered in support of internal research in FY16.

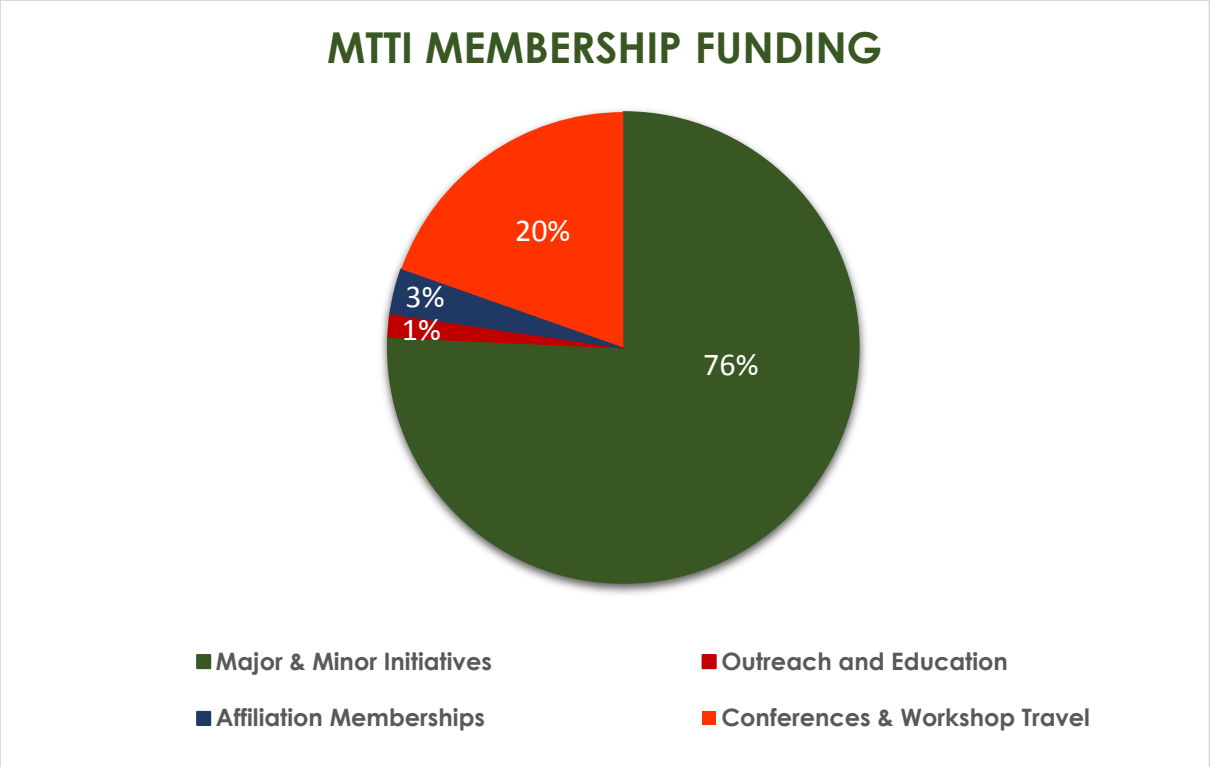


Figure 4: MTTI MEMBERSHIP FUNDING

MAJOR INITIATIVE FUNDING

Major initiatives are defined as larger, highly-collaborative activities that generate self-perpetuating resources such as long term external project funding which may lead to stable programs or centers under MTTI. Maximum funding levels are set at $60,000. Currently, two major initiatives are in effect.

PHILART JEON - **"Building the ENGIN (Exploring Next Generation IN-vehicle INterfaces Consortium) at MTTI"**

Philart Jeon (CLS/CS) was awarded Phase II funding in the amount of **$20,000** for his three year major initiative project. MTTI initiative funding is incrementally based on successful delivery of stated project deliverables and approval of MTTI Executive Committee. Jeon's three year project has a value of $60,000.

In Phase II, Jeon implemented the ENGIN seminar speaker series with MTTI sponsored funds. For spring 2016, the webinar series featured a multi-disciplinary cast of campus speakers. Beginning in 2017, the webinar series will extend to include worldwide guest speakers via GoTo Meeting or Skype, with experts from Georgia Tech, Virginia Tech Transportation Institute, University of New Hampshire, University of Michigan

Transportation Research Institute, University of Linz (Austria), University of Salzburg (Germany), Korean-German Institute of Technology (Korea), IBM, Google, Hyundai Motors and BMW Motors expected.

Featured campus speakers in spring 2016 were:

- **Philart Jeon** (CLS/CS) – "Lessons from Emotional Driving Research".
- **Maryam Shabnam FahrHosseini** (CLS/HIDE) and **Robert Pastel** (CS/HIDE) - "The Effects of Google Glass on Driving Behavior."
- **Mehdi Jafari** (ECE) and **Lucia Gauchia** (ECE/MEEM) - "Effect of the Real-World Driving Styles on EV Battery Performance and Aging."
- **Ye "Sarah" Sun** (ME-EM) - A Non-intrusive Body Sensor Network for Driver Vital Signal Acquisition."

Planned on campus speakers for FY17 include:

- October - **Jason Sterkenburg** (CLS) "Design and Evaluation of Auditory-Supported Air Gesture Controls in Vehicles".
- November – **Philart Jeon** (CLS/CS) – "Improving In-Vehicle User Experience Using Audio", joint session with CEE Graduate Seminar Series and Center for Human Centered Computing (HCC) World Usability Day.
- December – **Steven Landry** (CLS) or **Dave Nelson** (CEE) – research project update on driver behavior at rail crossings.

Jeon organized or co-organized driving research workshops, demos and tutorials at international conferences to promote team building, research dissemination and networking opportunities in 2016:

1. Workshop presentation "Persuasion on Transport Applications" at Persuasive Technology 2016 conference in Salzburg, Austria,
2. Presented "Ethically Inspired User Interfaces for Decision Making in Automated Driving at the AutoUI workshop in Ann Arbor, MI,
3. Developed tutorial on "In-Vehicle Auditory Interactions: Design and Application of Auditory Displays, Speech, Sonifications and Music" at AutoUI in Ann Arbor, MI,
4. Provided two demonstrations on "Listen to Your Drive: An In-Vehicle Sonification Prototyping Tool for Driver State and Performance Data" and "Development Tool for Rapid Evaluation of Eyes-Free-in-Vehicle Gesture Controls" at AutoUI in Ann Arbor, MI.

Six proposals were submitted with three projects awarded, one pending and two declinations. Awarded projects include:

- ☐ "Sonic Information Design for Intuitive In-Vehicle Interactions, Phase II" in the amount of $33,964 funded by Equos Research Co., Ltd. of Japan.

- ☐ Funded by the Federal Railroad Administration in the amount of $271,223, with support from Michigan Tech ($31,000) and NURail ($81,000), the "Highway-Rail Grade Crossing Research with NDS Data and Driver Simulator" project is a collaboration with PI **Pasi Lautala**, **Dave Nelson** and **Philart Jeon**.
- ☐ NSF travel support grant in the amount of $750 for the "Dagstuhl Seminar 16262: Automative User Interfaces in the Age of Automation".

22 papers were presented or published including journal articles, book chapters, conference proceedings, abstracts, and MS thesis. Jeon's students received the best student paper award at the International Conference on Auditory Display:

> Sterkenburg, J., Landry, S., Jeon, M., & Johnson, J. (2016) **Towards an In-vehicle sonically-enhanced gesture control interface: A pilot study**. Proceedings of the 22nd International Conference on Auditory Display (ICAD2016), Canberrra, Australia, July 2-8.

Jeon advised PhD student, **Steven Landry** (CLS) was selected as the "NURail Student of the Year" by the Department of Transportation.

Plans for 2017 activities, based upon approval of Phase III by the MTTI Executive Committee, include turning the ENGIN seminar series into a webinar based series with international industry and academic speakers with the possibility of developing a world-wide student doctoral colloquium series in the automated vehicle research domain. Coordination of four international workshops and conferences on driving research are planned. Expected proposal submissions on adult driver behaviors and automated vehicles and pedestrians are intended for 2017. 20 publications are expected and include two PhD dissertations. Additionally, automotive user interfaces course materials in Human Centered Design (PHY3870, PSY6991) will be developed and "Distracted Driving and In-vehicle Technologies" sessions for the Summer Youth Program will continue.

AMLAN MUKHERJEE - "Exploring the Science of Sustainability: Robustness and Resilience of Coupled Infrastructure and Natural Networks"

A second major initiative funded by MTTI and led by **Amlan Mukherjee** received Phase II funding of **$35,000** for continued research in FY17. Promised deliverables and successful progress was achieved in the first stage of funding and approval for continuation of the project was granted by the EC. Mukherjee's deliverables for Phase I included:

1. Three peer reviewed interdisciplinary journal papers establishing initial research outcomes in topics directly related to the Science of Sustainability. Four papers were submitted.

- Mukherjee, A. and Dylla, H. (2016) "Lessons learned in developing an environmental product declaration program for the asphalt industry in North

America," in the Proceedings of the 6th Eurasphalt and Eurobitume, 1-3 June 2016, Prague, Czech Republic.

- Mukherjee, A. (2016) "Life Cycle Assessment of Asphalt Mixtures in Support of an Environmental Product Declaration", Document published at NAPA EPD Program website: http://www.asphaltpavement.org/EPD.
- Mukherjee, A. and Dylla, H. (2016) "Challenges To Using Environmental Product Declarations In Communicating LCA Outcomes: The Case Of The Asphalt Industry," Submitted to the Journal of the Transportation Research Record.
- Mukherjee, A., Bhatt, C. and Dylla, H. "State of Implementation of EPD programs for Construction Materials," Paper is in preparation for submission to Journal of Life Cycle Assessment.

2. ***Five to seven collaborative proposals to a variety of national and regional governmental and non-governmental organizations.*** Mukherjee submitted six proposals of which three were funded, one is pending and two proposals were declined. Funded proposals include:
    - ☐ As Co-PI on the "Research and Implementation of Unmanned Aerial Vehciles (UAVs) for Assessment of Transportation Infrastructure" project funded by MDOT. Mukherjee's funding totals $60,000.
    - ☐ A collaborative proposal with the University of Washington to the National Cooperative Highway Research Program (NCHRP) titled "Sustainable Construction Practices" was awarded in the amount of $82,000.
    - ☐ "A Workshop to Address Data Needs to Support Sustainable Decision-Making for Civil Infrastructure" was awarded $150,000 by the Federal Highway Administration.

3. ***Hosting of a conference showcasing research and education efforts, bringing together a collaborative group of academics and stakeholders who will continue to sustain the initiative after the first year.*** The objective of this activity is to conduct a series of events to address the development and challenges of delivering a centralized data base for convenient access to life cycle inventory data for construction materials. Two workshops involving participation of industry and agency stakeholders were planned with an extended session at the upcoming 2017 Transportation Research Board (TRB) annual meeting.
    - A mini-workshop "Sustainability Workshop for DOT Engineers" was organized and held for MDOT in Lansing, MI in August 2015 to educate stakeholders and decision-makers on current practices in sustainable pavement design and construction methods. Representatives from the asphalt and concrete materials industries, Federal Highway Administration, Illinois Tollway, and state DOTs presented current methods and best practices in designing and constructing environmentally friendly pavements.

- The FHWA partially funded "Workshop to Address Infrastructure Life Cycle Inventory Data Needs: Supporting Sustainable Decision-Making for Civil Infrastructure Using EPDs" was a collaborative effort between MTTI, Caltrans and the University of CA Pavement Research Consortium (UCPRC) in organizing and hosting this event in Ann Arbor, MI. The objective of this workshop was to bring different stakeholders to the table for discussion on the current gaps and needs in life cycle assessment (LCA) data and develop a road map for filing the needs and gaps. The vision was to support the civil infrastructure industry and assess the obstacles in producing Environmental Product Declarations (EPDs). 36 participants from state DOTs, city governments, asphalt and concrete industries, academic institutions and transportation agencies provided input at the workshop. The third event in this activity will be continued at a session during the TRB annual meeting.

4. ***Education.*** A class on Life Cycle Engineering for Infrastructure Systems was developed and introduced in spring 2016 at the undergraduate level (CE4990) and graduate level (CE5390). 20 students registered for the class, with additional project requirements for the graduate class.

FACILITY UPGRADES

Although not technically defined as a major initiative per MTTI's funding matrix, a large capital expenditure was approved by Director **Hodek** and the Executive Committee in the amount of $60,000. Michigan Tech was awarded the EPA Environmental Center for the Great Lakes Region 5 in late FY14 with a contract finalized in 2015 (FY16). The six year, $4.8 million project is led by Principal Investigator **Tim Colling** (CTT) with multiple cross disciplinary co-investigators. With the award of the project, it was essential that additional employees be hired by CTT to satisfy the requirements of the EPA Center. At maximum capacity in their current workspace, additional office and work stations were a necessity. CTT collaborated with the Department of Geology to utilize unused space and convert rooms 311, 312, and 313 in Dillman Hall to offices for CTT use. CTT adjacent offices were also renovated.

As per Michigan Tech policy, renovation costs are the responsibility of the new user including asbestos abatement and electrical updates. Costs for renovation totaled $295,000 of which $60,000 was provided by MTTI.

MINOR INITIATIVES

Minor initiatives are exploratory projects, funded up to $10,000, and are expected to result in a deliverable that produces a chance of investment return to MTTI. All minor initiatives require 100% matching cost share funding from the researcher.

Dave Nelson (RTP) was awarded a minor initiative in the amount of $10,000 for his "Rail Crossing Behavior with National Data and Surveying Services (NDS) Data" study. MTTI funds were used for data acquisition fees and travel. Cost share funding was contributed through **Pasi Lautala's** startup funds and the National University Rail Center (NURail) project funds.

Nelson's project plan was to develop a program to investigate driver behavior from previous years at highway-rail grade crossings by using a driving simulator. Increased understanding of driver behaviors can lead to improved traffic control devices for rail crossings. Two data sets from the Virginia Tech Transportation Institute (VTTI) were purchased with the initiative funding and included data from 700 rail crossing traversals at seven different rail crossings. This information is being used to develop research techniques for working with the data.

This research effort is closely aligned in with the driver research program being developed by **Dr. Jeon** in the Department of Cognitive and Learning Sciences. The NDS work and the simulator validation should enhance Michigan Tech's position in this growing field allowing the researchers to seek additional funding for rail crossing and other simulator work, potentially make Tech a leader in a multi-university driver behavior network for grade crossings. Publications to date from this effort include:

- Lautala, P., Jeon, M, Landry, S., Nelson, D., Dean, A., *Driver Behavior at Highway-Rail Grade Crossings Using Naturalistic Driving Study Data and Driving Simulators*, American Railway Engineering and Maintenance of Way Association (AREMA) 2016 Annual Conference, Orlando, FL, August 28-31, 2016.

- Nelson, D., Lautala, P., Jeon, M., *Driver Behavior at Level Crossings Using Naturalistic Driving Study Data,* Global Level Crossing Safety and Trespass Symposium (GLXS), Helsinki, Finland, June 12-16, 2016.

- Landry, S., Jeon, M., Lautala, P., Nelson, D., *Design and Evaluation of In-Vehicle Auditory Alerts for Railroad Crossings*, Global Level Crossing Safety and Trespass Symposium (GLXS), Helsinki, Finland, June 12-16, 2016.

- Jeon, M., Landry, S., Lautala P., Nelson, D., *Design and Assessment of In-Vehicle Auditory Alerts for Highway-Rail Grade Crossings*, Transportation Research Part F: Psychology and Behaviour (under review since October, 2016)

To utilize the data and driving simulator results, a proposal was submitted to the Federal Railroad Administration (FRA) which resulted in funding of $271,223 for the "Driver Behavior at Highway-Rail Grade Crossings Using NDS Data and Driving Simulators" project.

As part of these research efforts, RTP/MEEM student Aaron Dean was able to expand on this work with the awarding of a Summer Undergraduate Research Fellowship (SURF) grant for his research on head tracking aspects of this data set. The SURF award was valued at $4,000.

OUTREACH

Financial support of affiliation fees to external organizations is provided by MTTI to members for an additional platform in which to network, encourage future collaborations and to showcase research expertise. MTTI funded membership dues to the American Public Transit Association (APTA), Council for University Transportation Centers (CUTC) and the National Road Research Alliance (NRRA).

APTA members are public organizations that are engaged in the areas of bus, paratransit, light rail, commuter rail, subways, waterborne passenger services, and high-speed rail. As members, MTTI researchers are able to respond to requests for proposals or white papers, attend conferences, join committees and participate in webinars at no cost.

Ralph Hodek represented MTTI at the Council of University Transportation Centers (CUTC) annual summer meeting in Los Angeles, CA. **Pam Hannon** traveled to the Transportation Research Board annual meeting in Washington, DC attending conferences and workshops as well as representing MTTI at the CUTC annual winter meeting. CUTC provides a forum for universities and transportation centers to interact collectively with government and industry.

Hodek also attended the NRRA inaugural meeting in Minneapolis, MN where MTTI is an associate member of the pooled fund organization. **Jake Hiller** is a current active member of the Flexible Pavement Team and **Zhanping You** represents MTTI on the Rigid Pavement Team. The NRRA is a pooled fund consisting of six state DOTS and 15 industry and academic institutions. NRRA members share their expertise and methods to improve and expand upon transportation systems nationally.

An additional outreach activity provided by MTTI to 50 campus researchers was the collection and organization of information for the proposal to and signing of a master contract to the MnDOT Academic Research Program. A key component of MTTI outreach is to provide services to the population who might otherwise not have access to those services.

EDUCATION

MTTI provides support to student summer activities in order to attract K-12 students to transportation related programs.

Joan Chadde (CSEO) coordinated travel for 22 Detroit area students from 13 high schools to MTU to explore natural resources, environmental science and engineering career paths. Students were required to write an essay and provide two letters of recommendation for the opportunity to attend the Transportation Education program. All expenses for the week long camp, including travel, food and housing, were provided by campus entities, of which MTTI participated financially.

The National Summer Transportation Institute (NSTI) is a national program designed to introduce education and career opportunities in transportation in a two week summer course. The program is funded by the Federal Highway Administration (FHWA) with the Transportation and Civil Engineering (TRAC) educational program sponsored by MDOT. Typically 30 high school students participate in the Summer Youth Program. MTTI provides administrative support for NSTI.

The Rail Transportation Program (RTP), an affiliate of MTTI, hosted its seventh annual Rail and Intermodal Transportation Summer Youth Program in which high school students participate in classroom workshops and enjoy field explorations at rail and intermodal settings. The one week program is a collaborative effort with the University of Wisconsin-Superior.

> **"I want to thank you for the rail and intermodal transportation class. I had a great time and learned a lot of new things that I hope to use both at the train museum I volunteer with and in my future career." Will Cosso, 2016 RTP SYP Participant**

Philart Jeon served as an instructor for two MTU Summer Youth Programs (Women in Engineering and Engineering Scholars) using data results from his MTTI funded initiative with the topic of "Distracted Driving and In-Vehicle Technologies", to encourage under-represented students to pursue driving research in their careers. In addition, the Mind Music Machine Lab held demo days using the driving research projects by visiting elementary students from Houghton and Dollar Bay schools plus the Horizons Alternative High School.

INTERCAMPUS SUPPORT

Five proposals were submitted for the University Transportation Centers request for proposal by the USDOT. Required cost share funding in the amount of $25,000 for the length of the project was approved for **Colin Brook's** UTC proposal "Remote Sensing for Asset Management University Transportation Center and $9,000 was guaranteed for **Thomas Oommen's** proposal with the University of Virginia, titled "RASTER: Remote Acquisition and Sensing for Transportation nEtwork Resilience". **Zhanping You** partnered with the University of Rhode Island for the "Center for Recycling Sciences and Technologies for Sustainable Societies". **Pasi Lautala** joined the University of Illinois-Urbana

Champaign for the National University Rail Center (NURail) proposal while **John Velat** submitted the "Tier I University Transportation Center for American Indian and Alaska Native Transportation Safety Issues" proposal with the University of Wyoming. All proposals are pending. In addition to the cost share support, MTTI supported pre-submission proposal development assistance for all five proposals.

A letter of support was written for **Pasi Lautala's** Research Excellence Fund (REF) Research Seed Grant proposal entitled "Driver Behavior at Highway/Rail Grade Crossings".

A support letter was also provided for **Larry Sutter** to the American Concrete Institute (ACI) Foundation's Concrete Research Council (CRC) for the proposal "3D Printing of Real Concrete" with the added stipulation that should funding be awarded by the CRC, MTTI would provide matching funds to the project if cost sharing is required.

On campus funding continued in 2016 with the MTTI sponsorship of the annual SAE Clean Snowmobile Challenge hosted by the Keweenaw Research Center (KRC) in the amount of $500.

In-kind support was provided to the UP Road Builders Association Scholarship for auction of items for fundraising. Proceeds from donations go directly to the student endowment fund. Last year, $12,000 in scholarship funding was awarded to MTU students by the association.

MTTI hosted MDOT Intelligent Transportation Systems (ITS) program manager Matt Smith as an invited guest speaker in fall of 2015. Recently, Smith sent a Request for Partnership letter to Director **Hodek** for a "Connected and Automated Vehicle Testing" project on I75 in Michigan. The letter was forwarded to MTTI members and collaborators which resulted in the KRC submitting a letter of interest to participate in the testing effort. Their expertise in winter road conditions and communication of meaningful data to motorists has resulted in an MDOT partnership with the hope that KRC will be able to learn what road infrastructure sensors will provide in terms of data or feedback and what can be added to our future test course enhancements as a part of this effort.

CONFERENCES AND WORKSHOP TRAVEL

The Michigan Department of Transportation (MDOT) invited ten MTTI researchers to their two day "MDOT Research Summit" held in Lansing, MI for discussions on future MDOT research needs. Invited attendees included: **Tess Ahlborn, Colin Brooks, Qingli Dai, Chris Gilbertson, Ralph Hodek, Pasi Lautala, Zhen Liu, Larry Sutter, Zhanping You and Kuilin Zhang**. The purpose of the summit was to further develop selected research ideas as MDOT priorities for the 2016, 2017 and 2018 research program. MTTI supported MDOT in organization of the Michigan Tech group as well as provided funding for member travel.

MTTI researchers are sought for their experience in transportation research and education both nationally and internationally through participation in local, state, national and international organizations. MTTI provides a $500 travel stipend to faculty or student members for conference, meeting or workshop participation. In 2016, travel funding was provided to the following members.

- As a member of the organizing committee for the First International Interactive Symposium on Ultrahigh Performance Concrete (UHPC) in Des Moines, Iowa, **Tess Ahlborn** (CEE) was in charge of symposium logistics.

- **Qingli Dai** (CEE) attended the Portland Cement Association (PCA) Professor training course in Skokie, IL. In addition, Dai visited the Argonne National Laboratory for discussions on Advanced Photon Source (APS) experiments. She then traveled to Manhatten, KS and presented two papers at the 6th Advances in Cement Based Materials conference of the American Ceramic Society.

- PhD student **Andrew Groeneveld** (CEE) attended the American Concrete Institute Conference in Milwaukee, WI and presented his research in a technical session. The trip provided opportunities for Groeneveld to learn about developments in concrete research and practice as well as expanded networking opportunities.

- **Tim Havens** (ECE) attended the Big Data in Railroad Maintenance Planning Conference at the University of Delaware. In addition, Havens visited with the program manager of the US Army Communications-Electronics Research, Development and Engineering Center and ARiA, LLC for possible collaboration opportunities.

- **Philart Jeon** (CLS) traveled to Austria where he gave an invited lecture at the University of Linz, organized a workshop, attended the Persuasive Tech 2016 Conference and discussed projects and collaborations at the University of Ingolstadt.

- **Yue Li** (CEE) explored international collaborative research opportunities in Design and Construction Sustainable Built Environments with companies in Helsinki, Finland.

- **Zhen Liu** (CEE) traveled to Lansing, MI to meet with principals at the Michigan Department of Transportation (MDOT) for talks on future research collaborations.

- **Thomas Oommen** (GMES) attended the International Conference on Geotechnical and Earthquake Engineering in Christchurch, New Zealand.

- As a member of the American Concrete Institute (ACI) and Secretary of ACI Committee 232 on Fly Ash, **Larry Sutter** (MSE) attended the annual ACI Convention in Denver, CO for meetings and conference presentations.

- PhD graduate **Xu Yang** (CEE) presented a poster at the annual Transportation Research Board meetings in Washington, DC.

- **Zhanping You** (CEE) traveled to Dalian, China for the 9th International Conference on Road and Airfield Pavement Technology, a platform for researchers, engineers, and practitioners from around the world to exchange ideas, research findings, practical solutions, and more with a focus on pavement technological development in developing countries.

- Along with multiple MTTI members, **Kuilin Zhang** (CEE) traveled to the annual Transportation Research Board meeting in Washington, DC for presentations and committee meetings.

INVITED GUEST SPEAKERS

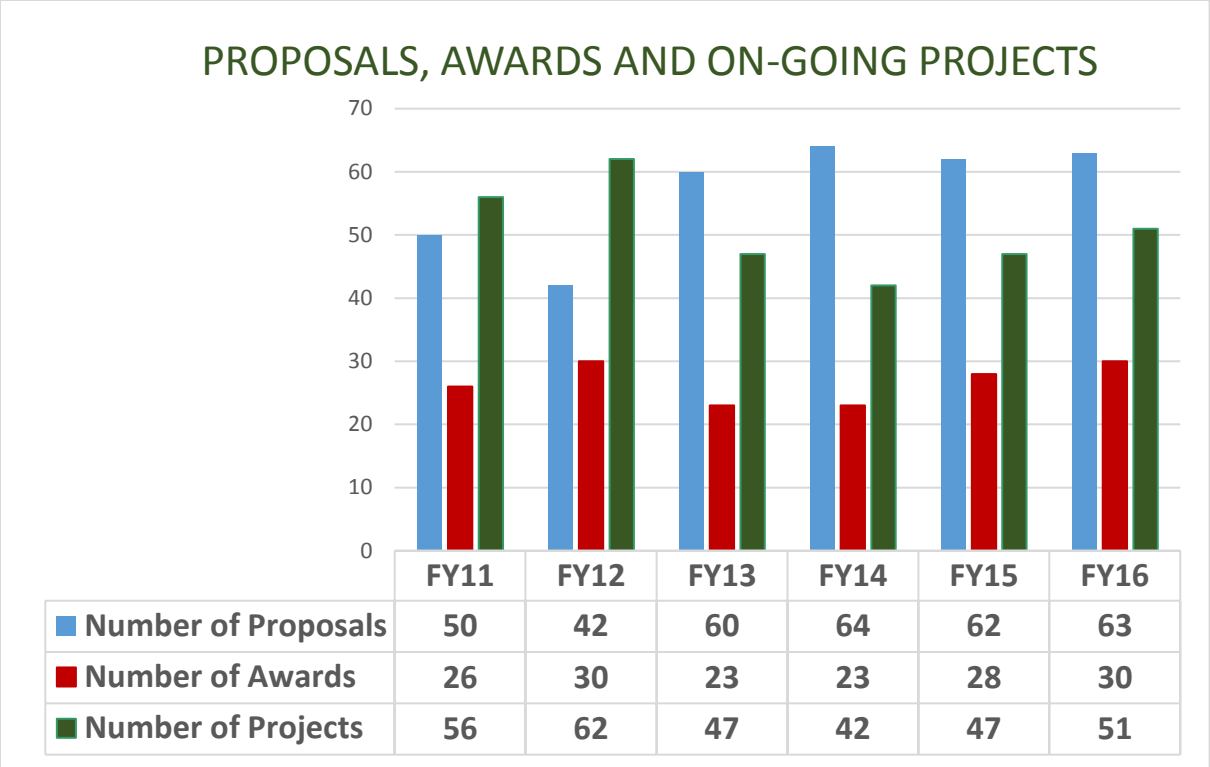
Terry Stepanski, Senior Project Manager at MDOT and a 1985 graduate of MTU in Civil Engineering was invited by MTTI as a campus guest speaker. Stepanski presented an overview of the I-94 corridor reconstruction and expansion, at an estimated cost of $5 billion, to the CEE graduate seminar and to two senior professional practice classes. A social reception open to campus researchers was hosted by MTTI.

ACCOMPLISHMENTS

RESEARCH

In 2016, MTTI researchers submitted proposal requests to multiple funding sponsors totaling **$26,029,791.** **63** proposals were submitted of which **30** were successfully funded. With a proposal approval rate of **48%,** MTTI research funding amounted to **$4,211,330.** MTTI currently has **51** proposals in progress.

Figure 5 provides a review of proposals, awards and on-going projects over the previous five fiscal years. Annual proposal submission values are depicted in Figure 6 with total research funding awarded to MTU through MTTI sponsored projects shown in Figure 7. All charts are for the time period FY12-FY16. A list of proposals submitted through in FY16 is included as Appendix A.



	FY11	FY12	FY13	FY14	FY15	FY16
Number of Proposals	50	42	60	64	62	63
Number of Awards	26	30	23	23	28	30
Number of Projects	56	62	47	42	47	51

Figure 5: PROPOSALS, AWARDS AND ON-GOING PROPOSALS

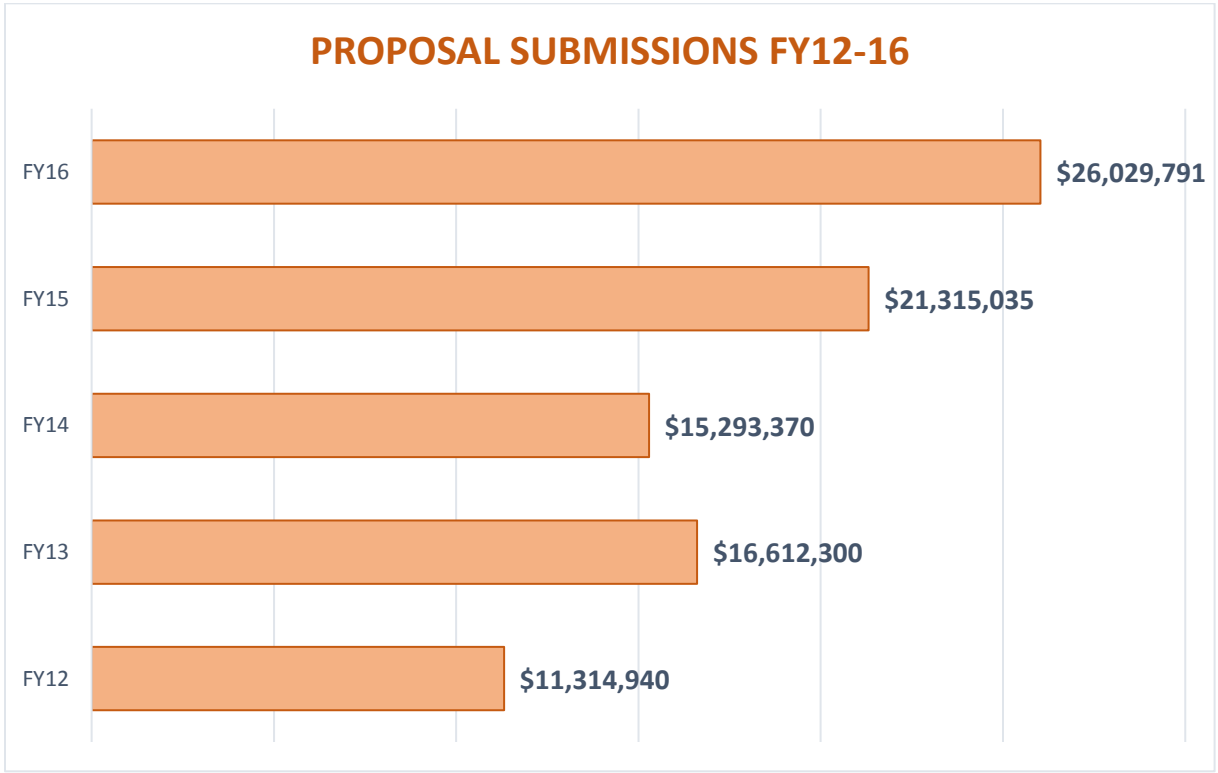


Figure 6: PROPOSAL SUBMISSIONS

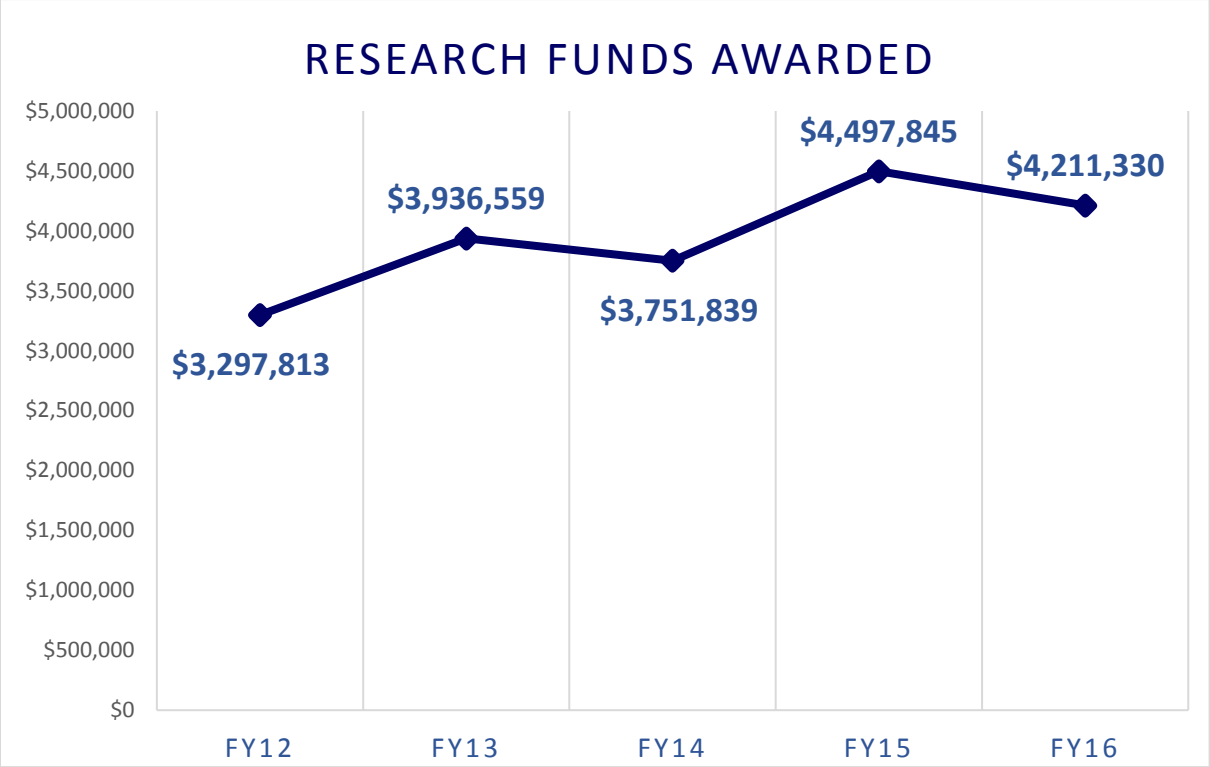


Figure 7: RESEARCH FUNDS AWARDED

INSTITUTE

MTTI membership increased to 70 researchers in multi-disciplinary centers, institutes, programs and departments. MTTI will continue to recognize and support members and to increase awareness of the institute. Current MTTI members are listed below.

CENTERS, INSTITUTES AND PROGRAMS

Center for Science and Environmental Outreach (CSEO)
Joan Chadde, Director

Center for Technology and Training (CTT)
Andi Barajas, Coordinator
Chris Codere, Senior Project Manager
Tim Colling, Director
Chris Gilbertson, Associate Director
John Kiefer, Research Engineer II
Nick Koszykowski, Principal Programmer
Dale Lighthizer, Training Development Specialist
Luke Peterson, Principal Programmer
Gary Schlaff, Senior Project Manager
Peter Torola, Research Engineer II

Great Lakes Research Center (GLRC)
Guy Meadows, Director

Keweenaw Research Center (KRC)
Russ Alger, Director, Snow Institute
Jay Meldrum, Director

Michigan Tech Research Institute (MTRI)
Don Atwood, Senior Research Scientist
Michael Battaglia, Assistant Research Scientist
Colin Brooks, Senior Research Scientist
Laura Bourgeau Chavez, Research Scientist
Rick Dobson, Assistant Research Scientist
Sarah Endres, Assistant Research Scientist
Liza Jenkins, Research Scientist II
Chris Roussi, Senior Research Scientist/Engineer
Reid Sawtell, Research Scientist I

Rail Transportation Program (RTP)
Pasi Lautala, Director RTP/Assistant Professor (CEE)
Dave Nelson, Senior Research Engineer

Sustainable Futures Institute (SFI)
Robert Handler, Operations Manager

Tribal Technical Assistance Program (TTAP)
John Velat, Director
Scott Bershing, Technical Editor

DEPARTMENTS AND SCHOOLS

Biological Sciences (BS)
Nancy Auer, Professor
Rupali Datta, Associate Professor

Chemistry (CHEM)
Shiyue Feng, Professor
Pat Heiden, Professor

Civil and Environmental Engineering (CEE)
Tess Ahlborn, Professor
Brian Barkdoll, Professor
Jennifer Becker, Associate Professor
Bill Bulleit, Professor
Qingli Dai, Assistant Professor
George Dewey, Associate Professor
Dave Hand, Department Chair
Jake Hiller, Associate Professor
Ralph Hodek, Associate Professor
Zhen Liu, Assistant Professor
Kris Mattila, Associate Professor
Amlan Mukherjee, Associate Professor
Eric Seagren, Professor
Bill Sproule, Professor
Andrew Swartz, Assistant Professor
Stan Vitton, Associate Professor
Dave Watkins, Professor
Veronica Webster, Associate Professor
Pengfei Xue, Assistant Professor
Zhanping You, Professor
Kuilin Zhang, Assistant Professor

Cognitive and Learning Sciences (CLS)

Kedmon Hungwe, Associate Professor
Myounghoon Jeon, Assistant Professor
Kelly Steelman, Assistant Professor

Computer Resources
Gowtham Shankara, Director

Computer Science (CS)
Laura Brown, Assistant Professor
Nilufer Onder, Associate Professor

Electrical and Computer Engineering (ECE)
Zhuo Feng, Associate Professor
Tim Havens, Assistant Professor
Chee-Wooi Ten, Assistant Professor

Geological and Mining Engineering and Sciences (GMES)
Snehamoy Chatterjee, Assistant Professor
John Gierke, Department Chair
Thomas Oommen, Associate Professor
Rudiger Escobar Wolf, Post Doctorate

Humanities (HU)
Ann Brady, Professor
Karla Kitalong, Professor
Erin Smith, Principal Lecturer

Materials Science and Engineering (MSE)
Jerry Anzalone, Lab Supervisor/Research Scientist I
Paul Sanders, Associate Professor
Larry Sutter, Professor

Mathematical Sciences (MS)
Min Wang, Assistant Professor

Mechanical Engineering-Engineering Mechanics (ME-EM)
Andrew Barnard, Assistant Professor
Joshua Pearce, Associate Professor
Ye Sun, Assistant Professor

Physics (PHYS)
Claudio Mazzoleni, Associate Professor

School of Business and Economic (SBES)
Jon Leinonen, Mentor in Residence
Paul Nelson, Associate Professor

School of Forest Resources & Environmental Sciences (SFRES)
Evan Kane, Assistant Professor

Social Sciences (SS)
Melissa Baird, Assistant Professor
Don Lafreniere, Assistant Professor
Carol MacLennan, Professor
Tim Scarlett, Associate Professor
Chelsea Schelly, Assistant Professor
Richelle Winkler, Assistant Professor
LouAnn Wurst, Professor

Van Pelt & Opie Library (LIB)
Sarah Lucchesi, Instructional & Learning Librarian

Visual and Performing Arts (VPA)
Patricia Helsel, Associate Professor

SPACE AND FACILITIES REQUIREMENTS

MTTI space and facilities currently consist of three offices for research development, a multi-media conference center equipped with technological communication

equipment which is also highly utilized by CTT, and a computing laboratory/library available for student activities.

Numerous facilities are available to MTTI members in each of the partnered departments, centers and institutes consisting of; Aquatic Ecology Laboratory, Asphalt Binder Rheology Research and Testing Facilities, Benedict Laboratory, Center for Data Sciences, Center for Interconnected MicroGrids, Center for Structural Durability, Computational Science and Engineering Research Institute, Environmental Bioremediation Laboratory, Environmental Optics Laboratory, Geospatial Core Facility and Historical Spatial Data Infrastructure, Graduate Soil Mechanics Laboratory, High-Performance Computing Laboratory for Sustainable and Intelligent Transportation Systems, Human-centered Monitoring Laboratory, Hydrodynamics Laboratory, Industrial Archeology Research Laboratory, Institute of Computing and Cybersystems, Institute of Snow Research, Lab for Innovation Characterization of Porous Materials, Laboratory for Adaptive Smart Structural Technology, Marine Engineering Lab, Michigan Tech Dynamic Systems Lab, MindMusicMachine Laboratory, MTU Curation Facility, Pattern Recognition and Intelligent Machines Engineering Laboratory, Renewable Energy Lab, Spatial Analysis Laboratory and Transportation Research Materials Center.

No additional facilities, offices or laboratories are required by MTTI at this time. Future needs will be dictated by growth of the institute.

FUTURE PLANS AND GOALS

In FY17 a newly elected Director will take over leadership of MTTI from **Ralph Hodek**, who served four years as MTTI Director. **Hodek** will retire from the university in spring of 2018 and will not include his name on the ballot for reelection.

Future activities for discussion by the Director and Executive Committee in FY17 include:

- Increase participation between institute and members providing more frequent updates on MTTI plans and strategies to make MTTI more transparent and welcoming.
- Implement a student summer research program similar to SURF.
- Continue development of a speaker series to increase number of invited guest speakers to campus.
- Increase funding for minor initiatives to encourage proposal development and return on investment to the institute.
- Make MTTI more visible across campus.
- Revamp and update MTTI website and produce marketing materials for better branding.

SUMMARY

MTTI continues to provide support to members through collaborative leadership of the director and executive committee. Under the directorship of **Ralph Hodek** over the past four years, MTTI has shown improvement in cross disciplinary membership growth, initiative funding, capital spending, outreach opportunities, invited guest speakers and large proposal support. The Executive Committee, membership and MTTI staff would like say **THANK YOU** to **Ralph** for his leadership and support of the institute.

With a newly elected director and three executive committee members, MTTI plans to strengthen and expand the institute, "partnering for the future of transportation" and successfully fulfilling MTTI's vision statement.

APPENDIX A: MTTI PROPOSAL SUBMISSIONS FY 2016

Principal Investigator	Co-Principal Investigators	Sponsor	Proposal Title	Project Value	Status
Joan Chadde		University of Wisconsin - Madison	CFIRE University Transportation Center	$41,178	Additional Funding
Qingli Dai		National Science Foundation	CAREER: Multiscale Mechanical & Thermal Properties of Nanomodified Self-Healing Asphalt Materials	$672,632	Declined
Tim Colling	John Kiefer	MI DOT	2016 Transportation Asset Management Council Technical Assistance Activities	$99,980	Awarded
Pasi Lautala	Myounghoon Jeon Dave Nelson	US DOT	Research Utilizing the SHRP2 Safety Data to Support Highway Safety	$124,806	Declined
Tim Colling	John Kiefer Chris Giblertson	MI DOT	2016 Transportation Asset Management Council Education Program	$176,138	Awarded
Chris Gilbertson	Andi Barajas	MI DOT	Update & Modernization of the TRAC Program	$81,614	Awarded
Chris Gilbertson	Andi Barajas	MI DOT	Improvements to the TRAC Pilot Project	$2,497	Awarded
John Velat	Dave Nelson Scott Bershing	MI DOT	Research Program Services	$696,496	Declined
John Velat		US DOT	18th Annual National Tribal Transportation Conference	$24,994	Awarded
Scott Bershing		Lac Courte Oreilles Band of Lake Superior Chippewa	2015 WisDOT Inter-Tribal Task Force (ITTF) Tribal Survey	$6,513	Awarded
Qingli Dai		National Science Foundation	Collaborative Research: Optimal Internal Curing in Concrete Using Engineered Cenospheres	$165,806	Declined

Principal Investigator	Co-Principal Investigators	Sponsor	Proposal Title	Project Value	Status
Zhen Liu		National Science Foundation	Exploratory Investigation into Multiscale-Driven Multiphysics for Thermally Induced Water Flux	$82,609	Awarded
Zhen Liu	Jay Meldrum Pengfei Xue Stan Vitton	National Science Foundation	Scientific Understanding of Mine Water as a Geothermal Resource	$449,743	Declined
Thomas Oommen		National Science Foundation	Advancing Landslide Life-Cycle Monitoring and Prediction Using Satellite Remote Sensing	$390,167	Declined
John Velat	Amanda Kerttu	MN DOT	2015 Minnesota Tribes and Transportation Conference	$18,000	Awarded
Tim Colling	Gary Schlaff Luke Peterson Nick Koszykowski	MI DOT	2016 RoadSoft Asset Management System Development & Support	$759,392	Awarded
Tim Colling	Nick Koszykowski	MI DOT	2016 MERL Development & Support	$116,453	Awarded
Zhen Liu		American Chemical Society	Scientific Understanding of Phase Interaction Multiphase Porous Materials Using Particle Hydrodynamics	$146,451	Pending
Larry Sutter	Zhanping You	MI DOT	Transportation Materials Research Center	$54,494	Awarded
Pasi Lautala		University of Illinois Urbana - Champaign	NURail Tier I	$58,200	Additional Funding
Pasi Lautala		Prime Focus LLC	Asset Management Strategies for Maintenance and Preservation of New City Interpassenger Car Fleet	$42,000	Declined
Kuilin Zhang	Yue Li	University of Chicago	Coordinated Transit Response Planning and Operations Support Tools for Mitigating Impacts of All Hazard Emergency Trends	$180,009	Declined
Zhanping You	Jack Chen Hui Yao	University of Michigan	How Will Pavement Materials Perform on Mars?	$15,500	Declined

Principal Investigator	Co-Principal Investigators	Sponsor	Proposal Title	Project Value	Status
Tess Ahlborn	Amlan Mukherjee Colin Brooks Reid Sawtell	MI DOT	Development of 3D & 4D Bridge Model Plans	$414,785	Declined
Chris Gilbertson	Bill Bulleit Nick Koszykowski	MI DOT	Developing Representative Michigan Truck Configurations for Bridge Load Rating	$313,751	Declined
Chris Gilbertson	Peter Torola	MI DOT	Evaluation of Costs/Benefits of Standardization of Secondary Route Bridges	$880,972	Declined
Kuilin Zhang		MI DOT	An Evaluation of Michigan's CCC Distribution	$85,888	Declined
Colin Brooks	Tess Ahlborn Tim Havens Amlan Mukherjee Thomas Oommen Kuilin Zhang	MI DOT	Implementation of UAVS for Assessment of Traffic Infrastructure	$598,526	Awarded
Larry Sutter	Gerald Anzalone Joshua Pearce	American Concrete Institute	3D Printing of Concrete	$77,403	Pending
Amlan Mukherjee	Kelly Steelman Veronica Webster Patricia Helsel Nilufer Onder	National Science Foundation	NRT NESE: An Entreprenurial Model to Deliver a Graduate Program in Data Enabled Infrastructure Systems Engineering	$3,000,000	Declined
Tim Colling	Chris Codere	MI DOT	Traffic Engineering Safety for Local/Appointed Officials	$16,294	Awarded
Gary Schlaff		Hawaii County DPW	Hawaii County Road Soft Training	$1,084	Awarded
Qingli Dai	Zhanping You	MI Dept of Environmental Quality	Development and Field Application of Fiber Reinforced Concrete with Increased Rubber Particle Content and Fibers Recovered from Waste Tires	$765,036	Awarded
Xiaoge Tian	Zhanping You Qingli Dai David Porter Xu Yang	MI Dept of Environmental Quality	Tire Rubber Modified Asphalt Emulsion for Pavement Preservation	$1,193,624	Declined

Principal Investigator	Co-Principal Investigators	Sponsor	Proposal Title	Project Value	Status
Zhanping You		MI Department of Environmental Quality	Foamed Rubber Asphalt Overlay Construction with Recycled Subbase	$1,264,008	Declined
Myounghoon Jeon		EQUOS Research	Sonic Information Design for Intuitive In-vehicle Interactions Phase II	$33,964	Awarded
Tim Colling	Gary Schlaff Chris Gilbertson		Bridge Design System Analysis and Modernization	$799,534	Awarded
Qingli Dai		National Science Foundation	Bio-inspired Self-Healing and Nano Reinforced Thermoplastic Materials for Improved Service Life	$291,872	Declined
Zhanping You	Patricia Heiden	National Science Foundation	SusChem: Discovering a Chemical Fool Set to Advance the Aggregate Polymer Asphalt Systems Assisted by Molecular Dynamics	$397,021	Declined
Zhen Liu		National Science Foundation	Exploratory Investigation into Multi-Scale Multiphysics for Thermally Induced Water Flux	$96,751	Awarded
Thomas Oommen	StanVitton Colin Brooks Rudiger Wolf	The National Academies	Development of an Implementation Manual for Geotechnical Asset Management for Transportation Agencies	$500,000	Pending
Kuilin Zhang		National Science Foundation	Collaborative Research: EAGER: Distributed Real Time Powertrain Control of Hybrid Electric Vehicles for Energy Efficient Dynamic Transit Systems	$61,126	Declined
Kuilin Zhang		National Science Foundation	CRISP Type 2: Collaborative Research: A Cyber Enabled Coordinated Disruption Response Framework for Enhancing the Resilience of Independent Infrastructure Systems	$400,000	Declined
Zhen Liu		American Chemical Society	Scientific Understanding of Phase Interaction Multiphase	$145,247	Pending

Principal Investigator	Co-Principal Investigators	Sponsor	Proposal Title	Project Value	Status
			Porous Materials Using Particle Hydrodynamics		
Thomas Oommen	Colin Brooks	University of Alaska - Fairbanks	Photogrammetric Methods for Pipe Terrain Stability Monitoring	$75,000	Pending
Amlan Mukherjee		University of Washington	Sustainable Highway Construction Practices	$82,000	Pending
Tim Colling	John Velat Jon Leinonen Eric Seagren Jennifer Becker Tom Merz Dave Hand Ralph Hodek Paul Nelson Robert Handler	Environmental Protection Agency	EPA Environmental Finance Center for Great Lakes Region	$4,727,879	Awarded
Qinli Dai	Larry Sutter	The National Academies	Developing UltraSonic Scattering Techniques for Air Void Measurement of Early Age Hardened Concrete	$150,000	Pending
Jake Hiller	Zhanping You Min Wang	MI DOT	Updated Analysis of MI Traffic Inputs for Pavement ME Design	$182,206	Declined
Thomas Oommen	Colin Brooks Stan Vitton Rudiger Wolf	MI DOT	Asset Management of Retaining Walls	$699,688	Declined
Qingli Dai		National Science Foundation	Collaborative Research: Nexus of Simulation Sensing & Actuation for Aerodynamic Vibration Reduction of Wind Turbine Blades	$10,000	Pending
Zhanping You		National Science Foundation	SusChEM/Collaborative Research: Fundamental Understanding of Foaming Process towards a New Warm Mix Asphalt	$10,000	Awarded
Zhanping You	Qingli Dai Xu Tan	University of Rhode Island	UTC: Center for Recycling Sciences and Technologies for Sustainable Societies	$300,000	Declined

Principal Investigator	Co-Principal Investigators	Sponsor	Proposal Title	Project Value	Status
Myounghoon Jeon		MN DOT	Development and Evaluation of Auditory Displays for Older Drivers' ITS Navigation	$100,000	Declined
Pasi Lautala		University of Illinois Urbana Champaign	NURail Tier 1 2016	$210,000	Declined
Thomas Oommen	Stan Vitton John Gierke Reid Sawtell	University of Virginia	RASTER: Remote Acquisition and Sensing for Transportation nEtwork Resilience	$450,000	Declined
John Velat	Pasi Lautala Karla Kitalong	University of Wyoming	Tier I UTC for American Indian and Alaska Native Transportation Safety Issues	$450,000	Declined
Colin Brooks	Tess Ahlborn Andrew Swartz Amlan Mukherjee Larry Sutter Tim Colling Thomas Oommen Pasi Lautala	US DOT	Remote Sensing for Asset Management University Transportation Center	$2,250,000	Declined
Amlan Mukherjee		Engineering & Software Consultants	A Workshop to Address Data Needs to Address Sustainable Decision Making for Pavements	$150,000	Awarded
Kuilin Zhang	Myounghoon Jeon	National Science Foundation	An Integrated Behavior Based Model of Information and Vehicular Traffic in a Connected Driving Environment	$300,000	Declined
Ralph Hodek	Various Multi-disciplinary	MN DOT	Research Services Academic Research Program	Unlimited	Awarded

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