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Rail Transportation Program Annual Report

Michigan Tech Transportation Institute

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2013

## **Rail Transportation Program Annual Report July 2012-June 2013**

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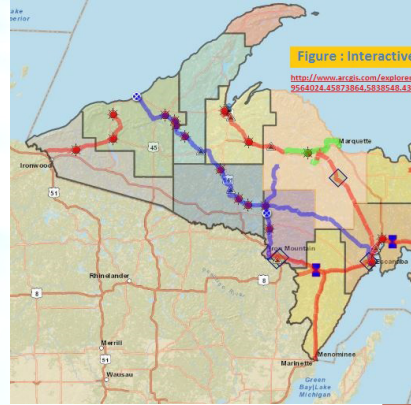
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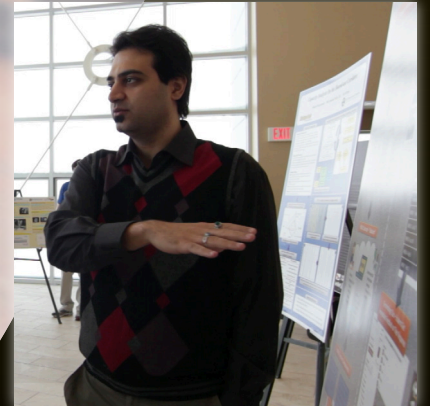
# Rail Transportation Program

Michigan Tech Transportation Institute • Michigan Technological University



# Annual Report

July 2012-June 2013





# DIRECTOR'S MESSAGE



It's my pleasure to once again report on another special year of growth for the Rail Transportation Program (RTP) at Michigan Technological University (Michigan Tech). During its sixth year of operation, the RTP has been able to add Dave Nelson as its second full time employee, secure a \$500,000 endowment from CN Railway, and get to full speed as one of the consortium members for the National University Rail Transportation Center (NURail). You can probably figure out from this opening paragraph that last year has been far from boring.

RTP has always taken a multi-disciplinary view to our program development and we saw some big breakthroughs in 2012-2013. We expanded our NURail team to cover five faculty members, all from different departments, our Department of Mechanical Engineering – Engineering Mechanics (MEEM) secured its first externally funded rail research project, our School of Business and Economics (SBE) developed a course in Transportation Supply Chain and Logistics, and we completed senior design projects that included students from Electrical Engineering, Mechanical Engineering, Materials Science and Engineering, Civil Engineering, Construction Management, and Humanities departments. It is encouraging to see how far we've come, but we also have a long way to go before we reach our goal of becoming a multi-disciplinary asset for the North American rail industry.

RTP is about people, so we continue to highlight our students and graduates in the report. There is nothing more rewarding than a new Michigan Tech intern or graduate in the rail industry, or a promotion announcement of one of our earlier graduates. Michigan Tech's growing presence is easily noted at rail conferences and at Michigan Tech Career Fairs with more and more of our alumni returning for recruitment. Later this fall, we will be rolling out one of our latest student projects, an RTP promotional video produced by the Cinoptic Enterprise team that features alumni on campus, and also industry leaders.

We recognize that rail transportation is more than a modest program. Based on the current direction, we shouldn't need to worry about running out of opportunities in North America. From the passenger sector, Amtrak continues to break annual ridership records, while freight rail has seen a robust recovery from economic downturn with an additional boost in the form of crude oil transportation. Improving industry demand and health means better resources for research and development and due to all the exceptional work by Michigan Tech and our academic colleagues, the rail industry is starting to recognize the role academia can play in this development. At the same time, the pace of university graduate hiring is escalating to address the growing transportation volumes and increases in retirements of current industry employees. With these trends, it is easy for our faculty, staff and students to continue our work and feel comfortable that Michigan Tech has an important role in the overall rail transportation puzzle.

Enjoy the report and all other materials that you can find from the Michigan Tech's Rail Transportation Program's web site at [www.rail.mtu.edu](http://www.rail.mtu.edu).

*Pasi, Director of the RTP*



Rail Transportation Program at Michigan

## **Rail Transportation Program Vision**

To expand its service to the rail industry by offering an interdisciplinary program in rail transportation engineering and urban rail transit that will provide opportunities for our students and faculty to participate in the development and operation of rail transportation for the 21st Century.

# RAIL INDUSTRY PARTNERS AND RECRUITMENT

Support comes in the form of operational funds as well as in substantial scholarship awards through donation by our long-time partners: CN and Union Pacific. We also thank Norfolk Southern for becoming a substantial and generous contributor to the program. We've been delighted to see the growing presence of our partners on campus. In 2013 Union Pacific expanded involvement by sponsoring a student project. The Strategic Internship in Rail Program (SIR) that was introduced in 2012 to offer continuous and consistent internship opportunities for RTP students has also been a success.

**Thank you for your generous support in 2012-2013!**

## CN \$500,000 Endowment

RTP thanks our program partner, CN, for a \$500,000 donation, establishing the CN Endowed Fellowship in Rail Transportation. This generous gift supports the goals and growth of the Rail Transportation Program (RTP) at Michigan Tech. Building on the CN Rail Transportation Education Center (CN RTEC) that opened in 2010, the endowment contributes to rail transportation-related projects and research, as well as hardware and software resources for students, and provide student scholarships.

CN is a leader in recognizing the importance of academia in the development of current rail systems, as well as recognizing the leadership that comes from Michigan Tech students in industry.

Director of the RTP, Dr. Pasi Lautala, highlights the importance of this substantial endowment. "Our staff and students have worked hard over the past years to develop and improve our program, but all the work would have limited meaning without CN's leadership and support. The program has witnessed tremendous growth since we received our initial support from CN, and this endowment will allow us to take the RTP to the next level. I feel grateful that CN sees the value of our efforts and is willing to guide us as we continue our path to develop one of the premier rail programs in North America."

### RTP Program Partner



### RTP Friends



CN presents Endowment to the RTP



# RTP FACULTY AND STAFF



Dr. Pasi Lautala

## **Dr. Pasi Lautala, P.E.**

While still a Ph.D. student in Civil and Environmental Engineering, Pasi Lautala and then advisor Bill Sproule, started the Rail Transportation Program at Michigan Tech with the Summer in Finland International Engineering course. Now director of the Rail Transportation Program and an Assistant Professor in the Civil and Environmental Engineering Department, Dr. Lautala is an actively involved leader in re-establishing rail transportation education in North American universities. He has created and teaches several courses in railroad engineering and is currently the principal investigator for several funded research projects related to railroads, multimodal transportation and railway engineering education. He has several years of railroad and railroad consulting experience in planning, design, and operations in the United States and Finland, and is a member of various professional associations including AREMA, ASCE, ASEE and TRB.



Bill Leder

## **Bill Leder, P.E.**

Bill Leder is the Roland A. Mariucci Distinguished Practitioner in Practice and Adjunct Professor of the Civil and Environmental Engineering Department at Michigan Tech. His interests include public transportation planning, engineering, airport planning and design, railroad engineering, design build contracting for large transportation projects, and project management. Professor Leder teaches courses in Public Transit Planning and Engineering and Introduction to Consulting Engineering. In addition, he applies his expertise from 34 years of service in the public sector to leading Senior Design Projects on campus.



Dr. Bill Sproule

## **Dr. Bill Sproule, P.E.**

Bill Sproule is a Professor in the Department of Civil and Environmental Engineering with over 35 years of service in government, consulting, and university research and teaching in Canada and the U.S. He assisted in the development of the current Rail Transportation Program at Michigan Tech and teaches various transportation courses. He has also recently authored a book, *Copper Country Street Cars*. Dr. Sproule's interests include transportation planning, traffic engineering, airport planning and design, public transit, automated people movers, and consulting engineering. Canadian born and a true ice hockey fan, Bill also teaches a class titled "Hockey History and Culture". Dr. Sproule has been recognized with several awards including a Michigan Tech Distinguished Teaching Award and the ASCE Horonjeff Award.



Pam Hannon

## **Pam Hannon**

Pam Hannon is the Coordinator of the Michigan Tech Transportation Institute and supports the Rail Transportation Program through project management, program development, and educational events coordination.

# RTP WELCOMES NEW FACULTY AND STAFF

## **Dave Nelson, P.E.**

David Nelson was welcomed into the RTP this summer as a Senior Research Engineer. He will support activities across the program. Dave brings a BS in Civil Engineering and an MS in Mechanical Engineering which will help as we continue to push for multidisciplinary collaboration across the university. He also has an MS in teaching, including seven years of experience in primary and secondary schools which assists RTP's development of materials geared towards energizing students at the K-12 level. Dave's 20+ years of engineering and management experience with the US Air Force, including an AF tour teaching at the US Air Force Academy, and Maine Department of Transportation bring a unique set of skills and experiences to our program.



Dave Nelson

## **Jeffrey Lidicker**

Jeffrey Lidicker is an Assistant Professor in Transportation Engineering at Michigan Tech in the Civil and Environmental Engineering Department. He has conducted research for several years at the Transportation Sustainability Research Center at UC Berkeley and was the founding Director of Statistical Consulting Services at the Center for Statistical and Information Science at Temple University. His areas of expertise and research are in Sustainable Transportation generally and specifically in Intelligent Transportation Systems, Asset Management, Rail Transit, Alternative Fuels in Freight Rail, Alternative Drive Trains for Automobile and Trucks, Economic Evaluation of Systems, Life-cycle Assessment, Transportation Mode Choice Models, Air Quality, Transportation Energy and Emissions, and Transportation Ecology.



Dr. Jeffrey Lidicker

## **Jess Juntunen**

Jess Juntunen is working as a technical communicator and as support staff with the Rail Transportation Program. Jess has an MS in Rhetoric and Technical Communication from Michigan Tech. She is heading the development of RTP materials such as the annual report, newsletter, and promotional materials. She is also developing web content, editing reports and papers, assisting organization of RTP events, and offering support for the RTP Director, coordinator, and overall RTP program.



Jess Juntunen



# ALUMNI HIGHLIGHTS



**Amanda DeCesare**  
Project Manager  
CSX Transportation

## **Amanda DeCesare**

### **Project Manager- Public Projects, CSX Transportation**

Being a Yooper, where railroads are scarce, I had no knowledge of the rail industry at all when I graduated from Michigan Tech in 2007 (BS in Construction Management, AAS in Civil Engineering Technology). I began working for CSX Transportation in July of 2007 in the Design and Construction department as a Management Trainee. During the Management Trainee program, I spent time at CSX's training facility in Atlanta, GA. I learned to drive a spike, string-line a curve, change a knuckle, throw a switch, and, most importantly, how to live the safety culture that surrounds CSX and the railroad industry. In between sessions at the REDI center, I traveled around the 23 states that CSX operates in learning as much railroading as I could with experienced managers in different departments. (My travel record was visiting 10 states in 9 days!) I was also able to manage some smaller construction projects, learning about my future role in Design and Construction.

From 2008 to 2012, I lived in Richmond, VA working as a Construction Engineer for CSX. In 2012, I took on my current role as Project Manager of Public Projects. My territory covers 5 states, including the best state in the country, Michigan! I work with the state DOTs and other local agencies to develop plans and construction agreements for various public agency projects that impact CSX, and I get to work with a wide variety of different people with a many types of projects every day.

I encourage anyone looking for "something different" to look into a railroad career. It is a thriving industry, and many opportunities exist in all different career paths all around the country.

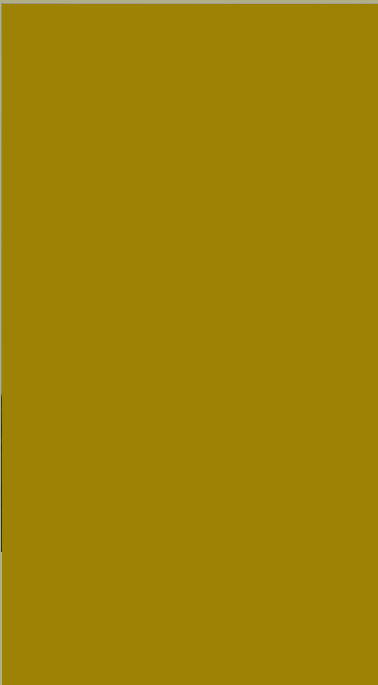
## **Amanda Hongisto, CSX Transportation**

### **Design Engineer- Design and Construction Department, CSX Transportation**

I graduated with an associate's degree in Civil Engineering Technology in 2005 and a bachelor's degree in Construction Management in 2007. I'm currently a Design Engineer in the Design and Construction department with CSX Transportation in Jacksonville, FL, but I started my railroad career with a CSX engineering internship the summer of 2006. I was hired as a full time manager in the Design and Construction department July of 2007.

CSX attends both job fairs that are held at Michigan Tech. It was during one of the job fairs that I was recruited. The internship with CSX provided insight into the railroad industry and peaked interest in developing my knowledge in the field. As an intern I was able to create my own development action plan that allowed me to learn areas that I wanted to understand. I went with Roadmaster's learning about track inspection, to Bridge Managers changing timbers for maintenance to riding the head end of locomotives with Engineers, while working at times in the office analyzing data from the local Division Engineer. I was allowed to experience multiple aspects of the industry. When I completed the internship I knew I wanted to pursue a career in the rail industry. While attending MTU I got involved in the rail industry by participating in the Summer in Finland (SIF) program. The program was offered once a year over a summer semester. The program was truly unique allowing me to see the difference between railroads in the United States and Finland. I learned about the past history, future, and standards. This provided me with a head start over my peers. After consideration and conversations with other Class 1 railroads I returned from Finland to start my CSX internship.

The railroad industry is fast paced, evolving, and provides advancement and opportunities for development. I have had the opportunity to hold positions that involved constructing track projects, developing project scopes with project sponsors, and designing projects. I went to MTU for construction management. Working for a class 1 railroad has allowed me to use my education to manage outside resources. Today I manage consultants daily to develop designs to our standards for capacity restricted areas. I see the industry continuing to make strides using modern techniques. I look forward to the future changes the industry will bring and how it is bridged with other entities.



# RECENT GRADUATE HIGHLIGHTS

## Matt Debar, CN

Matt is a 2012 graduate with a BS in Electrical Engineering Technology. He has worked full time for CN Railway since June 2012 as a Supervisor of Quality Assurance for the Signals and Communications Department.

“In the summer of 2011 I was on an internship with CN in the Quality Assurance for the Signals and Communications Department. Before speaking with CN at the Career Fair, I had never really thought about working for a railroad, but after my internship I realized it was for me.

My daily tasks range from testing software for signal locations called control points to overseeing the installation of new signal systems. My project management skills are greatly utilized in every field at the railroad since there are multiple projects going on at the same time. The summer of 2012 brought Hurricane Isaac and presented me with a chance to see firsthand how much work goes into dealing with a natural disaster. I have also worked in all temperatures and climates including the freezing cold with temperatures well below zero, which is something my time at Michigan Tech prepared me for.

In everything that is done on the railroad there is a strong sense of urgency and teamwork among everyone involved on a project. The days are never dull because each project presents a unique set of challenges.”



Matt Debar, CN

## Ed Hausen, Railworks Track Systems, Inc.

Ed Hausen is a 2012 graduate with a BS in Construction Management. He has worked as an Assistant Operations Manager with RailWorks Track Systems, Inc. since August of 2012.

“My interest for the railroad industry began as a child; I grew up in Chicago, IL, one of the nation’s largest hub stations. I grew up near a rail yard and just always loved to see the trains come and go. Then while attending Michigan Tech the Rail Transportation Program and the REAC opened my eyes on what the railroad industry has to offer for jobs. I then attended the Career Fair at Michigan Tech searching for opportunities in the railroad industry that were looking for Construction Management interns.

I began my journey in the railroad industry with RailWorks Track Systems, Inc. as an intern in May of 2012. As an intern I worked on quantity take-offs and I also went and looked at jobs that were out to bid. Also while an intern I helped with the transition of their payroll system. After three months of an internship I was offered a full time position as Assistant Operations Manager. My job title includes many day to day tasks including bidding and running jobs, and many accounting processes.”



Ed Hausen, Railworks Track Systems, Inc.

## Troy Sabo, Patrick Engineering

Troy graduated in December 2012 with a BS in Civil Engineering and has since been working as a staff engineer for Patrick Engineering.

“Growing up, some of my fondest memories were traveling to Pennsylvania to see the famous Horseshoe curve. Like a lot of kids, I wasn’t really aware of all the possibilities in the rail industry. That is until I came to Michigan Tech. I joined REAC and attended various events as well as AREMA conferences. The summer before my final semester, I had an internship with Norfolk Southern in Toledo in the Maintenance of Way Group. It was an amazing experience to see what takes place behind the scenes to make sure that the trains are always running.

At Patrick, I have been involved in multiple projects varying in size and scope. I have helped with the design of some large intermodal facilities, smaller industrial spur tracks and have recently started work on my own project for an industrial park and loop track in Wyoming. It has been a great experience thus far and I’m excited to continue learning.”



Troy Sabo, Patrick Engineering





# STUDENT INTERN/CO-OP HIGHLIGHTS



Chris Blessing, 2013 Railworks Intern

## **Chris Blessing (4<sup>th</sup> year, Civil Engineering) Railworks- Member of Strategic Internship in Rail Program\***

“This was my second summer working for Railworks, a railroad construction and maintenance company. I was an intern out of North Jackson, OH, about 20 minutes north of Youngstown, OH. Our office was responsible for most of the work on the upper east coast as well as the states of Ohio, Pennsylvania, Michigan, Kentucky, New York and West Virginia. Railworks serves all Class I railroads in the region, short-line railroads, and various manufacturing facilities and transit authorities. A typical day at work for me would consist of setting up some initial estimates for material costs; contacting steel, ballast, and tie suppliers; assembling bid packages, and running small errands for my bosses. Also, I worked for about two weeks (mostly in June) as a general laborer on a bridge near Pittsburgh, PA; a coal yard in Brownsville, PA; and a chemical plant in Louisville, KY.

I am very fortunate to have worked here. Not only did I learn the basics of railroad construction, but I also gained a lot of insight into project management and the contracting business. Not to mention, I formed many strong relationships and have met many people from all sorts of backgrounds. I really enjoyed working in the field with the labor crews and spending time with them after a 12 hour shift. The railroad can be a rough business, and I came out with a deep respect for each and every one of the employees at our office and the workers in the field. These are the people keeping our country running on a day-to-day basis and I would never have appreciated that fact had I not worked here. It only strengthened my plan to seek future employment in the railroad industry.



Antonio Passariello, 2013 Loram Intern

## **Antonio Passariello (3<sup>rd</sup> year, Electrical Engineering Technology) Loram Maintenance of Way**

“This past summer, I had the opportunity to work for Loram Maintenance of Way for the second time as general laborer on a high-performance ballast cleaner. Each crewmember has a specific role in the operation of a ballast-regulating machine. My particular role was the Senior B-Cab Operator. I was responsible for making sure B-cab operators were controlling the regulating boxes efficiently during operating hours. Another responsibility was training new crewmembers on how to regulate ballast and perform basic maintenance on B-Cab.

My time with Loram was very beneficial to me, as I had learned a lot about railroad regulations, safety, and key procedural operations. I have also picked up various mechanical skills from working with a crew on a ballast-regulating machine. This acquired leadership role and new skills have prepared me as I continue my vocation in the railroad industry.”



Sean Pengelly, 2013 Railmark Holdings Inc Intern

## **Sean Pengelly (1<sup>st</sup> year, Civil Engineering) Railmark Holdings Inc**

“I began working for Railmark Holdings Inc. of Wixom, Michigan in the summer of 2012. Railmark is an international railroad holding company providing unique, cost-effective services to the railroad industry, rail transportation users, rail shippers, governments, port facilities and the general public, that reflects “A NEW TRAIN OF THOUGHT ...®”.

As a summer intern at Railmark, my work covered nearly every aspect of the railroad industry. I operated out of Railmark’s many different core business units during the summer. Tasks included railroad operations (short line and industrial switching), track construction and maintenance, railroad logistics (rail-to-truck and truck-to-rail transloading) and railcar repair. I specialized mainly in the marketing and management of transloading facilities in southeast and southern Michigan, as well as development of new transloading facilities in other regions of state.”

**\*Visit our website to learn more about our Strategic Internships in Railroads partner program at [http://www.rail.mtu.edu/strategic\\_internships.htm](http://www.rail.mtu.edu/strategic_internships.htm)**

# STUDENT ACTIVITIES AND SCHOLARSHIPS

## Railroad Engineering and Activities Club (REAC) Update



REAC Spring Trip

REAC began in 2005 and became the first student chapter of the American Railway Engineering and Maintenance-of-Way Association (AREMA). The organization began with the goal of giving the community and students of Michigan Technological University an opportunity to explore the many opportunities within the rail industry. Since REAC's introduction, the multi-disciplinary organization has steadily grown and is looking to have record membership this coming year.

With the success of REAC, many opportunities are now available for everyone involved. The organization is highly active and hosts monthly meetings, trips, social gatherings, community outreach opportunities, and special events throughout the year. This past year, meeting presentations included Class I railroads, department of transportation representatives, industry representatives, and the president of the new Mineral Range Railroad located near Marquette, Michigan. Last spring, REAC members had the opportunity to

tour the E&LS car shop and the CN ore dock in Escanaba, Michigan. The highlight event of the spring was again the Railroad Night, an event where a board of industry representatives is present to share their experiences and network with participants. Despite a record blizzard, the event was a major success!

As REAC looks forward to a new year, we hope to continue providing the great opportunities that have made the organization such a success. The schedule is already full and, with the theme "Michigan Rail Year", REAC is hoping to share the many exciting projects currently going on in the state. A popular upcoming event is a trip to the annual AREMA conference, hosted this year in Indianapolis, Indiana. In addition, there will be monthly meeting and a fall trip capitalizing on the Michigan rail theme. As REAC reflects on all it has come to be over the last seven years, it looks forward to continuing to provide unique opportunities for another great year. *Nicholas Lanoue, REAC President*

## Rail Transportation Program Congratulates its Scholarship Winners

Each year the RTP offers internal scholarships funded by industry partners. External scholarships are offered through industry associations. Congratulations to the 2013 Scholarship Winners!

### UNION PACIFIC SCHOLARSHIPS (3 @ \$2000 each)

Nicholas Lanoue , Colin Lay, Modeste Muhire

### CN SCHOLARSHIPS (4 @ \$1000 each)

Chris Blessing, Sean Pengelly, Irfan Rasul, Akalu Tafesse

### AREMA SCHOLARSHIPS

Dylan J. Anderson - Michigan Tech Alumni Scholarship

Chris Blessing - AREMA Committee 27 - Maintenance-of-Way Work Equipment Scholarship

Nicholas Lanoue - REMSA Scholarship

Antonio Passariello - Michigan Tech Alumni Scholarship

Sean Pengelly - AREMA Committee 18 - Light Density & Short Line Railways Scholarship

Hamed Pouryousef - AREMA Educational Foundation Scholarship

Irfan Rasul - AREMA Committee 30 - Ties Scholarship



# GRADUATE STUDENTS

With the help of the National University Rail Center (NURail) grant, Michigan Tech has been able to experience significant growth in its rail related graduate students, currently supporting five students from three departments.

## **Alexander Hardy, MS Student, Mechanical Engineering**

Alexander Hardy is a PhD student in the Mechanical Engineering program. He completed his B.S. in Mechanical Engineering from Michigan Technological University. Currently Alexander is working on a project developing maps of driver scan patterns using railroad crossings as hazards which is funded by the NURail program.



Alexander Hardy

## **Hamed Pouryousef , PhD Student, Civil Engineering**

Hamed Pouryousef is a PhD in the Civil and Environmental Engineering Department under the supervision of Dr. Pasi Lautala. Hamed graduated with a Bachelor degree in Railroad Engineering from the Iran University of Science and Technology in 2001. He worked for Metra Consultant Engineers, affiliated with the Iran Department of Transportation where he was involved in several rail and transportation projects for eight years before joining the MIT-Portugal MS Program in 2008. After graduation with a Masters degree from MIT-Portugal in Lisbon, Hamed moved to Michigan Tech. In addition to his research work on railway capacity, Hamed has been the technical lead to a federally funded project “HSR Workforce Development through Online Education and Training” and was the instructor of the Rail Transportation Seminar course in the spring of 2013. Hamed is a Young Member of TRB as well as an active student member of AREMA in Committee 16 (Operations) and Committee 17 (High Speed Rail) since 2010.



Hamed Pouryousef

## **Irfan Rasul, MS Student, Civil Engineering**

Irfan Rasul is an International student from Bangladesh, where he finished his B.S. in Civil Engineering from Bangladesh University of Engineering and Technology (BUET). Currently Irfan is working on an MDOT funded project “Upper Peninsula Freight Rail Study”. He is also working to support the Upper Peninsula (UP) Shippers in optimizing their available transportation modes by using Multimodal Transport. His Masters research will try to identify the issues and locations for potential transloading facilities in and around the UP.



Irfan Rasul

## **Akalu Tafesse, MS Student, Civil Engineering**

Akalu Tafesse is an MS student in Civil Engineering with focus on Transportation. He received his BS in Civil Engineering from Addis Ababa University in his home country, Ethiopia. Akalu’s academic interests include railroad engineering, public transit and project management. He is currently working on his master’s project on short line railroad track asset management and he is also involved in the “Upper Peninsula Freight Rail Study” project.



Akalu Tafesse

## **Karl Warsinski, PhD Student, Materials Science**

Karl Warsinski is a PhD student in Materials Science. He completed B.S. degrees in Civil Engineering and Materials Science and Engineering at Michigan Tech in 2011. Karl is working on the development of Austempered Ductile Iron as a potential railroad wheel material. His project is funded through the NURail program under supervision by Dr. Paul Sanders.



Karl Warsinski

# GRADUATE STUDENT HIGHLIGHT

## Hamed Pouryousef, Capacity Study

There is a growing interest in the United States (U.S.) to operate higher speed passenger rail services on the shared-use corridors with freight rail services. Shared corridors tend to be challenging due to high heterogeneity, particularly in terms of available capacity. The projected growth in demand for rail transportation is likely to exacerbate the situation. Similar to the U.S., the European passenger rail services are generally operated on shared-use corridors, but the infrastructure conditions and the operational priorities and patterns are prioritized to allow more reliable and higher speed passenger operations in comparison to the U.S. trains.

There are two main approaches to improve the capacity levels, either by applying new capital investment (upgrading infrastructure components) or by improving operational characteristics and parameters of the rail services (using modeling and optimization techniques). While the majority of past work in the U.S. has concentrated on the first approach, the second approach is very common in European practices, typically via rescheduling and timetable management modeling methods.

Both continents use capacity and simulation software to analyze capacity allocations and operational limitations. However, the effects of the software selection haven't been investigated. This research uses U.S. and European simulation tools to examine different scenarios, and also includes a hybrid approach on a single case study, as well as applying a timetable compression technique (European approach) along a U.S. shared-use corridor (Figure 2).

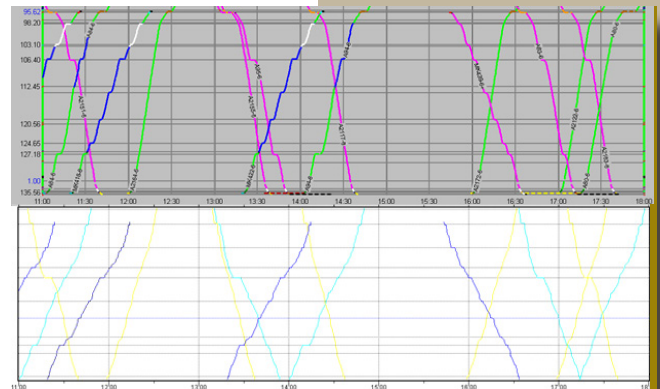


Figure 1- Simulated train string line schedule, applied in a common U.S. simulation package (Top) and a European simulation package (Bottom)

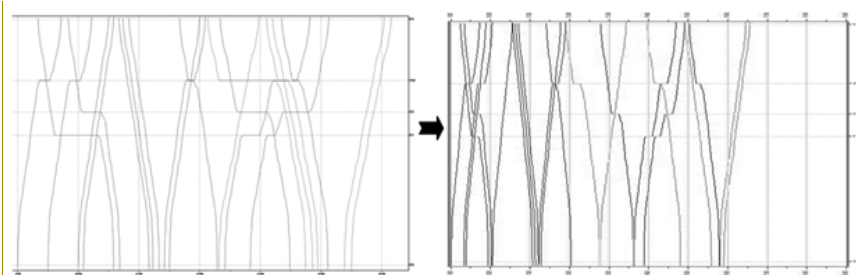


Figure 2- Snapshot of a sample string line developed in a European simulation package (Left) with improved string line (Right) using compression tools of software



Hamed Pouryousef at the Joint Rail Conference 2013 in Knoxville, TN



# YOUTH ACTIVITY HIGHLIGHTS

## **Rail and Intermodal Transportation Summer Youth Program**

Trains, Trucks, and Transportation – For the fourth year Michigan Technological University in partnership with the University of Wisconsin-Superior, sponsored a summer youth program that gave students an opportunity to explore career opportunities in the transportation business. Seventeen high school students from around the country were provided full stipends by the NURail grant and RTP’s industry partners to participate in the week-long exploration. The curriculum went far beyond the standard slide show and craft activity at many summer camps. They rode trains in Minnesota and Michigan; toured railroad maintenance shops and yards in Wisconsin and Michigan; visited the facilities at a trucking firm in Superior, WI, and the rail/ship interface for the iron ore business in Duluth, MN. Interspersed with the field trips were lessons in many aspects of intermodal transportation, with a focus on rail activities. The students had a great time, when asked about their favorite activity one student responded, “The Ore Docks- most definitely. This was where we saw ships, rail trains, and trucks all converge to transport taconite from start to finish (from ore to the steel mill).”



Summer Youth Program participants at CN Ore Dock in Duluth

### **What will you remember five years from now?**

*“Amazing experiences and connections made”*

-SYP student

## **Transportation Education Workshop Series for Detroit Public Schools**

22 teachers from the Detroit area met to participate in Dr. Pasi Lautala’s rail transportation workshop, organized by Joan Chadde, on March 23. The purpose of the workshop was “...to introduce students to careers in transportation and provide teachers with a curriculum connection for teaching about transportation management via core subjects (math, science, social studies)”. Dr. Lautala captivated his audience with presentations on many aspects of the rail industry, and how rail activities work with other transportation modes to provide a complete transportation system, using his unique experience set as global expert in rail activities. The workshop included a field trip to the Norfolk Southern Railyard. Teacher comments at the end of the workshop included; “The workshop was perfect!” and “I have a push-pull science unit to teach and the trains are a great way to do that.”



Teacher Education Workshop Series

## **RTP partners with Michigan Tech K-12 Education & Outreach Program**

The Rail Transportation Program partnered for two youth events with the Western Upper Peninsula Center for Science, Mathematics and Environmental Education, a collaboration program with Michigan Technological University. One event that sprang from this collaboration was a Family Transportation Night, held at the Chassell Public School in April, 2013. Elementary school students and their parents attended an inquiry-based activity led by Michigan Tech students. Nick Lanoue, Rail Engineering and Activities Club (REAC) president, helped facilitate and lead the session which investigated transportation experimentations and lessons.

In another cooperative event, the RTP facilitated a mag-lev rail activity for a session on “Things That Move” during a Summer Science Camp Explorations program hosted at Michigan Tech. Twelve children, grades 1-3, enjoyed the activity presented by Mr. David Nelson, that included a short lesson on how mag-lev trains operate, and the opportunity to build a model mag-lev train platform.



Transportation Summer Camp

# RAILROAD EDUCATION AT MICHIGAN TECH

## Student Projects Update

RTP strongly believes that one of the best educational methods for today's students is through hands-on activities. With the support from NURail and RTP's industry partners, Michigan Tech was able to complete a record number of student projects in 2012-2013.

Over the fall and spring semesters, students from the Electrical and Computer Engineering department were sponsored by Union Pacific Railroad to develop an ultrasonic sensor for remote determination of sand levels in locomotive tanks. Simultaneously, students from Mechanical, Material Science and Civil Engineering departments were sponsored by NURail and externally advised by Amsted Rail, Transportation Technology Center, Inc. and BNSF Railway to re-design the knuckle of Type-E coupler and to evaluate the potential for using austempered ductile iron (ADI) in the manufacturing process.

Two projects that will continue in fall, 2013, include Performance of Grade Crossing Surface Materials, sponsored by MDOT and conducted by students in Construction Management and Civil Engineering, and a NURail funded project to develop a promotional video for the Rail Transportation Program, conducted by the CinOptic Media Enterprise.

## New Course

### Logistics and Transportation Management OSM 4700

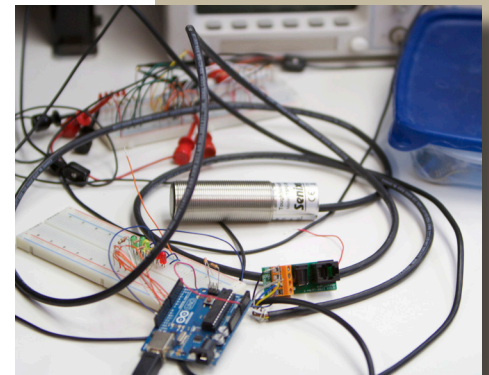
Dr. Gregory Graman is teaching a new course in the Business School about transportation and distribution services that support demand fulfillment from the receipt of customer orders to order fulfillment. Topics include customer service, order fulfillment, inventory, transportation costs and modes, facility design and operation, carrier selection, and negotiation.

#### Course Objectives:

- Understand the regulatory, economic, and operational aspects of transportation
- Be familiar with the unique operating and cost characteristics of the five basic modes of transportation
- Determine the transportation needs of a firm involved in global operations
- Analyze a shipper's freight operations
- Appreciate the current challenges facing both shippers and carriers in the transportation environment



CinOptic Enterprise students creating video for RTP promotional video project



Sand sensor prototype for locomotive tanks



Michigan Tech team visiting Union Pacific to collect materials for OSM 4700



# SPEAKERS AND PROFESSIONAL DEVELOPMENT



Michigan State Senator Tom Casperson and RTP Director Pasi Lautala in the CNRTEC

## RTP Visitor Highlights

**Clint Jones**, President of the Mineral Range Railroad and Michigan Tech alum, gave a presentation to the Railroad Engineering & Activities Club (REAC) at their April 2013 general board meeting titled "Mineral Range Railroad - New Addition to Upper Peninsula Railroads". Jones provided the students with his experiences as a lifelong railroad employee and discussed the challenges related to the opening of the new railroad. Mineral Range became the owner of 12 miles of railroad track in Marquette County, Michigan on January, 2013 and will be serving new mining development in the area.

**Tom Casperson**, Michigan State Senator and Chair of the Senate Transportation Committee, conducted a fact finding visit to the Rail Transportation Program CN Rail Transportation Education Center (CNRTEC) labs on the campus of Michigan Tech. Casperson and RTP Director Pasi Lautala met for an overview of rail activities including research, outreach and education conducted by RTP and for discussions on rural freight in the UP of Michigan. Casperson's visit resulted in an invitation for Director Lautala to provide testimony to the Senate Economic Development Committee on the status and problems affecting the rural freight systems of the UP.

## RTP Visitors

**Bill GeMeiner**, Senior Mgr, Methods & Research, Union Pacific Railroad - March 26th-27th, 2013, "Wayside Detection/Monitoring Systems."

**Dave Ferryman**, Vice President, System Engineering for CN - April 2nd, 2013. Presentation and discussion "CN Engineering Challenges" was held on campus. Mr. Ferryman visited Michigan Tech to review the facilities and to discuss future collaboration and activities with students and faculty.

## Publications and Research Reports

Lautala, P., Dick, T., NURail-Developing a New Generation of Railway Professionals. *UTC Spotlight University Transportation Centers Program: USDOT Research and Innovative Technology (RITA)*, June, 2013.

Lautala, P., Meeting the Needs – What Does the Railroad Industry Need and Expect from Higher Education? *Transportation Research Record: Journal of the Transportation Research Board*, Volume 2328/2013 Research and Education, pages 32-39. Transportation Research Record No. 2328, July, 2013.

Abbas, D., Handler, R., Dykstra, D., Hartsough, B. Lautala, P., Cost Analysis of Forest Biomass Supply Chain Logistics. *Journal of Forestry*, 111(4):000-000, online, July 4, 2013.

Stewart, R., Lautala, P., Ogard, E., Evaluating Export Container Pooling Options in MN, WI, and MI's Upper Peninsula. *Wisconsin DOT: Putting Research to Work and National Center for Freight Infrastructure Research & Education*, April, 2013.

## Courses and Workshops Attended

### UW Madison Continuing Education - October 24<sup>th</sup>- 26<sup>th</sup> 2012

Engineering Mass Transportation Systems: Light Rail-Rapid Transit-Commuter Rail  
Jeff Lidicker, CEE Faculty

### UW Madison Continuing Education - November 5<sup>th</sup>-6<sup>th</sup> 2012

Fundamentals of Railway Train Control and Signaling, Including PTC Systems  
Hamed Pouryousef, PhD candidate

### Rail Traffic Controller (RTC) Workshop, Fort Worth, TX - November 7<sup>th</sup>-8<sup>th</sup> 2012

Hosted by BNSF and Berkeley Simulation Inc.  
Hamed Pouryousef, PhD Candidate

### Natural Gas, Argonne- Argonne National Library - October 2<sup>nd</sup>-3<sup>rd</sup> 2012

Natural Gas Locomotive Technology Workshop sponsored by FRA  
Jeffrey Lidicker, PhD and Jaclyn E. Johnson, PhD

### REAC Guests and Speakers

**Summer Interns** - Troy Sabo, Chris Blessing, and Nick Lanoue - September, 2012. Presented and reported on Past Summer Internship Experiences

**Jonathan Warlof**, Supervisor of Design Services for BNSF Railway (CEE '11) - October 9th, 2012. "Positive Train Control – What it is and What it Means to BNSF"

**Steven Sams**, CEE '09, WisDOT Railroad Specialist and Brent Marsh, CEE '09, WSOR Project Engineer - November 13th, 2012. "Growing Rail Transportation in Wisconsin – WSOR Projects"

**Pasi Lautala**, PhD, PE, RTP Director - December 4th, 2012. "Full Speed Ahead: A brief review of current rail activities at the Rail Transportation Program"

**Richard Hisrich and Chris Durden**, CSX Intermodal Terminals, Inc. January 22nd, 2013. "The Next Generation Terminal"

# CONFERENCES

## Conferences and Conference Presentations

**American Railway Engineering & Maintenance-of-Way Association (AREMA), Chicago, IL, Sept 16-19, 2012**  
Director Pasi Lautala, Assistant Professor Jeffrey Lidicker and 20 Railroad Engineering and Activities Club (REAC) students attended the AREMA annual conference in Chicago. Michigan Tech RTP students were recognized for their AREMA scholarship success. Lautala and REAC students represented Michigan Tech as a partner in the first USDOT granted University Transportation Center focused on rail at the National University Rail Center (NURail) exposition booth.

- Lautala, P.T., D.P. Babbitt and K. Pepin. 2012. Win-win: Shortline railroad and university team up for education and development. *Proceedings of American Railway Engineering and Maintenance-of-Way Association Annual Conference*, Chicago, IL, September 16-19, 2012.

### High Speed Rail Workforce Symposium, Chicago, IL, September 19, 2013

Conducted by the RTP as a deliverable of an FRA project with Michigan Tech, the symposium was offered live at the Chicago Hilton and via webinar to approximately 50 total participants.

### The Standing Committee on Rail Transportation (SCORT), October 24, 2013

SCORT and the American Association of State Highway and Transportation Officials (AASHTO) hosted a live webinar with an emphasis on workforce development for state rail employees. It included an update on workforce development initiatives by Monique Stewart, FRA, Peter Haas, Mineta Transportation Institute (MTI), and Pasi Lautala, Michigan Technological University.

### Transportation Research Board (TRB) Annual Meeting, Washington, DC, January 13-17, 2013

- Pouryousef, H., Lautala, P.T., Review of Capacity Measurement Methodologies; Similarities and Differences in the U.S. and European Railroads. *Proceedings of the Transportation Research Board Annual Meeting of the National Academies*, January 12-16, 2013.

- Lautala, P., Meeting the Needs – What Does the Railroad Industry Need and Expect from Higher Education? *Transportation Research Record: Journal of the Transportation Research Board*, Volume 2328/2013 Research and Education, pages 32-39. Transportation Research Record No. 2328, July, 2013.



American Railway Engineering & Maintenance of Way Association (AREMA)

## Conference Highlights

### Joint Rail Conference (JRC), Knoxville, TN, April 15-18, 2013

Director Pasi Lautala and seven students represented the RTP at the 2013 Joint Rail Conference. Lautala presented during the opening plenary session, as well as organized and chaired two National University Rail (NURail) Center Sessions. Pouryousef chaired a session on Infrastructure Development.

In the Education/Student Project technical session, the Senior Design team of Justin Breeland, Jake Glair and Jeff Langlois showcased their project, "Locomotive Sand Tank Level Sensing System," sponsored by Union Pacific Railroad. Kyle Pepin and Yidan Lou represented their Senior Design teams, "Redesign of Type E Rail Car Coupler," sponsored by the NURail Center and Rail Transportation Program.

- Hardy, A., Hill, J., Creating Scanning Pattern Maps of Driver Fixations During Hazards, *Proceedings of Joint Rail Conference*, Knoxville, TN, April 16-18, 2013.

- Pouryousef, H., Lautala, P., Evaluating the Results and Features of Two Capacity Simulation Tools on the Shared-Use Corridors, *Proceedings of Joint Rail Conference*, Knoxville, TN, April 16-18, 2013.

- Lautala, P.T., Dick, T.C., McKinney, J.L, Clarke, D.B., Railway Engineering Education Symposium (REES) - Universities and Industry Collaborate to Develop Railway Education, *Proceedings of Joint Rail Conference*, Knoxville, TN, April 16-18, 2013.

### World Congress on Rail Training, St. Polten/Vienna, Austria, April 24-26, 2013

The main purpose of the conference is to enhance workforce development through sharing best practices in rail training across the entire industry. During his stay in Europe, Director Pasi Lautala also visited the Technical University of Braunschweig, Germany, the Open Track Railway Technology company in Zurich, Switzerland and the University of Newcastle upon Tyne in the United Kingdom. He provided a guest lecture on railway capacity in Braunschweig and conducted discussions for capacity research collaboration in Braunschweig and Zurich. In Newcastle, he led a discussion related to railway and intermodal education and research with the faculty, staff and students of the Rail Research Laboratory and was introduced to RiFLE, a curriculum development project.

- Lautala, P.T., Haas, P., Identifying and Meeting Challenges to Securing and Educating the Next Generation of Rail Industry Workforce in the U.S. *Proceedings of 2nd UIC World Congress in Rail Training*, St. Polten/Vienna, Austria, April 24-26, 2013.





# NURAIL



## National University Transportation Center (NURail)

In 2012, the seven university consortium, including Michigan Tech, was awarded the first National University Rail Transportation Center (NURail) by the USDOT Research and Innovative Technology Administration (RITA). The primary objective of the NURail Center is to improve and expand rail education, research, workforce development, and technology transfer in the U.S. The first round of NURail sponsored and co-sponsored projects have been progressing throughout the 2012-2013 academic year and the first projects will be complete in late 2013 and early 2014. The grant has also supported various educational and student activities and projects, covered earlier in this report.

### Ongoing NURail Projects

#### Austempered Ductile Iron (ADI) in Railroad Wheels

Dr. Paul Sanders and PhD Student Karl Warsinski are working on the development of Austempered Ductile Iron as a potential railroad wheel material. As part of the project, Warsinski has been collaborating with a local railroad to collect data on wheel temperatures during the braking application.

#### Influences of Driver Attention on Rail Crossing Safety

Myoungsoon "Philart" Jeon and Alex Hardy, a graduate student in Mechanical Engineering – Engineering Mechanics are continuing the work started by Hardy and Dr. John Hill. The research has concentrated on mapping the automobile driver eye fixation patterns, as they cross highway rail at-grade crossings. The project attempts to evaluate the effects of various safety devices to driver behavior and how different distractions change the behavior.

### MDOT and NURail Co-Sponsored Projects

RTP has two ongoing research projects co-sponsored by the Michigan Department of Transportation (MDOT) and the NURail. In addition, Michigan Tech has been leading the organization of 1st Michigan Rail Conference.

#### Assessment of Aggregate Sources in Michigan for High Speed Railroad Ballast

Dr. Stan Vitton is leading a project that analyzes acceptable aggregates available in Michigan for railroad ballast on high speed rail lines. The current work on the railroad ballast project involves identification and testing of a select number of aggregates to evaluate whether their characteristics meet ballast specifications. In the spring the project began static and dynamic testing of ballast sources in the Upper Peninsula of Michigan, especially the carbonate aggregates.

#### UP Rural Freight Rail Study

This project concentrates on identifying challenges faced by rural rail service providers and shippers along light-density lines and on developing tools and methods that facilitate the use of rail and multimodal transportation alternatives in the Upper Peninsula of Michigan.

## Michigan Technological University NURail Researchers

Michigan Tech is expanding its research faculty involved in NURail activities. In addition to Dr. Pasi Lautala, who leads Michigan Tech activities and functions as Associate Director of Education for the NURail consortium, other Tech faculty involved includes Dr. Paul Sanders, Assistant Professor, Material Science and Engineering; Tim Havens, Assistant Professor, Department of Electrical and Computer Engineering; Myoungsoon "Philart" Jeon, Assistant Professor, Dept. of Cognitive and Learning Sciences; and Thomas Oommen, Assistant Professor, Dept. of Geological Engineering.



Tim Havens



Thomas Oommen



Paul Sanders



"Philart" Jeon

# SPECIAL UNION PACIFIC PARTNER PROGRAM EVENT

Three members of the RTP program, Hamed Pouryousef, David Nelson, and Greg Graman, participated in the Union Pacific (UP) Home Plate – University Partners program on June 17-18, 2013. The event is an annual recruiting program sponsored by UP in conjunction with the College World series. Our group heard from senior executives and recent hires about career opportunities at UP and was hosted by UP to a College World Series game. The Michigan Tech group also had special visits with senior operations, engineering, signals, and transportation planning staff to strengthen the relationship between UP and Michigan Tech and to collect information on the new Logistics and Transportation Management course. The visits included tours of the Council Bluffs rail yard and the Harriman Dispatch Center.

## ONGOING RESEARCH HIGHLIGHT

### High Speed Rail (HSR) Workforce Development through Education and Training

#### Principal Investigator, Dr. Pasi Lautala, CEE/MTTI

As the U.S. and other countries around the world continue to work on development of High Speed Rail (HSR) systems, the RTP team has nearly completed an interactive web system geared towards providing education and training to support the planning, design, construction, operations and maintenance of HSR systems.

The proof-of-concept site, funded under a grant by the Federal Railroad Administration, has been implemented and tested with HSR material developed specifically for the site and various supporting materials related to HSR workforce development. The system has been open to public at [www.rail-learning.mtu.edu](http://www.rail-learning.mtu.edu) since early July, 2013 and the early results are promising. The site has been used by a wide variety of people (Table 1). The site currently includes three courses, HSR 101 – An Introduction to High Speed Rail, HSR 102 – High Speed Rail Management, and HSR 103 – High Speed Rail Advanced Technologies. It also contains the proceedings of the Michigan Rail Conference 2013, the October 2012 SCORT Work Force Development webinar, and the High Speed Rail Workforce Development Symposium held at the 2012 AREMA annual conference. The current project will be completed by the end of September, but discussions and planning for continuing development have already been started.

The screenshot shows the High Speed Rail Learning System (HSRLS) web portal. At the top, there is a navigation menu with 'Home', 'Courses', 'Contact Us', and a 'Log in' button. The main content area is divided into several sections. On the left, there is a 'HSR101 Complete!' announcement stating that the long-awaited course, 'HSR101: An Introduction to High Speed Rail', is open to enrollments. Below this, there is a description of the course as highly interactive and geared towards those who want to quickly familiarize themselves with concepts and terminology related to high speed rail. To the right of the text are three maps of the United States showing different HSR routes. Below the maps is a train labeled 'HSRLS'. On the right side of the page, there is a 'Get Registered!' section with a 'Get Registered' button and a list of benefits: 'All of the free courses the HSRLS offers.' and 'A community of people interested in HSR and eLearning'. Below that is an 'External Links' section with a list of links including 'Cisco Networking Academy' and 'Code Academy'. At the bottom of the screenshot, there is a caption: 'High Speed Rail Learning System web portal'.

<b>Registered Users: Over 350</b>
<b>Total Visitors: Over 2000</b>
<b>Visitor Age Range: 15 to 61</b>
<b>International Users: Over 25 countries</b>

Table 1: HSRLS user statistics

Please visit the site at <http://www.rail-learning.mtu.edu/>



# ONGOING RESEARCH HIGHLIGHTS

## **Evaluating Export Container Pooling Options in Minnesota, Wisconsin and Michigan’s Upper Peninsula (Sept. 2011 – April, 2013)**

Sponsored by National Center for Freight and Infrastructure Research and Education (CFIRE). Principal Investigator, Dr. Richard Stewart, Univ. of Wisconsin-Superior. Co-PI, Dr. Pasi Lautala, CEE/MTTI.



Chassis (above) and Container (below) used in the shipping industry

“Containerization has revolutionized the shipping industry and coupled with advance communications technology, the global supply chain industry has helped connect suppliers, manufacturers and consumers in an effort to reduce costs. The U.S. National Export Initiative, along with a weaker dollar, has ignited an interest in exporting and helped identify new markets and funding for trade missions, but has fallen short in helping exporters to identify equipment availability or to facilitate the physical movement of goods.

The objective of the research was to investigate the issues that limit containerized exports and cause export container shortages from Minnesota, Wisconsin and the Upper Peninsula of Michigan. Some of the key findings included:

- Ocean carriers effort to exit the chassis business and improve asset utilization and equipment turn times has resulted in an increased transshipment of ocean containers closer to the ports of entry and reduced the flow of ISO equipment inland, including .the study region.
- Heavy or overweight containers cause problems for highways and rail and marine carriers face difficulties in maximizing their asset utilization when provided with too many heavy grain containers.
- Long drayage distances in study region increase the possibility of “lost containers, or containers with extended loading periods.

The main study recommendations included using available tools to identify equipment availability and visibility and the establishment or expansion of a few selected intermodal terminals, potentially in the Green Bay and Twin Cities regions.

## **High Pressure Heat Exchanger (HiP HEX) (May, 2013 - May 2014)**

Principle Investigator, Dr. Jeff Naber, MEEM, Michigan Tech.

The Rail Transportation Program is collaborating with the Advanced Power Systems Research Center at Michigan Tech to provide an Independent Review of a proposed High Pressure Heat Exchanger (HiP-HEX) System for use on rail locomotives. A group of Mechanical Engineering faculty, staff and students has been engaged in a theoretical review of the waste energy available at the engine manifold and how much of that energy can be captured and converted to electrical energy to help drive a locomotive, without adversely affecting engine performance. The project is funded by the Federal Railroad Administration.

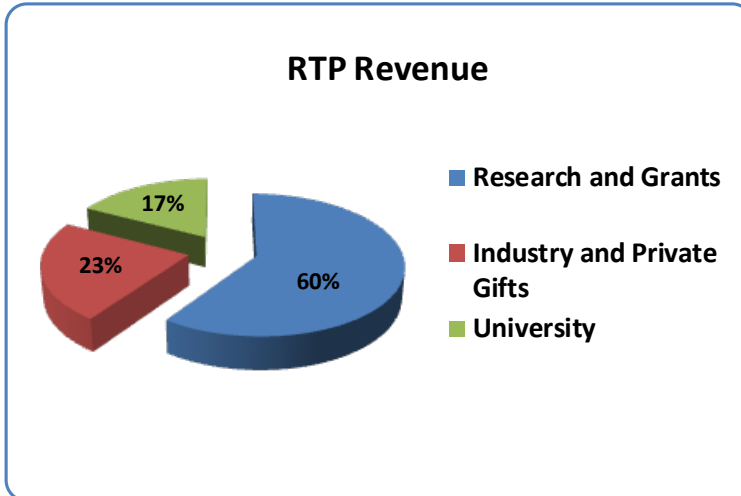
## **OISE-PIRE: Sustainability, Ecosystem Services, and Bioenergy Development across the Americas (January, 2013 – December, 2017)**

Principle Investigator, Dr. Kathleen Halvorsen. RTP lead, Dr. Pasi Lautala.

The Rail Transportation Program is participating in a multidisciplinary and multinational research project funded by the National Science Foundation (NSF). The project concentrates on the sustainability challenges of one form of bioenergy—liquid transportation fuels or “biofuels”. Specifically, the project investigates “the impacts of biofuel development on socio-ecological systems and associated ecosystem services, and how can those impacts best be measured, modeled, and mitigated?” RTP will work on investigations related to transportation logistics, including development of indicators to compare transportation systems based on the availability of modal and multimodal transportation alternatives and identification of case studies with different feed-stock types, climate, transportation infrastructure, and ownership structures.

**RTP Funding**

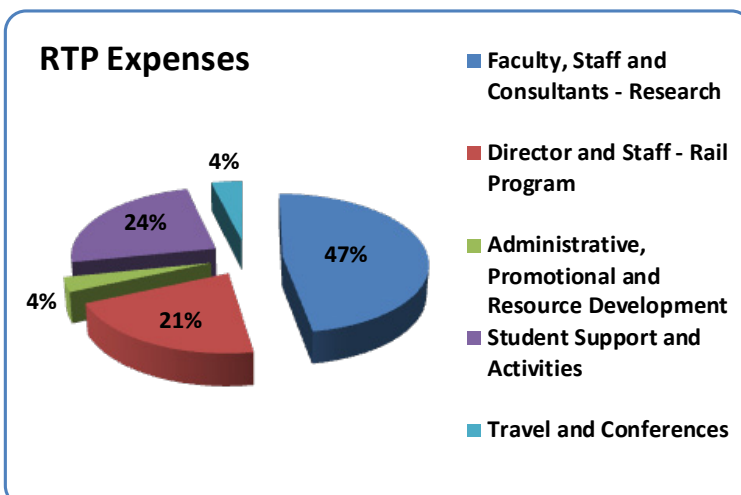
Financial support for the Rail Transportation Program is received internally at Michigan Tech from the Department of Civil and Environmental Engineering (CEE). External funding consists of sponsored program research projects, industry contributions and gifts from private individuals.



**RTP Expenditures**

Expenditures to support the rail transportation activities have been divided into several categories:

- **Faculty, Staff and Consultants (Research)**- Research expenses are wages, salaries, and subcontracts plus overhead charges specific to sponsored research projects.
- **Director and Staff (RTP)**- Rail program expenditures include director and staff salaries and other direct expenses used to support and continue development of the Rail Transportation Program.
- **Student Support and Activities** includes expenses which benefit students directly such as tuition and stipends, expenses for conference fees and field visits, travel, and sponsorship for student events and REAC activities.
- **Travel and Conferences** includes all non-student support for travel and participation in rail and educational conferences and meetings to facilitate the development of the rail transportation program. This includes travel expenses incurred in sponsored research projects.
- **Administrative, Promotional, and Resource Development** expenditures are expenses incurred in the operation and development of the rail program, such as marketing, material development, and purchase of program resources (software, books, manuals, etc).



## About the Michigan Tech Transportation Institute

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.

MTTI is an umbrella organization bringing together the cross-disciplinary centers and principle investigators conducting transportation related research and education initiatives that address national and global needs. Principal Investigators conduct transportation research under MTTI within six transportation focused areas:

- Transportation Structures including bridges and pavements. Other related areas include geo-technical, construction, and nanotechnology related to sensors.
- Transportation Materials including concrete, asphalt, steel, wood, and aggregates. Other related areas include construction, geo technical, and nanotechnology related to sensors and materials.
- Transportation Systems including waterways, traffic/safety, construction, rail, air, public transportation, freight, intelligent transportation systems, vehicle infrastructure integration, nanotechnology related to sensors, and radio frequency identification devices.
- Environmental Aspects of Transportation includes environmental impacts, energy, carbon dioxide and other pollutants, fugitive dust, wildlife, flora and fauna, and carbon credits.
- Social Aspects of Transportation includes policy, planning, human factors, history, economics, and archeology.
- Transportation Technology Transfer includes all outreach, management systems, and workforce development programs.

Director, Ralph Hodek, MTTI  
rjhodek@mtu.edu, 906-487-2797

**MichiganTech**  
Transportation Institute  
[www.mtti.mtu.edu](http://www.mtti.mtu.edu)

## About Michigan Technological University

Michigan Technological University is a leading public research university, conducting research, developing new technologies, and preparing students to create the future for a prosperous and sustainable world. Michigan Tech offers more than 120 undergraduate and graduate degree programs in engineering, forestry and environmental sciences, computer sciences, technology, business and economics, natural and physical sciences, arts, humanities and social sciences.



**MichiganTech**  
Create the Future

Michigan Technological University is an equal opportunity educational institution/equal opportunity employer.

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## Rail Transportation Program

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