Undergraduate eXpo 2013

Innovation • Design • Entrepreneurship • Leadership

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Mary Raber, Director, Enterprise Program

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Scope
The Undergraduate Expo highlights hands-on, discovery-based learning at Michigan Tech. Nearly one thousand students in Enterprise and Senior Design teams showcase their work and compete for awards. A panel of judges, made up of corporate representatives and Michigan Tech staff and faculty members, critique the projects. Many team projects are sponsored by industry, which allows students to gain valuable experience through competition at the Expo, as well as direct exposure to real industrial problems. The Expo is a combined effort of the College of Engineering and the Institute for Leadership and Innovation.

Student Awards

Senior Design Awards
Based on poster
First place—$150
Second place—$100
Third place—$75
Honorable Mention—$50 (three to be awarded)

Enterprise Awards
Based on poster and presentation
First place—$300
Second place—$150
Third place—$100

Undergraduate Expo Image Contest
Photo or non-photo graphics
First place—$100
Second place—$50

Enterprise and Senior Design Patent Disclosure Competition
Winners announced at the Expo
Best Overall—$250
Best Technical Specification—$150
Best Prior Art Review and Competitive Analysis—$100

More Special Thanks
To the distinguished judges who give of their time and talents to help make the Expo a success, to the faculty advisors who generously and richly support Enterprise and Senior Design, and to all the behind-the-scenes superstars (you know who you are)—thank you for your dedication to our students.

On the cover, L to R
Testing a command twin closure plate for the pressure decay leak test machine. Team sponsored by Kohler.

Emily Raffa, President and John Holbrook, Vice President of Communications, Wireless Communication Enterprise (2012).

A Michigan Tech electrical engineering undergraduate student adjusts a laser interferometer.
Reliable, modernized grid

Energy is essential to the way we live, work and play.

ITC operates, builds and maintains the region’s electric transmission infrastructure. We’re a Novi, Michigan company working hard to improve electric reliability and increase electric transmission capacity throughout the Midwest.

We’re ITC – your energy superhighway.
Welcome to the Thirteenth Annual Undergraduate Expo!

The Expo highlights the core foundations of a Michigan Tech education: experiential learning; teamwork; application of theory, design and innovation; leadership and communication; and multidisciplinary solutions to problems. The Enterprise and Senior Design students showcasing their projects today have embraced these foundations. We take tremendous pride in their accomplishments and hard work.

Michigan Tech’s innovative Enterprise Program enables interdisciplinary learning, leadership development, and team-based work. Teams of first- through fourth-year students from diverse disciplines operate much like real companies to develop products, processes, and services within their market space. Faculty advisors serve as coaches and mentors, with industry leaders playing a supporting role as collaborators and clients.

Senior Design enables small teams of highly dedicated students to explore and solve real industry challenges throughout their senior year. Our program connects students and industry through open-ended projects, which enable teams to experience and follow the complete design process—from ideation to realization.

We would like to take this opportunity to thank the many sponsors who generously support our educational mission by providing invaluable project experiences, along with guidance and mentorship for our students. The benefits of industry and academia working together as partners in higher education are clearly evident today, here at Michigan Tech’s Undergraduate Expo.

Sincerely,

Leonard J. Bohmann
Associate Dean for Academic Affairs
College of Engineering

Mary Raber
Associate Director
Institute for Leadership and Innovation
Director, Enterprise Program
101 Identification of Sources of Rattle in a Steering System Using Signal Processing Techniques

Test bench set up

Team Members
Jacob Kosanke, Computer Engineering; Sean Miller, Kellin Jayne, Tim Stolzenfeld, and Yingkun Zhu, Electrical Engineering

Advisor
Duane Bucheger

Sponsor
Nexteer Automotive

Project Overview
Nexteer Automotive, based in Saginaw, Michigan, is a leader in active and electric power steering technology. Within the steering system, a rattle can occur, which creates an issue with customer satisfaction, as well as with the warranty on parts. Using signal-processing techniques in the MATLAB environment, our goal is to develop a method of detecting the source of the rattle: from the ball nut or pinion side.

102 In Vivo Sensor System to Measure Environmental Conditions on Implantable Medical Devices

Implantable cardioverter defibrillator

Team Members
Margaret Brunette, Mechanical Engineering; Thadeus Sansom, Teresa Armstead, Christopher Helmer, and Karl Koivisto, Biomedical Engineering

Advisor
Keat Ghee Ong

Sponsor
Boston Scientific

Project Overview
Boston Scientific’s Cardiac Rhythm Management Group expressed a desire to have an implantable device that can measure loading conditions, which affect implantable cardioverter defribillators (ICDs). The goal was to create a force sensor that could be implanted in vivo to satisfy Boston Scientific’s needs.

103 Jaipur Foot Improvement

Cross-section of revised Jaipur foot

Team Members
Miriam Paquet and Reid Barber, Mechanical Engineering; Stephanie Boomgaard, Ben Cottrill, and Kevin Peterson, Biomedical Engineering

Advisor
Nina Mahmoudian

Sponsor
Department of Mechanical Engineering-Engineering Mechanics

Project Overview
The Jaipur foot was developed to provide an amputee in India with a simple, practical, and low-cost prosthetic that is compatible with an active and culturally appropriate lifestyle. In 2011, a design team successfully made improvements to the Jaipur foot to reduce its weight. The new objective was to improve compatibility of materials with the manufacturing process, while maintaining the affordability and functionality of the foot. The project culminated with a trip to India to meet with Dr. Anil Jain and observe patient use of the prosthetic.
104
**Locomotive Sanding Container Level Sensing**

*LED display shield on Arduino platform*

**Team Members**
Andrew Ranta, Justin Breelend, Jacob Glaire, Kellen Murray, and Meng Yang, Electrical Engineering; Jeff Langlois, Computer Engineering

**Advisor**
Duane Bucheger

**Sponsor**
Union Pacific

**Project Overview**
Under conditions requiring improved acceleration, locomotives use compressed air to spray sand in front of the drive wheels. Such systems are referred to as “sanders” by the industry and are mandated by federal regulations. The sand is stored onboard the locomotive in tanks or sand boxes, and refilling these tanks is performed at a rail yard via a sanding tower. Our team will be implementing a remote-sensing system to detect sand levels in each of the sanding containers on the GE AC4400 locomotive. The data will be displayed to allow for quick and safe assessment of sand levels.

105
**Nexteer Rack Bearing Improvement**

*Adams View computer model for Nexteer Automotive.*

**Team Members**
Stewart Eddy, Chadwick Kern, Shawn Lesko, and Matthew Verbiscus, Mechanical Engineering

**Advisors**
Charles Van Karsen and Gordon Parker

**Sponsor**
Nexteer Automotive

**Project Overview**
The specific causes of a steering column rattle are unknown, so Nexteer needs an inexpensive way to locate and eliminate any rattle within the system. We have been tasked to create an analytical model and design a prototype of a conventional rack-and-pinion power-steering system. We will construct a computer model to locate the rattle and then validate the results of the model by constructing a prototype.

106
**Mobile Wellness Systems**

*The team with units made for the van—shelving system, table, generator rack, and more*

**Team Members**
Brian Wilterink, Steve Elsesser, and Jeff Kaindl, Mechanical Engineering Technology

**Advisor**
Nick Hendrickson

**Sponsor**
ArcelorMittal

**Project Overview**
The main focus of this project is to provide mobile diagnostic tools to local doctors in Ghana. Most villages in Ghana have extremely limited access to medical facilities in cities because of a lack of adequate infrastructure. The clinics that do exist in these small villages have limited treatment capabilities. Many ailments contracted by Ghanaians could be diagnosed, or even treated, but village doctors cannot provide adequate care. The mobile clinic will bring basic health care services to remote Ghanaian villages.
Team Members
Andrew Schrader, Andrew Nienow, Liz Nunn, Jacob Budnick, David Flint, and Kevin Hency, Mechanical Engineering
Advisors
Charles Margraves and William Endres
Sponsor
Tyco Fire Suppression

Project Overview
Our team is trying to develop a unique foam concentrate proportioner to be used in an industrial setting for Tyco. The current proportioning system distributes the foam concentrate into water at correct proportions, but this is accomplished by various designs, each with limited abilities. Tyco is looking for a design that can encompass all advantages and minimize the disadvantages. This will be accomplished by challenging fresh minds to develop a new, innovative design.

Team Members
Bethany Aebli, Greg DeVillers, Jacqueline Kukulsi, Elizabeth Reinke, and Alicia Walby, Mechanical Engineering
Advisor
Paul van Susante
Sponsor
General Motors

Project Overview
Hand cycles for disabled athletes are currently unreliable and require designs that meet their needs while remaining competitive. The need for a newly designed hand cycle was voiced by Achilles Freedom Team members and heard by GM. Four Senior Design teams began designing two different alpha prototypes in January 2012, and they were completed in December 2012. Our team has taken the best designs from the two alpha prototypes and integrated them into a single beta prototype with further optimization and new design.

Team Members
Michael Witt and Christopher Adams, Electrical Engineering; John LaPine and Ahren Sitar, Computer Engineering; Young Na, Mechanical Engineering
Advisor
Trever Hassell
Sponsor
Cinetic Automation

Project Overview
Our goal is to design a laser-dimensioning device to quickly scan parts, in order to determine if the size and position of key features are within the required specifications.
110 Personal Ultraviolet Radiation Dosimeter

Team Members
Anne Francois, Caroline D’Ambrosio, Marie D’Ambrosio, and Kelsey Sherman, Biomedical Engineering

Advisors
Megan Frost and Sean Kirkpatrick

Sponsor
Department of Biomedical Engineering

Project Overview
The personal ultraviolet radiation (UVR) dosimeter is a single-use, disposable device. It indicates when the user has received the maximum suggested dose of UVR before an erythema response, a minimal erythema dose (MED). The device is a one square cm adhesive patch composed of polysulfone film over a smiley-face graphic. Polysulfone is a polymer that changes its optical density when it is exposed to UVR. The shade of the smiley-face graphic corresponds to that of the polysulfone after it has been exposed to one MED. When the graphic is no longer visible, the user should get out of the sun.

Shade change in polysulfone patch with exposure to ultraviolet radiation

111 R/V Agassiz Forward Cabin Design

Team Members
Matt Hyrkas, Jonathan Miller, and Marc Fournier, Mechanical Engineering Technology

Advisor
Nick Hendrickson

Sponsor
Michigan Tech Great Lakes Research Center

Project Overview
Our goal is to redesign the forward cabin of the Michigan Tech Research Vessel Agassiz to provide more usable storage and work space for the increasing aquatics research programs.

R/V Agassiz in GLRC dry dock

112 Kyocera Printing Application Business Plan

Team Members
Belinda Wirtanen, Accounting; Thomas Brown and Dan Yi, Marketing

Advisor
Roger Woods

Sponsor
Wireless Communication Enterprise, Kyocera

Project Overview
Our team is working with the Wireless Communication Enterprise (WCE) to create a business plan for the printing application they are developing for Kyocera.

Dan Yi, Belle Wirtanen, and Thomas Brown
113
Improved Walker Design

Team Members
Daniel Muckala, Richard Gridley, Travis Graham, and Matt Kilgas, Biomedical Engineering

Advisors
Bruce Lee and Jinfeng Jiang

Sponsor
Department of Biomedical Engineering

Project Overview
There are currently 1.5 million walker users in the United States, and this number will rise as the average age of our population increases. Concerns with the safety of walkers have arisen with an observed increase in the likelihood of falling, especially at night. Our goal is to develop a new walker that is both customizable for a particular user and safer and easier to use, compared to current market walkers.

Team Members
Alyssa Sahr, Materials Science and Engineering; Francis Bremmer, Yidan Lou, and Justin Tumberg, Mechanical Engineering; Kyle Pepin, Civil Engineering

Advisor
Paul van Susante

Sponsor
NuRail Center and Michigan Tech Rail Transportation Program

Project Overview
The mechanism used to link rail cars in the heavy freight rail industry is known as a coupler. The coupler has not been significantly redesigned since the original patent in 1873. The current coupler can have mechanical failure during use. The knuckle of the coupler fractures, causing costly delays when the cars detach. The team has studied coupler performance, and designed and tested a prototype to increase the fatigue life of the knuckle.

Team Members
Lisa Shoemaker, Emma Getty, and Megan Johnson, Biomedical Engineering; Meredith Mulder, Materials Science and Engineering; Ellesse Bess, Chemical Engineering

Advisor
Feng Zhao and Jeremy Goldman

Sponsor
Boston Scientific Corporation

Project Overview
A bioabsorbable magnesium surgical staple may retain high mechanical strength and harmlessly disappear after natural wound healing. We will design a magnesium staple that is able to support the same loads as a titanium staple with a customizable diameter and maintain structural integrity for the duration of tissue wound healing. This new staple would be a strong, rapidly deployable closure device that does not require a second procedure to remove, as well as closing the structural integrity and bioabsorbability gap between polymer sutures and permanent staples.
Portable Assisted Mobility Device (PAMD)

**Team Members**
Dominic Augustine, Beau Byers, John Zarafonitis, Xiaoyu Song, and Craig Watson, Mechanical Engineering; Lloyd Tubbs, Electrical Engineering; Dayna Pomeroy, Accounting; Jiang Qiu and Chad Pietila, Marketing

**Advisors**
William Endres and Roger Woods

**Sponsor**
Department of Mechanical Engineering-Engineering Mechanics

**Project Overview**
Heavily populated cities are facing problems with congestion; the purpose of the PAMD is to alleviate these problems by bridging the gap between the public transit station and the end destination. The PAMD is a personal transportation device to replace road vehicles or walking in congested urban areas. The criteria defining the device are: a single-user system, powered by electric motor, which transports the rider to or from public transportation stations. This PAMD must incorporate a level of portability allowing users to move or carry it throughout crowded cities and transit systems.

Attachment and Release Mechanism for Catheter Delivery Device

**Team Members**
Hal Holmes, Jon Juszkiewicz, Alex Keim, Will Paces, and Hal Holmes

**Advisors**
Rupak Rajachar

**Sponsor**
Medtronic

**Project Overview**
Medtronic has produced a fully implantable pacemaker less than 1cc in volume designed to be implanted directly into the ventricle. Currently, these devices are deployed using a catheter; this approach, however, is difficult and unreliable. Medtronic requested we develop an improved delivery system. The goal of this project was to create a device capable of holding the pacemaker in the catheter, delivering it into the heart tissue, and recapturing the device should it need repositioning.

Portage Health Hospital Noise Monitoring Device

**Team Members**
Christina Jufflak, Ryan Kent, David Carli, Amelia Seelman, and Jon Parker, Biomedical Engineering

**Advisor**
Michael Neuman

**Sponsor**
Department of Biomedical Engineering

**Project Overview**
This project improves upon a previously designed hospital sound-level alarm system. The improved device will be implemented at Portage Health in Hancock. Clinical trials were conducted on the newly redesigned sound-level alarm system. The device will alert hospital staff and visitors when their noise exceeds a certain level and interferes with patient rehabilitation. The redesign improves upon the original external housing of the device, the data storage, and the wiring design. A wireless system was added to the device as suggested by the Portage Health staff.
120
Low-Cost Prosthetic Knee

Dave Weyland, Bobby Pizzey, and James Hartel discuss possible changes to the bottom frame of the design.

Team Members
Robert Pizzey, David Weyland, and Ruth Eischer, Biomedical Engineering; James Hartel, Mechanical Engineering
Advisor
Nina Mahmoudian
Sponsor
Department of Mechanical Engineering-Engineering Mechanics

Project Overview
Our team is redesigning and evaluating a cost-optimized prosthetic knee joint created by a previous Senior Design team. The joint must be manufactured in India with local materials and be affordable for the hospital and patients. We have settled on a four-bar linkage design with a variable friction element to provide adjustable resistance to the user.

121
FSAE Business Team

Car model F-274B

Team Members
Aaron Henriksen, Accounting; Tyler Welcher and Allyssa Loven, Marketing
Advisor
Roger Woods
Sponsor
Michigan Tech Formula SAE

Project Overview
Development of a business plan for Formula racing car.

122
Business Feasibility Analysis of a Student-Made Widget

Husky head bottle opener

Team Members
Rui Pan, Management Information Systems; Reginald Hicks, Marketing; and Weixiang Chen, Finance
Advisor
Roger Woods
Sponsor
Advanced Metalworks Enterprise

Project Overview
Advanced Metalwork Enterprise’s Widget Team is manufacturing a bottle-opener key chain. The Widget Team would like to sell this widget for profit to offset the operating cost. The design will be loosely based on the Michigan Tech logo. This project went through the process that was necessary from legal, designing, manufacturing, marketing, and selling this widget. We will focus more on marketing, financial analysis, legality, and point of sale.
**Four Season Fun**

**Team Members**
Jake Tilmann, Anthony Miller, Reuben Schultz, and Darren Kesti, Mechanical Engineering Technology

**Advisor**
Nick Hendrickson

**Sponsor**
School of Technology

**Project Overview**
Our goal is to design and manufacture a lightweight, easy-to-install, low-cost solution to convert a dirt bike into one that can be used in the snow. The finished product will use a track-and-ski system to operate over the snow. Our constraints include time, money, and fork design.

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**Automated Sealant System**

**Team Members**
Brian Dvorak, Peter Denney, Joseph Trapp, Karl Drache, Paul Zimmerman, and Brian Boyce, Mechanical Engineering

**Advisor**
Charles Margraves

**Sponsor**
HGS Aerospace

**Project Overview**
Aircraft wing spars (structural members) are currently sealed using a manual process that is very time consuming. HGS Aerospace is seeking an automated solution that would allow this process to be completed much faster. The team must design a nozzle that can apply the sealant to an aircraft wing spar according to industry specifications. To validate that the nozzle is accurate, a test system must also be designed to simulate an actual application process.

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**Automation of Water Works Valve Test System**

**Team Members**
William Preston and Hanyu Lou, Electrical Engineering; John Ozoga, Computer Engineering; Neil White, Mechanical Engineering

**Advisor**
Trever Hassell

**Sponsor**
EJ Group

**Project Overview**
Our team is developing a conceptual system that will further automate the leak testing of water works valves to improve cycle time and reliability over that of the current test method.
126
Mine Feasibility and Design Project for CD-IV Pit at Cliffs Natural Resources Michigan Operations

Cliffs Natural Resources CD-IV optimized mine expansion

Team Members
Matt Matteson, Cassie Johnson, Kevin Spence, and Chris Droste, Geological Engineering; Alex Schwenk, Civil Engineering

Advisor
Muhammad Raza

Sponsor
Cliffs Natural Resources

Project Overview
Cliffs Natural Resources is the largest producer of iron pellets in the United States. The company’s Michigan operations involve operating two large iron-ore pits (Empire and Tilden Mines) in its leased area near Marquette. This project requires our team to complete a comprehensive feasibility study for Cliffs Natural Resources CD-IV pit to aid in determining if this expansion would be feasible in the future based on an optimized pit, detailed mine layouts, equipment requirements, and a detailed economic model.

127
AquaShock

AquaShock being tested in Michigan Tech lap pool

Team Member
Jeffrey J. Finni, Mechanical Engineering Technology

Advisor
David Wanless

Sponsor
School of Technology

Project Overview
AquaShock is an electrically powered, jet-propelled sea kayak. This vessel would meet or exceed the capabilities of a normal sea kayak but would be suitable for the physically challenged or disabled.

128
Conveyor slide bed redesign

One of the industrial ovens

Team Member
William Fruin, Mechanical Engineering Technology

Advisor
Linda Wanless

Sponsor
Infratrol

Project Overview
Infratrol makes industrial ovens. The company’s conveyor bed needs a new material in order to handle high loads, heat, and extended run times.
Photogrammetric Small Unmanned Aerial Vehicle

**Team Members**
Joe Metz and Dan Stevenson, Electrical Engineering Technology; Fernanda Lima dos Santos, Mechanical Engineering

**Advisor**
Aurenice Oliveira

**Sponsors**
Surveying Engineering Program, Integrated Geospatial Technology Program

**Project Overview**
The project consists of the design, construction, and testing of a small, unmanned aerial vehicle (UAV), which will be used for photographic research. The UAV should be easy to use, stable, and safe so that new students and researchers could operate the device. The UAV will be used as additional learning material for several classes.

Design of an Eta Phase Strengthened Nickel-Based Alloy

**Team Members**
Peter Enz, Bryan Turner, Ben Wittbrodt, and Matthew Wong, Materials Science and Engineering

**Advisor**
Calvin White

**Sponsor**
John Shingledecker, Electric Power Research Institute

**Project Overview**
Nimonic-263 is a commercial nickel-based alloy that is gamma-prime ($\gamma'$), age-hardenable, and used in advanced ultra-supercritical steam boilers and turbines. Much research has been done for alloys, however, there is a need for alloys that can retain strength at temperatures above 750°C where the $\gamma'$ precipitates will coarsen and dissolve. The eta ($\eta$) phase has higher stability than $\gamma'$ above 750°C and has been proposed as a strengthening phase at temperatures above those where coarsening of $\gamma'$ will occur. The scope of this proposal is to design an alloy compositionally similar to Nimonic-263 that contains higher amounts of $\eta$ above 800°C.

Lightweight Swing Gate

**Team Members**
Thomas Schmidt, Eric Lindholm, Katherine Schattl, Caleb Carlson, and Andy Wybo, Mechanical Engineering

**Advisor**
Charles Van Karsen

**Sponsor**
Chrysler

**Project Overview**
Students must design, engineer, build, and test a new lightweight swing gate for 25 percent mass reduction and insertion into the current Jeep Wrangler. The new design has to uphold standard structural and durability requirements while being able to be manufactured.
**Alternative Energy Storage System**

Team Member
Jonas Wolfe, Mechanical Engineering Technology

Advisor
Nick Hendrickson

Sponsor
School of Technology

**Project Overview**
This project was launched to test the feasibility of using alternative sources of energy around the Michigan Tech campus. We are using wind power and a load/diversion system from TRI-STAR.

*Working on the vertical axis wind turbine (VAWT)*

**Flexible Hydraulic Station**

Team Member
Derek Eek, Mechanical Engineering Technology

Advisor
David Wanless

Sponsors
ArcelorMittal, HydraForce

**Project Overview**
The flexible hydraulic station is intended for elective courses within the School of Technology. The goal is to design a new station that has horizontal and variable mounting methods compared to the vertical and rigid hydraulic stations currently in use. Additionally, the use of cartridge-valve technology has been incorporated with the electrical control via a PLC for added flexibility over the mechanical controls currently in use.

*Proposed frame design for use with electrical and hydraulic components.*

**Caterpillar Extendable Boom**

Team Members
Andrea Klumpp, Gareth Tomlinson, Robert Jane, Andrew Kremkow, and Luka Stupar, Mechanical Engineering

Advisor
Gordon Parker

Sponsors
Caterpillar, Kent Smith

**Project Overview**
Our team is developing a variable-length boom for a Caterpillar Pipelayer. This boom will have the ability to extend from 24 to 28 feet. The transition from the 24- to the 28-foot length position is performed through the rotation of extension bars that are attached to the boom end. These extension bars are attached to a cross beam while at the 24-foot position and are detached from the cross beam to extend to the 28-foot position.

*Isometric view of the 24-foot boom setting*
136  
**Sickle Section Material and Heat Treatment Investigation**

*Image of a sickle section assembly from the field*

**Team Members**  
Kelsey Michael, Anne Wiese, Luke Operhall, and Bradley Pasionek, Materials Science and Engineering

**Advisor**  
Mark Plichta

**Sponsor**  
Kondex

**Project Overview**  
Kondex Corporation has asked us to analyze new materials and heat treatments for sickle sections. The improvement of the sickle sections will encompass material selection and heat treatment options, both of which have to be readily employable at Kondex’s manufacturing facility. The improvement process will primarily look at varying alloy additions in steels and induction hardening as this heat treatment is most commonly employed in the industry. The materials to be examined are 1080, 5140, 8660, 10B38 steels along with A-2 tool steel.

137  
**Materials Test Stand**

*Image of a test stand*

**Team Members**  
John VanDussen and Gabe Lannet, Mechanical Engineering Technology

**Advisor**  
Mark Johnson

**Sponsor**  
School of Technology

**Project Overview**  
Our goal is to build a teaching tool for the Department of Materials Science and Engineering.

138  
**Microstructural Contribution to Thermal-Mechanical Fatigue Properties of Gray Iron Brake Rotors**

*Image of ultrasonic testing influenced by the graphite morphology in gray iron*

**Team Members**  
Matt Smith, Thaddeus Waterman, Collin Tether, Alex McQuarter, and Melissa Wright, Materials Science and Engineering

**Advisor**  
Paul Sanders

**Sponsor**  
Meritor

**Project Overview**  
Meritor is a global leader in drivetrain, mobility, braking, and aftermarket systems for commercial and industrial vehicles. Currently, the test conducted by Meritor to evaluate the thermal-mechanical fatigue properties of brake rotors is a dynamometer performance test. Due to the destructive nature of the testing procedure, not all brake rotors can be tested. As a result, Meritor has asked us to develop a nondestructive method to predict the thermal-mechanical fatigue properties of their gray iron brake rotors. The nondestructive method of ultrasonic testing will be the primary testing method.
139
Automotive Leak-Tester Software

Team Members
Nathan Booms, Computer Engineering; Rachel List and Fran Madsen, Electrical Engineering

Advisor
Trever Hassell

Project Overview
We will test and evaluate leak-tester software for an automotive application. Functionality and aesthetics were evaluated for each software revision. Competitive analysis of current leak-testing units was conducted to further understand the needs of the market.

The team at work: Fran Madsen, Rachel List, and Nathan Booms

140
Soldier Personal Cooling System

Team Members
Nathan Morris and Daniel Fowler, Mechanical Engineering; Andrew Apsite, Nathan Hineline, and Bryan Belvin, Electrical Engineering

Advisor
Trever Hassell

Sponsor
BAE Systems Land and Armaments

Project Overview
Military vehicles, such as the Bradley Fighting Vehicle and Ground Combat Vehicle, are operated in harsh environments that can be physically demanding on soldiers. Heat-related stress when traveling to and from missions is often detrimental to the soldier and mission objectives. Conventional vehicle-level climate-conditioning systems require a lot of power to operate. Current heat-abatement systems applied to soldiers are bulky, heavy, or require removal of body armor to use properly. This project seeks to design a personal-cooling system to reduce heat-related stress.

Thermoelectric personal-cooling system

141
Tactical Traverse Apparatus

Team Members
Karl Gubert, Mary Gardner, Ben Daavettila, Cole Hume, Chelsea Ruff, Nathan Saliga, and Benjamin Kalis, Mechanical Engineering

Advisor
Jeff Allen

Sponsor
Air Force Research Lab

Project Overview
The Air Force Research Lab has organized a design competition between universities across the country: develop a tactical traversing apparatus for use by airmen on the ground during missions. Current solutions include avoiding the obstacles, crossing without a tool, or bringing a bulky and cumbersome aluminum ladder. The apparatus will be judged at the competition by criteria such as spanning length, weight, carrying capacity, compacted volume, additional functions, etc.
142 Meritor Axle Carrier Weight Reduction

Dismantling the current axle carrier to generate some new ideas

Team Members
Nick Harris, Michael Ponte, Le Lin, and Michael Hubble, Mechanical Engineering
Advisor
Michael LaCourt
Sponsor
Meritor

Project Overview
Our goal is to decrease the dry weight of a current axle by 100 pounds or 25 percent. Due to a decreased input load to the new systems, major components have been scaled down in order to decrease the weight. A new carrier housing has been developed that is cast of aluminum rather than gray iron. In order to verify the scaling and geometric changes, shafts have been tested based on maximum input torque.

143 Hatchback Rear Header Optimization

Hatchback rear header

Team Members
Scott Thompson, Daniel Polovich, Benjamin Kloster, Jacob Bruggink, and Clayton Brown, Mechanical Engineering
Advisor
Charles Van Karsen
Sponsor
Chrysler

Project Overview
Our goal is to design, engineer, and build a rear header/liftgate hinge system on a compact vehicle.

144 Intrusion Detection Systems

The three intrusion detection systems that we evaluated

Team Members
Alex Kordas, Matthew Gaedke, and Derrick Smith, Computer Network and System Administration
Advisor
Xinli Wang
Sponsor
School of Technology

Project Overview
We have selected three different intrusion detection systems (IDS) and elected to compare each of them to see which application is superior. To do this, we have created a comprehensive metric to evaluate each application. This metric will provide us with justification and reasoning for the score each application will receive.
145
Breaker Wear Monitoring

Team Members
Beau Baldwin, Matt Boersema, Nathan Rogers, Sarah Wells, and Elias Whitley, Electrical Engineering

Advisor
John Lukowski

Sponsor
ITC Holding and Mitsubishi Electric

Project Overview
Our goal is to create a setup to test a Mitsubishi 120SFMT40J transmission breaker at low voltage/high current (40,000A) (LVHC) and to use interruption data from specific ITC breakers to estimate percent wear based on a new Mitsubishi wear curve. The LVHC test will use an SEL-351-s relay, determined to be the best by a previous Senior Design team, to monitor the current and the corresponding interruption. We want to verify that the wear-accumulation program on the relay is functioning as specified.

146
Helical Gear Differential Test Rig

The testing rig that was assembled by past teams

Team Members
David Couillard, Brandon Hein, Zachary Hersch, and Keegan Post, Mechanical Engineering

Advisor
Bill Endres

Sponsor
American Axle and Manufacturing

Project Overview
American Axle and Manufacturing (AAM) requested a test rig be built to evaluate surface treatments of their differential housings. This rig should test different surface treatments applied to differential housing to determine the best for wear prevention. Currently, AAM uses a full axle and differential, which is both costly and time consuming in addition to the catastrophic failures that compromise their results. This is a continuation of past Senior Design teams who were unable to achieve repeatable accuracy in their testing, as required by AAM.

147
Extension Ladder and Automatic Leveler Integration

Team Members
Kyle Kovacs, Aaron Lilly, John Sand, and Huajun Ni, Mechanical Engineering

Advisor
Bill Endres

Sponsor
Jershon Inc.

Project Overview
We are designing an extension ladder with an automatic leveling system integrated into the design. We are completing the extension ladder project for Butch Kurzer of Jershon Inc., working with a second Senior Design team, which has designed the ladder-leveling system. The most important constraint for the system integration project is that the ladder is 29 feet in length when fully extended. Also, the ladder system should meet a 30 percent weight reduction from the target ladder. All design aspects must meet all ANSI standards that apply.
148  
**Stainless steel-bonded titanium carbide**

*Running a transverse rupture test to establish a baseline for mechanical properties of tungsten carbide test bars*

**Team Members**
Max Rebottaro and Michael Buhr, Mechanical Engineering; Carolyn Lahti and Andrew Miko, Material Science and Engineering  
**Advisor**
Paul Sanders, Materials Science and Engineering  
**Sponsor**
Kennametal

**Project Overview**
Our team has developed stainless-steel-bonded titanium carbide as an alternative material for cobalt-bonded tungsten carbide. The need has arisen due to escalating prices for tungsten carbide. This alternative material will be developed using powder metallurgy processing as well as hot isostatic pressing (HIP).

149  
**Blast Specialty Tapping Bit**

*Drill set up for drilling a sample of blast furnace clay*

**Team Members**
Mike Doll, Mechanical Engineering Technology; Ben Holtz, Electrical Engineering and Mechanical Engineering; Greg Holl, Materials Science Engineering; and Evan Yuhala, Chemical Engineering  
**Advisor**
Paul Sanders  
**Sponsor**
ArcelorMittal

**Project Overview**
Blast furnace tapping at ArcelorMittal's steel plant requires a specialty bit. These bits experience wear due to intense heat and pressure as they bore through tap holes filled with refractory clay. As a consequence of this operation, bits can break before the hot metal is reached. Previously, an Advanced Metalworks Enterprise team constructed a test rig employing a pneumatic rock drill. This year, the test method will be developed and a range of test conditions will be evaluated. Based on these findings and materials knowledge, the team will design and fabricate a bit for tapping ArcelorMittal's blast furnaces.
Get Involved

Support of High School Enterprise allows Michigan Tech and partnering institutions in K-12 and higher education to implement learning in ways typically unavailable to K-12 students. HSE aims to expand the pathway into STEM postsecondary education and careers with emphasis on underrepresented groups. You can help by pledging your support to the program in several ways. Support a team at a school near you, support the outreach efforts at Michigan Tech, or both. Please contact us to discuss options.

Douglas E. Oppliger, Director
High School Enterprise Program
Michigan Technological University
oppliger@mtu.edu • 906-487-2514

www.highschoolenterprise.org
Mining is a high-tech world at Cliffs Natural Resources, and Cliffs Michigan Operations is dedicated to helping students learn about it. Cliffs recently made contributions totaling $2,000 in support of the robotics programs at local high schools. These robotics programs incorporate Science, Technology, Engineering and Math (STEM) into their curriculum. The program helps prepare students for high-tech, high-demand jobs in the future.

Technology-based jobs are a priority at Cliffs, where technology plays a significant role in the mining operations on a daily basis, as well as in the areas of research and development of mining processes and procedures. We are proud to serve as a source of support for the educational and occupational advancement of the youth in our community.

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Team Leaders
Alisha Clark and Justin Poirier, Mechanical Engineering
Advisor
James DeClerck, Mechanical Engineering-Engineering Mechanics
Sponsors
Autodesk, Plascore, The Michigan Tech Fund

Project Overview
Each year, students from Michigan Tech gather to imagine, design, build, test, and race a small-size formula-one race car as the Formula SAE Enterprise team. Students gain hands on experience with topics such as engine tuning, Autodesk and CAD designing, budgeting, working around space constraints, and much more. This event is run through the Society of Automotive Engineers and takes place in the summer at locations all over the world.

Team Leaders
Evan Beckner, Operations and Systems Management; Katy Hickey, Biomedical Engineering
Advisor
Robert Warrington, Institute for Leadership and Innovation; Michael Neuman, Biomedical Engineering

Project Overview
International Business Ventures is a biomedical product development Enterprise dedicated to creating biomedical solutions for problems around the globe. Featuring a wide array of majors, IBV is one of the most diverse Enterprises on campus. We structure ourselves after corporate businesses and include a hierarchy of management that emulates what students will find on the job market. We currently focus on three projects; an infant heart annunciator, a pandemic ventilator, and a mobile clinic that will be shipped to Ghana to provide aid to remote villages. We also feature a business team responsible for grant writing, marketing, and fund management.

Team Leaders
Michael Wood and Chad Kromrey, Mechanical Engineering
Advisor
Jason Blough, Mechanical Engineering-Engineering Mechanics
Sponsors
Camoplast, John Deere, DENSO, Cummins, Vconverter, 3M, HMK, TIAL Sport, E3, ArcelorMittal, Oshkosh, Autodesk, Ford Motor Company, Polaris, Chrysler, Woody’s, ArcticFX, IceAge, NGK, AMSOIL

Project Overview
Clean Snowmobile Enterprise is given the task of creating cleaner and quieter snowmobiles while maintaining performance. We design two completely different snowmobiles every year: one internal-combustion-powered snowmobile and one all-electric snowmobile with zero emissions. Each snowmobile is built with a specific purpose.
Enterprise Teams 2013  •  25

204
Blue Marble Security

Team Leaders
Rachel Swaney, Electrical Engineering, and Tyler Novak, Computer Engineering

Advisor
Glen Archer, Electrical and Computer Engineering

Sponsors
ArcelorMittal, Cinetic Dyag, Pall Corporation, Fox Converting, Physics Department, Harris Corporation

Project Overview
Our Enterprise has developed a culture that fosters high professional standards, creativity, productivity, and a burning desire to learn. Our graduates are ready for the world’s most challenging careers. Blue Marble’s main business thrusts continue to be focused on industry-sponsored R&D and commercial product development. We sponsor several projects over a wide variety of technological specialties, including optical communications, power applications, and industrial process control. Though located in the ECE department, members of Blue Marble come from a host of other disciplines, including mechanical engineering, computer science, and business.

205
Aerospace Enterprise

Team Leaders
Jacob LaSarge, Mechanical Engineering; and David Kiektveld, Mechanical Engineering Technology

Advisor
L. Brad King, Mechanical Engineering-Engineering Mechanics

Sponsor
Air Force Research Laboratory

Project Overview
The Aerospace Enterprise team works within the field of aerospace design to create, construct, test, and operationally manage all areas of a satellite mission. The current project of the Aerospace Enterprise is the Oculus-ASR, a nanosatellite designed to act as a calibration satellite for Air Force telescopes. The Oculus-ASR project team is assembling and testing the final flight components of the vehicle, in order to be ready for integration and future launch.

206
Wireless Communication Enterprise

Team Leaders
Scott Geverink and Kara Eshelman, Electrical Engineering

Advisor
Christopher Cischke, Electrical and Computer Engineering

Sponsors
HGST, Chrysler, DTE Energy, Electro Dynamic Applications, Team Tech, Kyocera

Project Overview
Wireless Communication Enterprise (WCE) is a student-led virtual company focused on wireless, optical, and renewable energy. WCE has project experience in lasers, RFID, wind/solar power, PCB design, and embedded systems programming. We work as a think-tank for companies looking to push their product lines to a higher level. We also work as entrepreneurs, taking our own ideas to a level where they can be useful for industry and consumers alike. We are always looking for sponsors to challenge us with projects. WCE members come from many majors, including electrical, computer, biomedical, and mechanical engineering; scientific and technical communication; and business.
Alternative Fuels Group

Team Leaders
Cory Schafer and Robert LeBrell, Chemical Engineering

Advisors
Wenzhen Li, Chemical Engineering, and Jay Meldrum, Keweenaw Research Center

Sponsors
Ford Motor Company Fund

Project Overview
Our enterprise is devoted to researching new and innovative alternatives to fossil fuels. We are currently working on three exciting alternative-fuel-related projects: fuel cell, solar car and clean energy. The direct crude fuel cell team is developing a very low-cost fuel cell that can directly use biodiesel waste crude glycerol for high-power density bioelectricity generation. The interdisciplinary solar car team is building a competitive solar-powered vehicle. The clean-energy team, which is supervised by the KRC Director Jay Meldrum, is determining how clean energy, such as solar array, geothermal energy, and micro-hydropower, performs in the UP.

Ford Motor Company Fund

Mini Baja Enterprise

Team Leaders
Nathan Koetsier and Zachary Peck, Mechanical Engineering

Advisor
Brett Hamlin, Engineering Fundamentals

Sponsors

Project Overview
The SAE Baja team designs a single-seat off-road race car around a stock 10 HP Briggs and Stratton engine. The team focuses on suspension and drive-train design and optimization. The two main projects taken on by seniors this year were a hydraulic energy-recovery system and the application of alternative material (nonmetallic) in high-stress areas of the car. The energy-recovery team looks to regain some of the energy lost in braking and apply it to acceleration. The materials team looks to use composites and polymers in suspension components throughout the car.

Efficiency Through Engineering and Construction

Team Leaders
Nathaniel Jurmu, Civil Engineering, and Jessey Poissant, Construction Management

Advisor
Lynn Artman, School of Technology

Sponsors
NuRail, Michigan Department of Transportation (MDOT)

Project Overview
ETEC is currently involved in two projects with a total of nine members. Within ETEC, Team 1 is conducting research for MDOT with funding from NuRail, collecting data on statewide railroad crossings, determining deterioration estimates based on average daily traffic, surface type, and current conditions, and developing a recommendation on surface types and surface evaluations for future projects. Team 2 is currently working at the Ford Forestry Center in Alberta, Michigan, to reduce heating costs and increase sustainability through proper insulation and maintenance of its current structures, while maintaining a reasonable budget.
Husky Game Development

Two members playing Ryxius, a space game created by HGD.

Team leader
Ryan George, Computer Network and System Administration
Advisor
Scott Kuhl, Computer Science

Project Overview
Husky Game Development (HGD) focuses on the design and implementation of video games for educational, commercial, and entertainment purposes. Our goal is to prepare our members for a career in game development by using industry standard practices, such as agile development, to create polished, quality games. HGD is proud to invite more than 100 Michigan Tech and Northern Michigan University students and faculty to participate in the annual BonzAI Brawl, an artificial intelligence (AI) competition hosted with Women in Computer Science, where competitors are challenged to create an AI that plays a game created by Husky Game Development exclusively for BonzAI.

ITOxygen

Information Technology, Web and Software Development: It’s not Greek to us.

Team Leaders
Kris Gauthier, Computer Engineering, and Ben Christensen, Computer Network and System Administration
Advisor
Russ Louks, School of Business and Economics

Sponsors
Target, CCI Systems, Marblehead and Lobster Company

Project Overview
ITOxygen members work on real-world projects that foster skills development and business savvy. Custom IT solutions are not Greek to us! Projects include: Target mobile, a cross-platform mobile app used to by Target employees to arrange carpooling; Target CloudRed, finding a way to rapidly deploy Target Lab environments fully configured at the click of a button; and CCI Beacon, a Ruby on Rails app made to monitor developer performance by using Github API.

SAE Supermileage Systems Enterprise

Team Leaders
Justin Engwis and David Deisenroth, Mechanical Engineering
Advisor
Rick Berkey, Institute for Leadership and Innovation
Sponsors
Alcoa, Chrysler, Cummins, DENSO, Caterpillar, Ford, 3M, Polaris, ArcelorMittal, GM, John Deere, Mitsubishi Electric, Teamtech, Pi Innovo, Autodesk

Project Overview
Supermileage Systems Enterprise (SSE) designs, engineers, and fabricates a one-manned, super-high mileage vehicle built around a 3.5 HP Briggs and Stratton, four-stroke single-cylinder engine. The team's goal is to evaluate and redesign system failures to achieve our desired system goals of 1,500 MPG or better; three hours of continuous load without malfunctions; sound engineering; vehicle functionality; rules compliance; and serviceability/ease of maintenance.
213 Consumer Product Manufacturing

Solid separator created by CPM’s aquaponics team used to remove waste from process water

Team Leaders
Robert Parker and Elaine Emerick, Chemical Engineering

Advisors
Tony Rogers and Sean Clancey, Chemical Engineering

Sponsors
Kimberly-Clark Corporation, Dow Corning Corporation, nanoMAG LLC, Sustainable Futures Institute, The Pavlis Institute, and Kanwal Rekhi

Project Overview
In CPM, multidisciplinary student teams create innovative product and process solutions that address the needs of commercial and University sponsors. Current projects include optimizing manufacturing processes, improving the life cycle of repurposed manufacturing wastes, optimizing a sustainable aquaponics system, developing a new consumer product, integrating high-tech materials into athletic equipment, and tailoring biochar production to meet the needs of developing countries.

214 Velovations

Grinding down parts for use in nonstandard applications

Team Leader
David Kravis, Mechanical Engineering

Advisor
John Ganshenson, Mechanical Engineering-Engineering Mechanics

Sponsors
Cane Creek, Niner, Park Tool, Saris Cycling Group, Specialized, SRAM, World Bicycle Relief.

Project Overview
We are the bicycle-design enterprise. We collaborate with bicycle-industry partners to develop new products and processes. Through hands-on project work for our industry sponsors, we research, design, prototype, and test the next generation of bicycles and bicycle components.

215 Hybrid Electric Vehicle Enterprise

HEV Enterprise team

Team Leaders
Andrew Hoekstra, Computer Engineering; and Michael Carey, Mechanical Engineering

Advisors
Robert Page and John Lukowski, Mechanical Engineering-Engineering Mechanics

Sponsors
Engineered Machined Products, Trubiquity, ByteWorx, Kramer Metal Fab, TurboTools, Martin Collision, Department of Mechanical Engineering-Engineering Mechanics, Department of Electrical and Computer Engineering, General Motors, and Ididit, Inc.

Project Overview
The Hybrid Electric Vehicle (HEV) Enterprise is a three-year program to research, design, build, and test a state-of-the-art hybrid electric vehicle, based on a 1950 Chevrolet truck. Students will learn about the performance trade-offs of different types of hybrid powertrain architectures and components, program management, component/subsystem design and testing, and will gain valuable leadership skills.
Advanced Metalworks Enterprise (AME)

Team Leaders
Daniel Freiberg and Michel Knudsen, Materials Science and Engineering
Advisor
Paul Sanders, Materials Science and Engineering
Sponsor
ArcelorMittal, Eastern Alloys, GE Aviation, Kennametal, Macliner, Meritor, Michigan Technological University

Project Overview
Advanced Metalworks Enterprise (AME) focuses on the production of high-quality metal products and development of precision processes and methods for our industrial sponsors. We are a diverse group of business majors and mechanical, chemical, and materials science engineers who are always looking for new members. AME has increased productivity and expediency of completed projects. We strive to expand beyond traditional manufacturing to increase quality of our products and results to better satisfy our sponsors and customers.

BoardSport Technologies

Team Leaders
Jonathan May, Mechanical Engineering Technology; and Brian Weisner, Mechanical Engineering
Advisor
Ibrahim Miskioglu, Mechanical Engineering-Engineering Mechanics
Sponsor
Michigan Technological University

Project Overview
BoardSport Technologies is working to create a press that can be used for not only pressing skis and snowboards but for skateboards and eventually longboards as well. The team is also creating a manual that can be used by anyone looking to build his or her own skis. This manual will include everything from how to build a press and die to material selection and building instructions.

Green Campus Enterprise

Team Leaders
Zach Ziemke, Environmental Engineering; and Douglas Weyher, Mechanical Engineering
Advisor
Christopher Wojick, Civil and Environmental Engineering
Sponsor
Michigan Technological University

Project Overview
The overall goal of Green Campus Enterprise is to reduce Michigan Tech’s carbon footprint. The Wind Team and Buildings Team are both presenting their projects as they near completion. The Wind Team is collecting wind data in the Houghton area and using that data to determine whether it would be feasible for Michigan Tech to install a wind turbine. The buildings Team is designing and installing a solar-thermal collector demonstration system to test the feasibility of solar-thermal technology in the Houghton area.
Team Leader
Margo Woller-Carter, Psychology
Advisor
Robert Pastel, Computer Science
Sponsor
Chrysler

Project Overview
We develop and test user-centered applications for Chrysler's UConnect system.

Team Leaders
Megan Crowley, Applied Ecology and Environmental Sciences; Matthaeus Saavedra, Computer Engineering
Advisor
Aleksandr Sergeyev, School of Technology
Sponsors
ArcelorMittal, GM, BAE Systems

Project Overview
The Robotic Systems Enterprise works hand in hand with area high schools through the worldwide FIRST Robotics program to spread interest in the fields of science and technology. Outside of FIRST, the Robotic Systems Enterprise is working on industry projects involving robotics. Our current project is developing a proof of concept of a vision system for ArcelorMittal.
CinOptic Communication and Media

Team Members
Nathan Hunter and Lindsey Johns, Electrical Engineering Technology
Adviser
Erin Smith, Humanities
Sponsors
Michigan Tech Rail Transportation Program, Department of Chemical Engineering

Project Overview
CinOptic is creating videos for two clients. The Rail Transportation Program needs a promotional video that encompasses an audience of students and potential sponsors, showing them that rail is the future. The Department of Chemical Engineering wants a new safety video for some of its chemical labs as part of their project to create a safer lab environment.
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