

MICHIGAN STATE  
UNIVERSITY



MICHIGAN STATE UNIVERSITY *Fall 2014*  
**Design Day**  
COLLEGE OF ENGINEERING



**BOSCH**

*Executive Partner Sponsor*



# Providing innovative solutions

## Welcome to Design Day!

Bosch is proud to partner with MSU on this important event that showcases the innovation, competitive spirit and commitment to excellence that has long defined MSU.

Engineers have the ability to not only ask the "what-if" questions that take innovation to the next level, they also have the capabilities to bring these ideas to life. For those who are participating in Design Day: Congratulations. This is your time! The quality of the capstone projects and the dedication of the MSU students is what keeps companies like Bosch coming back to this great event.

For more than 125 years, Bosch has focused on innovating and bringing to market technologies that will make people's lives better, safer, cleaner, and more economical. We say, Bosch technologies are, "Invented for life." MSU is one of our go-to universities to find this top talent.

Today, Scott Winchip, regional president of Chassis Systems Control, will address Design Day to highlight automated driving. Bosch has been a leader in developing safety and driver assistance technologies that not only make today's vehicles better and safer, they also enable automated driving.

Let's learn more about one another during Design Day; we look forward to it. Go Green!

Sincerely,

Charlie Ackerman  
Senior Vice President, Human Resources  
Robert Bosch LLC

[www.boschcampus.com](http://www.boschcampus.com)



**BOSCH**  
Invented for life

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# Welcome from the Dean



## **As Dean of the College of Engineering, on behalf of the entire faculty, I welcome you to Design Day!**

We wish you an enjoyable event as you experience our students and their amazing talents through presentations, competitions, demonstrations and posters.

We are pleased to acknowledge Bosch as our Design Day Executive Partner Sponsor and Whirlpool as our Design Day Directing Partner Sponsor. Our Design Day Supporting Partner Sponsors include ArcelorMittal, Auto-Owners Insurance, Chrysler, General Motors, the MSU Alumni Association, the MSU Federal Credit Union, Norfolk Southern and TechSmith. We thank all of our sponsors for their generosity and their ongoing commitment to Design Day.

As you explore the exhibits throughout the Engineering Building, you are encouraged to take time to learn about the projects by talking with our students. They are an incredible group of people who love to share their enthusiasm for engineering.

Starting in their first semester, our freshmen learn about the importance of engineering and the positive impact that engineers make on society and the world around them in our Cornerstone and Residential Experience for Spartan Engineers program. Be sure to stop by and see how they innovate, communicate and perform at the highest levels in an increasingly global and demanding world.

Another exciting part of Design Day is the Dart Foundation Day of Engineering Innovation and Creativity for 7th-12th Grade Students, which involves some 200 local junior high and high school students. On Design Day, these future engineers explore design principles with hands-on projects requiring the application of their creativity and ingenuity.

The headliners of Design Day are our graduating seniors as they present their design projects through exhibits, posters and presentations. Their projects represent the capstone of their educational career. You will see that our graduating MSU engineers are ready to lead, create and innovate.

Our capstone programs and Design Day would not be possible without the continued support of our capstone project sponsors who provide both funding and a professional experience for our capstone design teams. We appreciate their generosity and their time.

Please join us for the Design Day Awards Ceremony in Anthony Hall Room 1281 at 1:15 pm when we will honor all of our talented Spartans, the best of the best.

A handwritten signature in black ink, appearing to read 'Leo Kempel', with a long, sweeping horizontal line extending to the right.

**Dr. Leo Kempel**

Dean of the College of Engineering  
Professor of Electrical and Computer Engineering  
Michigan State University

Michigan State University



# Design Day Events Schedule

## Friday, December 5, 2014

EVENTS	7 a.m.	8 a.m.	9 a.m.	10 a.m.	11 a.m.	Noon	1 p.m.
Audio Enthusiasts and Engineers		2nd Floor Room 2228 8:00 a.m. – Noon					
Engineering Student Organizations		1st Floor Lobby and East Lobby 8:00 a.m. – Noon					
Tesla Coil			EB/Room 2205 9:00 a.m. – Noon				
ECE 101 Presentations			2nd Floor 2200 Hallway 9:00 a.m. – Noon				
EGR 100 Presentations			2nd Floor 2300/2200 Hallway 9:00 a.m. – 11:30 a.m.				
ME 371 Demonstrations			1st Floor Rooms 1225 & 1230 9:00 a.m. - Noon				
ME 412 Competition			1st Floor Room 1240 8:30 a.m. - Noon				
ME 471 Competition		1st Floor Room 1345 8:00 a.m. - Noon					

CAPSTONE COURSES					
All Capstone Posters for most projects		1st Floor 1300 Hallway 8:00 a.m. - Noon			
CE 495 Project Presentations			1st Floor Room 1538 & 3rd Floor Room 3540 9:00 a.m. - 11:40 a.m.		
CSE 498 Project Presentations		3rd Floor Room 3405 7:30 a.m. - Noon			
ECE 480 Project Presentations		2nd Floor Room 2250 8:00 a.m. - 11:40 a.m.			
ME 481 Project Presentations			1st Floor 1200 Hallway/Rooms 1208 & 1220 8:30 a.m. - Noon		

OPENING, LUNCH AND AWARDS							
High School Opening			1st Floor Anthony, Room 1279 8:00 a.m. – 8:40				
High School Award			1st Floor Anthony, Room 1279 12:15 p.m. – 12:30 p.m.				
MSU Awards			1st Floor Anthony, Room 1281 1:15 p.m. – 2:00 p.m.				



### Social Media Links:

"Like" the College: <https://www.facebook.com/SpartanEngineering>

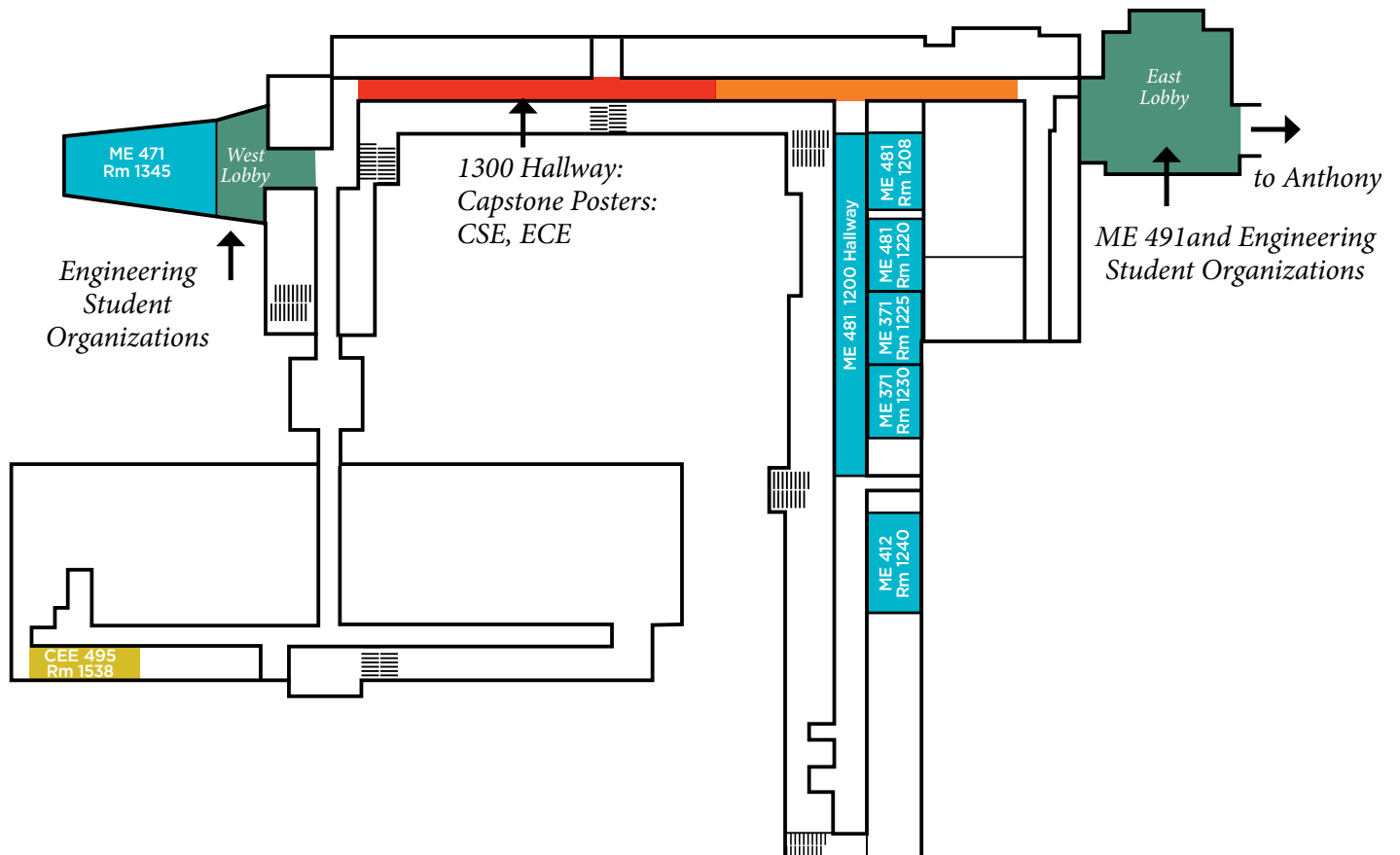
"Follow" the College: [https://twitter.com/msu\\_egr\\_news](https://twitter.com/msu_egr_news)

### To stay up to date w/Careers in Engineering:

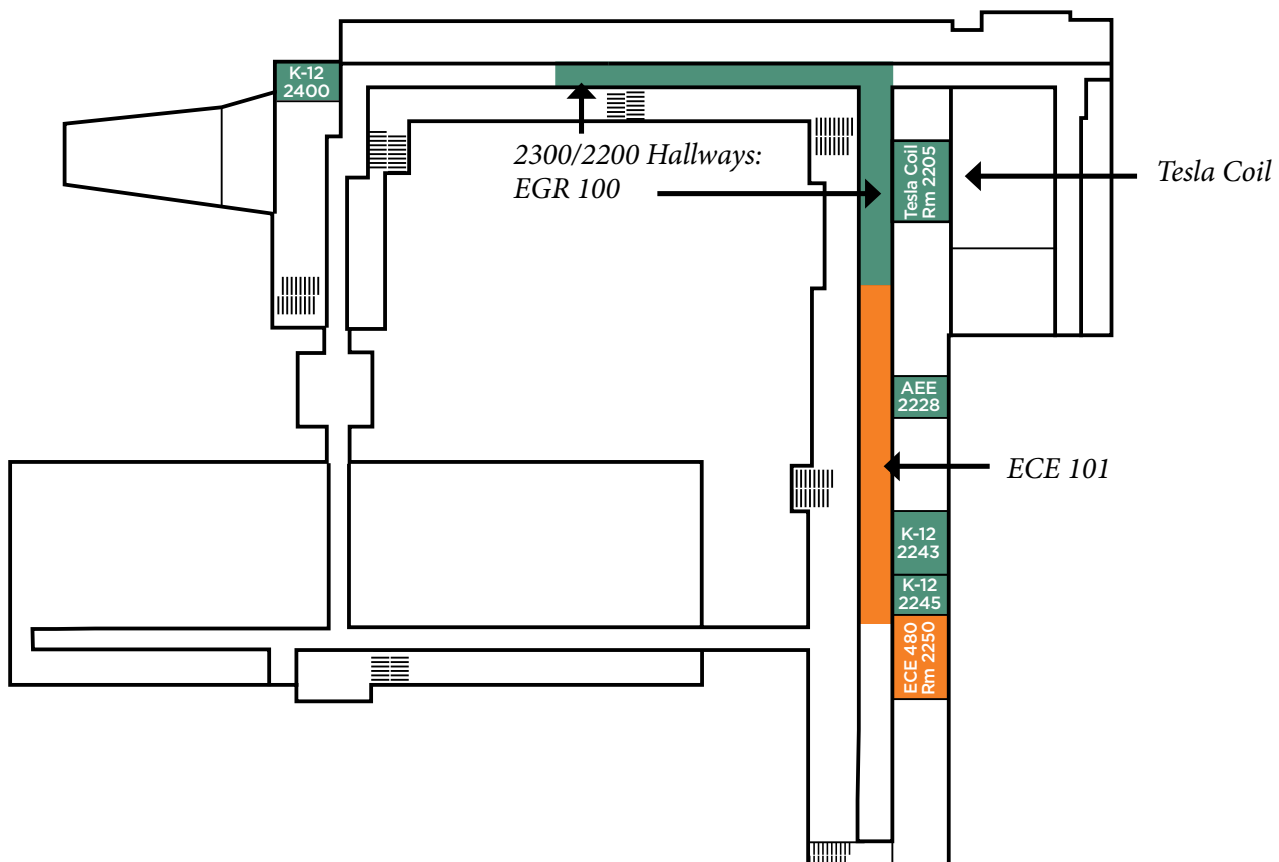
"Like" Us <http://www.facebook.com/pages/The-Center-for-Spartan-Engineering/226159694117936>

"Follow" Us: <https://twitter.com/msuengineer>

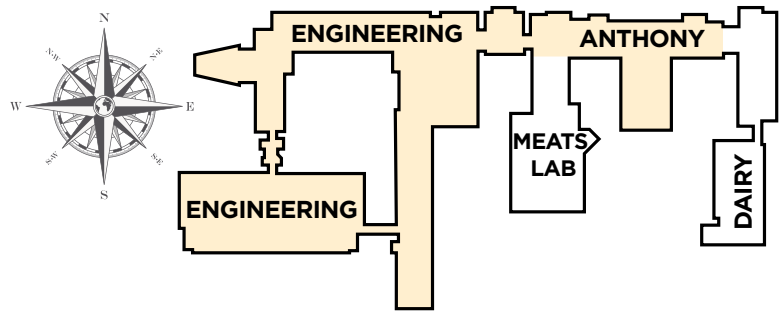
## 1st Floor Engineering



## 2nd Floor Engineering

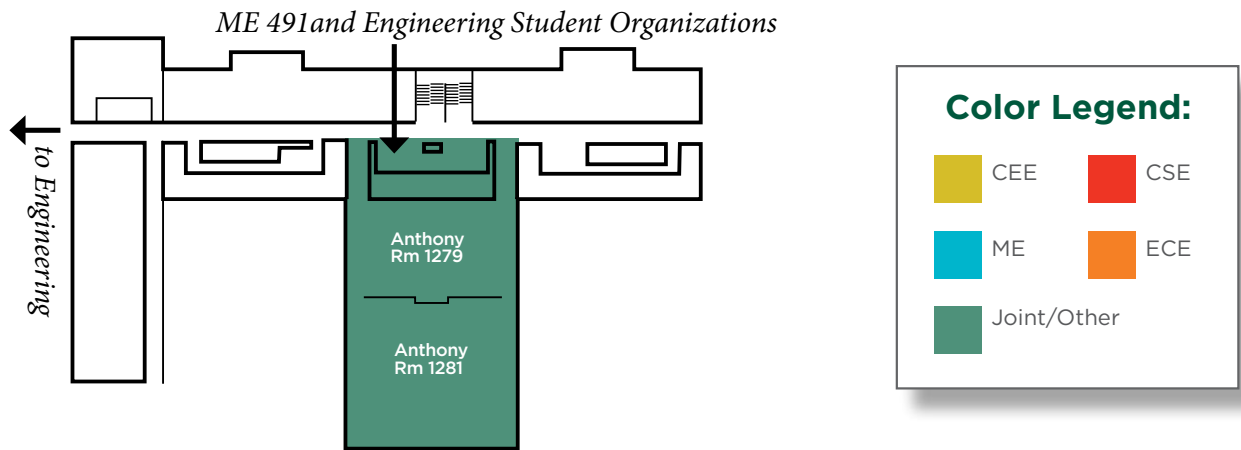


Overview

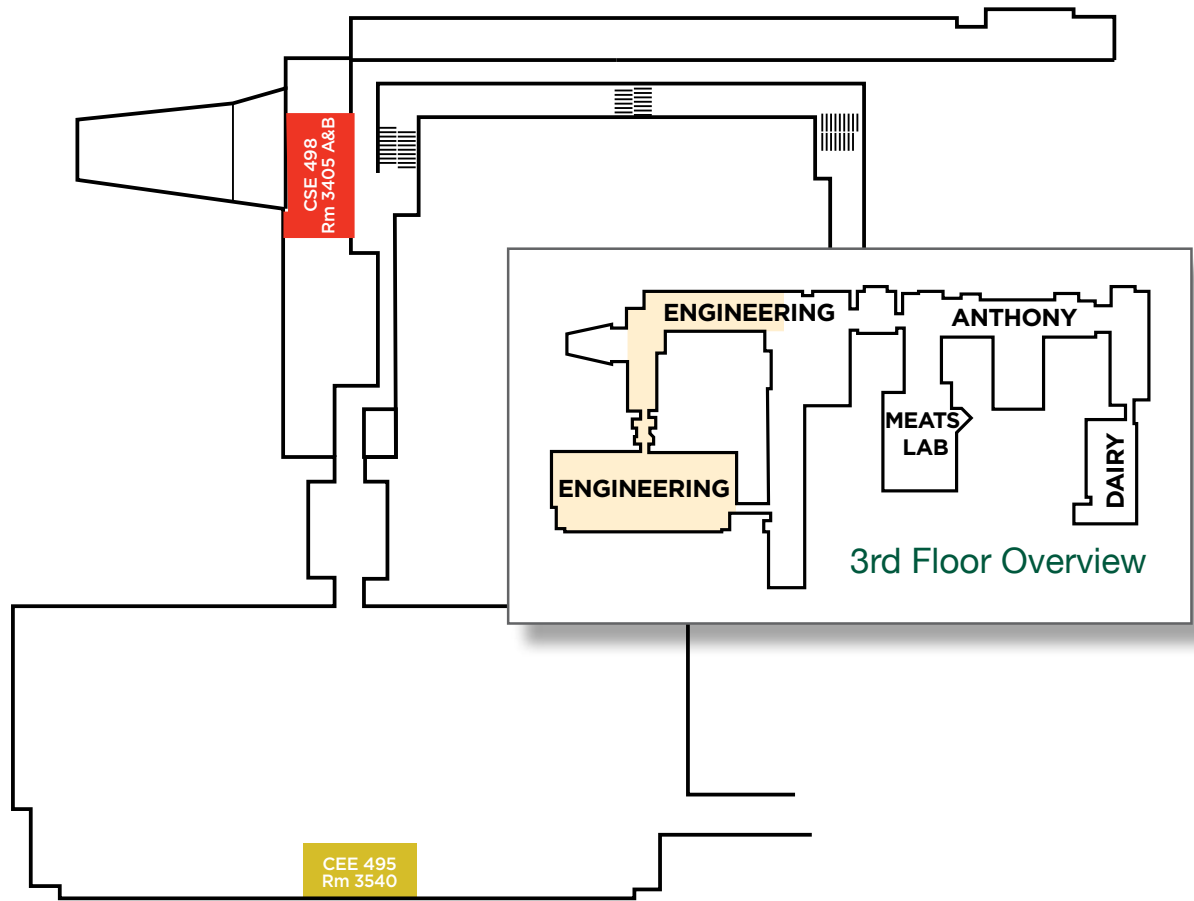


Design Day  
Floor Plans  
of the MSU  
Engineering  
Building

1st Floor Anthony



3rd Floor Engineering







**Success stories don't just happen. They are made.**



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Invented for life

## **Careers of the future: Green technology at Bosch**

### **Make your personal contribution to the green technology of the future.**

- ▶ Bosch is an innovator of resource efficient and eco-friendly technologies
- ▶ Almost 45 percent of our development budget is spent on future technologies that save energy and conserve resources
- ▶ Energy Star Sustained Excellence Award 2012 from the United States Environmental Protection Agency (EPA)

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# Dart Day of Innovation and Creativity *for 7th-12th Grade Students*



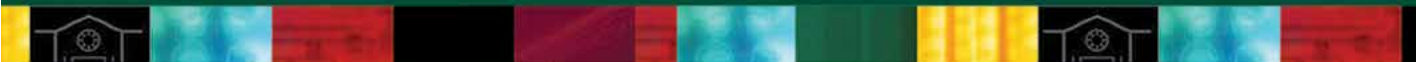
## Our Future Lies in Some Very Precious Hands...

At the Dart Foundation, we are committed to developing scientifically literate students in Michigan. We're proud to sponsor the MSU College of Engineering Design Day for pre-collegiate students.

Funded by the Dart Foundation



MICHIGAN STATE UNIVERSITY | College of Engineering



# The Dart Foundation

## Middle and High School Innovation and Creativity Day

**Precollege Student Voting:** During the morning on Design Day all visiting precollege students will be viewing Engineering Projects and voting.

During this time college students will have a chance to interact with “non-engineering” students and demonstrate the underlying principles from their projects. This interaction allows the college students an opportunity to practice explaining engineering concepts to non-engineers. As the precollege students work their way through the wide variety of presentations, they will get an overview of the many different branches of engineering. Additionally, as the precollege students see both entry-level and advanced engineering applications; it allows them to see the natural progression of engineering. Lastly, this session also provides a chance for the precollege students to interact with student organizations within the College of Engineering.



Office for Inclusion  
and Intercultural Initiatives



	Room 1279 Anthony Check in	C.E./M.E. Team Build Room 2245	VEX Robotics Room 2400	1st & 2nd Floor Voting/ project viewing	Center for Highway Pavement Preservation Room 2243
8:00–8:40	All Schools 1 thru 8				
8:40–9:30		Schools 1 & 2	Schools 5 & 6	Schools 3 & 4	Schools 7 & 8
9:30–10:20		Schools 7 & 8	Schools 1 & 2	Schools 5 & 6	Schools 3 & 4
10:20–11:10		Schools 3 & 4	Schools 7 & 8	Schools 1 & 2	Schools 5 & 6
11:10–12:00		Schools 5 & 6	Schools 3 & 4	Schools 7 & 8	Schools 1 & 2
12:15–12:30	All students in Room 1279 Anthony for the awards ceremony. Lunch will immediately follow.				

<http://www.egr.msu.edu/future-engineer/> LIKE US: <https://www.facebook.com/futurespartanengineers>

### UNIVERSITY TRANSPORTATION CENTER FOR HIGHWAY PAVEMENT PRESERVATION (CHPP)

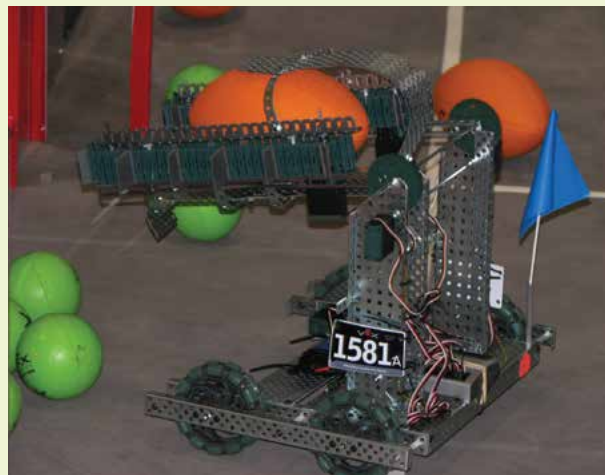
The need to protect the massive national highway infrastructure investment is recognized by Congress and clearly cited in the “Moving Ahead for Progress in the 21st Century Act” or the “MAP-21”. The establishment of CHPP is consistent with the U.S. Secretary of Transportation’s strategic goal of “State of Good Repair.” The mission of CHPP is aimed at providing a new platform for accelerating innovation in highway pavement preservation. The center will assist in meeting the increasing

demand for highway pavement preservation research and will further the goal of increasing the reliability and performance of the nation’s highways. Encouraging the best and brightest future engineers pursuing degrees and careers in transportation-related engineering disciplines should be a big priority. This CHPP session will center on showcasing innovative, creative, and fun challenges, as well as opportunities for participating high school students and teachers.



## VEX ROBOTICS

Our team of experts has designed a lab experience to give precollege students an introduction to robots. Students will work in small groups and have a hands-on approach learning to control the VEX robot. They will write programs using Robot C language, and they will program the robot to be controlled by a remote control. Application and discovery of how programming works will be similar to lessons presented in science and math classes. Each team will discover how to adjust their programs based upon the program inputs and actual output (robot performance). During each phase, new challenges will be introduced to engage the students. This will reinforce new ideas and concepts while exposing students to the newly emerging capabilities of student-controlled robotics programs.



## INTERDISCIPLINARY ENGINEERING BUILD

In this build you and your team will be integrating practices from multiple fields of engineering to build and evaluate a support system. Support systems can range from simple beams to intricate bridges composed of gussets, trusses, cables, etc. These types of systems are used throughout Civil, Mechanical and Structural Engineering works. This session will start with a brief introduction to the forces and stresses that act on support systems. Additionally, you will see how digital sensors can read and convey data about these stresses to a computer. We will also look at the computer code that takes this raw data and converts it into a format that can easily be interpreted.

During the build portion of this session you and your team will be given the design constraints for the structure. Utilizing the information learned at the start of the session and the limited materials provided, your team will need to design and then construct a model to be tested. Your finished structure will be placed on one of our

test beds for evaluation. With the help of MSU Engineering students, the results will be collected by a sonic ranging sensor. These data points will be interpreted by the computer program and your team will be evaluated on percent deflection of your support. Throughout this session you will need to listen, learn and utilize your team to be successful. Good Luck.



## MEMBERS OF THE ORGANIZING COMMITTEE FALL 2014



**Drew Kim**  
MSU Engineering  
Assistant to the Dean  
Recruitment,  
Scholarships, and K-12  
Outreach



**Dean Buggia**  
Instructor and  
Technology  
Teacher, Okemos  
High School



**Luis Donadoto**  
Assistant  
Director of MSU  
Engineering  
Recruitment and  
K-12 Outreach



**Rachel Esch**  
K-12 Outreach  
Administrative  
Assisant



**Alexandria Fisher**  
K-12 Outreach  
Design Student  
Coordinator



**Russ Pline**  
Okemos High  
School and MSU  
Engineering  
Recruitment and  
K-12 Outreach  
Design Day  
Coordinator



**Samantha Pohlen**  
K-12 Outreach  
Design Student  
Coordinator



**Bob Watson**  
MSU Engineering  
K-12 Outreach  
LEGO and  
VEX Robotics  
Coordinator



**Imen Zaabar**  
UTC Faculty and  
Outreach Team



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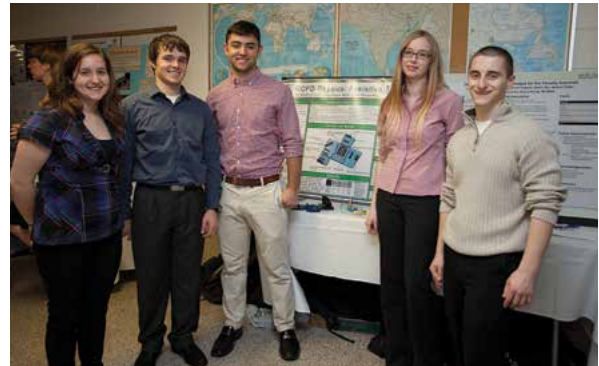
## **EGR 100** **Introduction to Engineering Design**

**Mr. Timothy Hinds**  
**Academic Director**

### **Course Project**

EGR 100, Introduction to Engineering Design, is a college-level course required of all incoming first-year engineering students. It is an integral part of the CoRe (Cornerstone and Residential) Experience. The course introduces students to the engineering profession and the engineering design process through team-based, interdisciplinary design projects and assignments. There are 926 students enrolled in EGR 100 this semester.

For the final course project, the student teams selected from six project types: (i) Solar Car Competition, (ii) Cell Phone App Inventor, (iii) Solar Water Heater Design, (iv) MSU Resource Center for Persons with Disabilities (RCPD) Adaptive Designs, (v) MSU Residential Hall Waste Reduction Designs, and (vi) CoRe industry-sponsored projects. There were two RCPD projects including Basic Electronics Assistive Tools and the MSU Adaptive Sports Clubs Hand Cycle Transfer Aid. Teams from each of the project types will display their prototypes at Design Day along with posters detailing their design concepts. Pre-college students will recognize the most outstanding projects with awards.



*RCPD Assistive Tools Physics*



*RCPD Electronics Project Presentation*

### **Spring 2014 EGR 100 Project Poster Award Winners:**

l-r: Pat Walton,  
Daniel Hurley,  
Victoria Toomajian,  
Tim Hinds, Leo  
Kempel, Pat Asmus  
(not pictured) Brian  
Jones, Jacob Richison



<http://www.egr.msu.edu/core/>



Resource Center for  
Persons with Disabilities



**Consumers Energy**  
Count on Us



**MICHIGAN STATE**  
UNIVERSITY

Residential College in the  
Arts and Humanities



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**ArcelorMittal**

# The Capstone Projects

**Faculty Advisors:**  
**Professors Haider, Ingle, Kodur, Li and Masten**



Haider



Ingle



Kodur



Li



Masten

## Presentation Schedule – Engineering Building, Rooms 1538 & 3540

Time	Team	Room
9:00 a.m.	Team One	Third Floor Room 3540 EB
10:20 a.m.	Team Two	Third Floor Room 3540 EB
9:00 a.m.	Team Three	Third Floor Room 1538 EB
10:20 a.m.	Team Four	Third Floor Room 1538 EB

## CE 495 Senior Design in Civil & Environmental Engineering

Undergraduates in Civil and Environmental Engineering must take CE 495. This capstone course prepares students for the workplace by providing an experience with the following challenges:

- A project with multiple issues that must be resolved using civil and environmental engineering knowledge;
- Formulation of conceptual solutions and resolution of conflicting design elements;
- Development of plans that comply with regulations and provide a basis for cost estimates;
- Balancing individual responsibility and group participation in a team based effort;
- Preparation of written reports and oral presentations.

Each team is responsible for developing a design that addresses environmental, geotechnical, hydrological, pavement, transportation, and structural issues for the project. A student project manager coordinates each team. Design reports are judged by the faculty; progress reports and the oral presentations are judged by a board of practicing professionals.

# CE 495 SENIOR DESIGN IN CIVIL & ENVIRONMENTAL ENGINEERING

## PROFESSIONAL SEMINAR SPEAKERS

Neeraj Buch, PE  
Michigan State University

Michele J. Buckler, PE  
Fishbeck, Thompson,  
Carr & Huber

Daniel G. Fredendall, PE  
OHM Advisors

Iman Harsin  
Michigan State University

Cheryl A. Kehres-Dietrich,  
CGWP  
Soil & Materials Engineers, Inc.

Emin Kutay, PE  
Michigan State University

Ryan D. Musch, PE  
Fishbeck, Thompson,  
Carr & Huber

Robert D. Rayl, PE  
RS Engineering, LLC

Charles Rolfe, PE  
OHM Advisors

Scott K. Stowitts, PE  
Walbridge

Michael J. Thelen, PE  
Soil & Materials Engineers, Inc.

Daniel Thome, PE  
Nicholson Construction  
Company

Roy D. Townsend, PE  
Washtenaw County Road  
Commission

Mark A. VanPortfleet, PE  
Michigan Department of  
Transportation

Christian G. Youngs, PE  
Michigan Department of  
Transportation

## PROFESSIONAL EVALUATORS

Engineers and scientists associated with the following firms, municipalities, and companies donated time to provide students with a practicing professional's perspective. We gratefully acknowledge their generous contributions.

Rick Chelotti, PE  
Bergman Associates

Andrew Hermiz, EIT  
Harley Ellis Devereaux

Todd Sneathen, PE  
Director of Public Works

Emily Warners, PE  
Consumers Energy

David Conklin, PE  
Fishbeck, Thompson,  
Carr & Huber

Matt Junak, PE  
HNTB

Geneva Vanlerberg, PE  
Fishbeck, Thompson,  
Carr & Huber

Lauren Warren, PE  
Parsons Brinckerhoff

Tyler Dawson  
NTH Consultants

George McKenzie, PE  
Consumers Energy

Phillip Vogelsang, PE  
URS Corporation

## Rolla C. Carpenter Senior Design Award

*The Rolla C. Carpenter Senior Design Award (\$700 and plaques) is presented to the best team as judged by the faculty and a panel of practicing engineers.*

Rolla C. Carpenter, Renaissance Engineer, was a graduate of The State Agricultural College in 1873 with a Bachelor of Science degree. After earning a Master of Science Civil Engineering, he was appointed professor of the Department of Mathematics and Civil Engineering at the State Agricultural College, which would later become MSU. He designed bridges, built ice houses, taught students French, astronomy, mathematics, mechanical drawing, hydrostatics, hydraulics, survey, and civil engineering. He prepared the design and working drawings for the Farm Lane Bridge, laid a water supply pipe to Williams and Wells Halls, and designed a pile driver for a dam built across the Red Cedar River. He later designed several buildings on campus, including the Mechanical Building, which was constructed in 1885. Throughout all of his work on campus, he involved students throughout the analysis, design, and construction, forming what was essentially the first senior capstone design class.



*The faculty and students of the Department of Civil and Environmental Engineering gratefully acknowledge the generous contributions from Fishbeck, Thompson, Carr & Huber, Inc. (FTC&H) and Barr Engineering Co.*



# Michigan State University

## Mixed-use Development

**S**tudent-teams developed preliminary designs for elements of a 29-acre site located west of Marsh Rd. and south of Haslett Road. The site was to be designed as a mixed-use development following the Meridian Township Planned Unit Development (PUD) requirements.

The project development must include both residential and commercial land uses. The objective of this project was to provide Meridian Township Planning Commission with a Preliminary Engineering Design. Major goals were to maximize green space; create a walkable community and ensure pedestrian and bicycle access to the Inter-Urban pathway, local schools, and Meridian Township; to protect as many of the mature trees on-site as possible; and to identify and protect any federally classified wetlands on-site.

### TEAM ONE:



Back row, l-r: Mark Calbeck (H), Tyler Heitzeg (T), Zachary Jelenek (E), Jeffrey La Hood (T). Front row, l-r: Catherine Nyombe (P), Vincent Tomczak (PM), Xiyan Wang (S)

### TEAM TWO:



Back row, L-R: Jacob Holda (PM), Joshua Langenderfer (T), Cole Cavalieri (S), Tyler Smith (H). Front row, L-R: Zefeng Li (S), Di Chang (P), Meredith Kulesa (E).

### TEAM THREE:



Back row, l-r: Zachary Lefere (E), Thomas Bahmer (S), Joshua Curtis (P), David Harris (PM). Front row, l-r: Halle Doering (H), Brandon Hasso (T)

### TEAM FOUR:



l-r: Priyank Patel (H), Kyler Sheerin (P), Hayley Betker (E), Evan Pomeroy (PM), Charles Stcyr (T), Kyle Jasina (T), Duncan McLean (S)

Key: E = Environmental, G = Geotechnical, H = Hydrology, P = Pavements, PM = Project Manager S = Structures, and T = Transportation

## Computer Science and Engineering

# Capstone Course Sponsors

We thank the following companies for their generous support of the computer science capstone course.

### Amazon

Seattle, Washington & Detroit, Michigan



### Auto-Owners Insurance

Lansing, Michigan



### Bosch

Farmington Hills, Michigan



### Ford Motor Company

Dearborn, Michigan



### General Motors

Detroit, Michigan



### Meijer

Grand Rapids, Michigan



### MSU Federal Credit Union

East Lansing, Michigan



### Quicken Loans

Detroit, Michigan



### Spectrum Health

Grand Rapids, Michigan



### TechSmith

Okemos, Michigan



### Urban Science

Detroit, Michigan



### Whirlpool Corporation

Benton Harbor, Michigan





## The Capstone Projects

**Dr. Wayne Dyksen**  
Professor of Computer Science and Engineering

### Presentation Schedule – Engineering Building, Room 3405

Time	Team	Project
7:30 a.m.	Amazon	Twitter Trending Effects on Amazon Sellers
7:50 a.m.	Auto-Owners	Navigation Assistant and Accident History App
8:10 a.m.	Bosch	Mobile App for XCP Measurement and Calibration
8:30 a.m.	Ford	Vehicle Audit Analytics
8:50 a.m.	GM	Productivity Toolbar (aka Fast App Launcher)
9:10 a.m.	Meijer	Mobile Location-Based Product Promotion
9:30 a.m.	Break	
9:45 a.m.	MSUFCU	Refer A Friend Website and Mobile App
10:05 a.m.	Quicken Loans	Enterprise Architecture Visualizer
10:25 a.m.	Spectrum Health	Employee Discount Mobile App
10:45 a.m.	TechSmith	GroupWork for Google Chrome
11:05 a.m.	Urban Science	HR Matters
11:25 a.m.	Whirlpool	Windows 8 Apps for Smart Appliances

## CSE 498 Collaborative Design

CSE 498, Collaborative Design, provides the educational capstone experience for all students majoring in computer science. The course objectives include the following:

- Designing, developing, and delivering a comprehensive software system to a client;
- Learning to work effectively in a team environment;
- Developing written and oral communication skills;
- Becoming proficient with software development tools and environments;
- Learning about system building and system administration; and
- Considering issues of professionalism and ethics.

Project sponsors are local, regional, and national, and have included Amazon, Auto-Owners Insurance, Boeing, Bosch, Chrysler, Dow, Electronic Arts, Ford, GE Aviation, General Motors, Google, IBM, Meijer, Microsoft, Motorola Mobility, Mozilla, MSU Federal Credit Union, Quicken Loans, Spectrum Health System, TechSmith, Toro, Union Pacific Railroad, Urban Science and Whirlpool.

### The Capstone Experience Lab Sponsored By



URBAN SCIENCE.

We thank Urban Science for their generous support of the Capstone Experience Lab.





# Amazon

## Twitter Trending Effects on Amazon Sellers

Amazon Marketplace provides a platform for individuals and businesses to sell products to hundreds of millions of online customers. Since more than 40% of Amazon unit sales now result from third-party sellers, Amazon is committed to improving and optimizing their experiences.

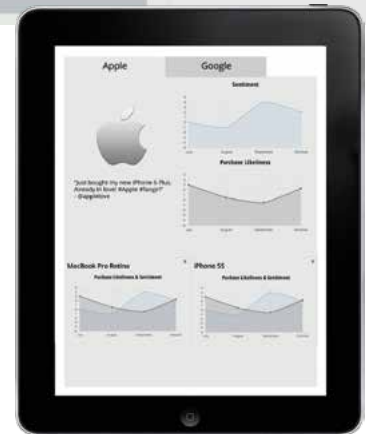
One of the main challenges faced by Amazon sellers is that of determining what products to stock and in what quantities. To assist them, the Amazon Seller Services team would like to provide its sellers with a free and fast alternative to traditional market studies, which are expensive and time-consuming.

Our Twitter Trending Effects on Amazon Sellers system analyzes Twitter tweets to determine what Amazon products consumers are talking about, what they think of them, and what products Amazon customers are buying.

These Twitter trends are displayed in a responsive, real-time dashboard that Amazon sellers customize for their specific needs, adjusting timeframes and overlaying data sets for comparison. Information about a particular brand or product includes the volume of tweets, the overall positive or negative sentiment and the sentiment of tweeters who mention owning it or purchasing it.

Using our dashboard to forecast the popularity of brands and products, Amazon sellers can make better-informed decisions for the types and quantities of products they stock.

Our system is written in Java using the Kinesis, Redshift, and Elastic Compute Cloud (EC2) Amazon Web Services with a cloud-hosted Ruby on Rails web interface.



### Michigan State University

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### Amazon

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# Auto-Owners Insurance Navigation Assistant and Accident History App

**A**uto-Owners Insurance is a Fortune 500 company working with more than 6,200 independent agencies in 26 states. Founded in 1916, Auto-Owners continually improves their products and services for their policyholders.

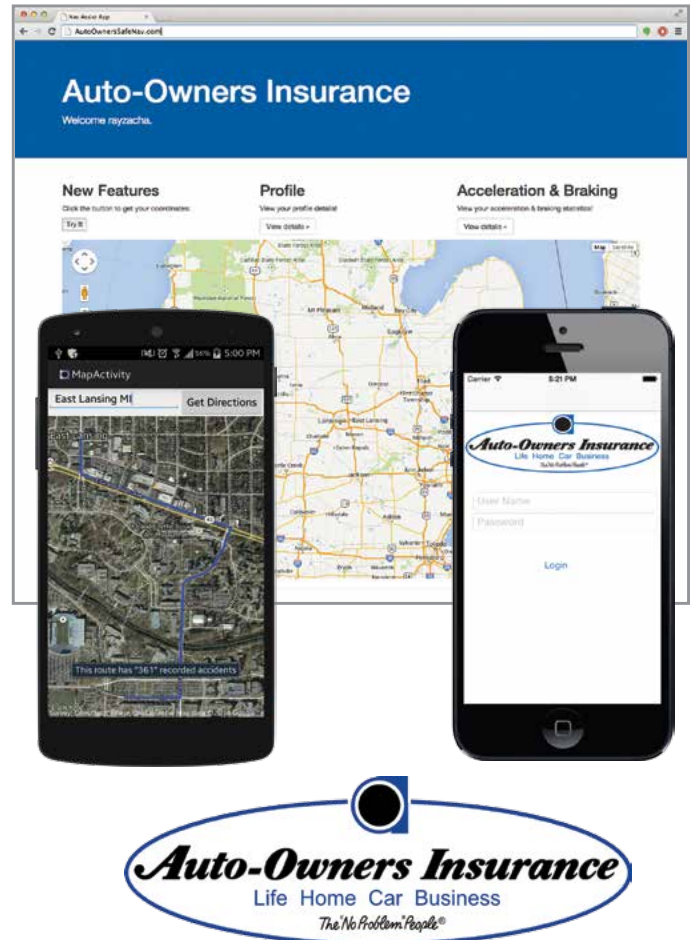
Our Navigation Assistant and Accident History App gives customers tools to help them practice safer driving habits. By learning and suggesting safer driving routes, as well as tracking and displaying basic driving statistics, it helps users reduce the likelihood of getting into accidents.

In order to do this, the mobile app keeps track of a user's frequently visited locations via GPS. Once the app learns a user's frequent locations, the app analyzes the routes between them. After the safest option is found, the user is sent a notification before departing to their next location. This notice provides the user with new directions to their destination.

Each customer has a profile that includes information about their driving habits. They can view how often they take safer routes, maps of frequently visited locations, as well as their acceleration and deceleration patterns. This information is available using either the mobile app or the online web app.

The web app gives Auto-Owners administrators an overview of general driving statistics, which enables them to gauge the effectiveness that the mobile app has on creating and encouraging safer driving habits.

The Android and web apps are written in Java; the iOS app is written in objective-C. Customer data is stored using SQL Server and accessed through a web service written in C#.



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**Jim Schumacher**  
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## Bosch

# Mobile App for XCP Measurement and Calibration

Bosch is a global engineering and electronics company with products sold in 150 countries worldwide. In addition to its industrial and building lines of products, Bosch is the world's leading supplier of automotive components.

Today's cars and trucks include up to 50 computers which monitor, control and regulate many things such as fuel efficiency, emissions and braking.

Our Mobile App for XCP Measurement and Calibration gives automotive engineers a quick and easy way to interact with a vehicle's computers wirelessly using any Android device.

A vehicle's computers provide a wide variety of measurements about performance such as the wheel speed or the steering angle. Using our app, these values can be viewed in real-time or stored for analysis later.

Our mobile Android app gives users the ability to identify problems quickly. The measurement and calibration features of our app can be used to adjust settings to improve a vehicle's overall performance.

The computers in cars and trucks communicate with each other using a network protocol called the Universal Measurement and Calibration Protocol or XCP. Our Android app abstracts the details of this protocol, making access to the computers transparent and easy for the user.

Our Mobile App for XCP Measurement and Calibration is written in Java for the Android platform. The primary component of our project is a standalone Java library with an Android application used as a control interface.



# BOSCH

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# Ford Motor Company Vehicle Audit Analytics

Ford Motor Company manufactures and sells Ford and Lincoln cars and trucks across six continents with 181,000 employees and 70 plants worldwide.

Ford takes a data driven approach to all aspects of designing, developing and manufacturing vehicles by critically evaluating Ford and Lincoln products against their global competitors to ensure that Ford designs are the very best.

Called “vehicle audits,” this evaluative process is currently done manually by designers using spreadsheets and, in some instances, even paper forms.

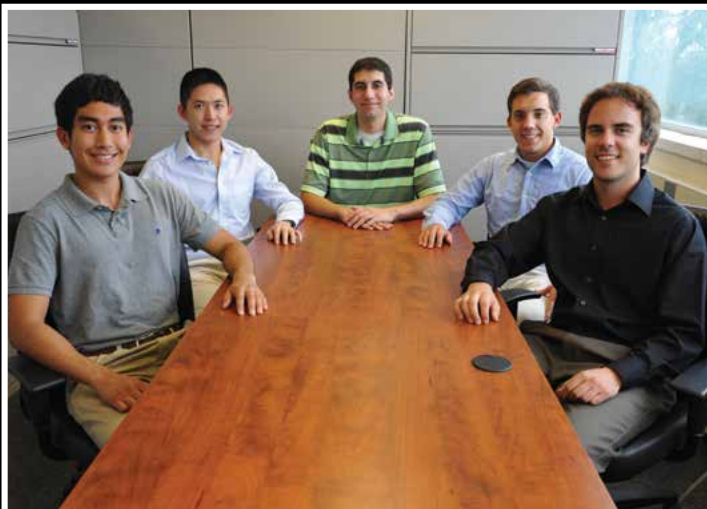
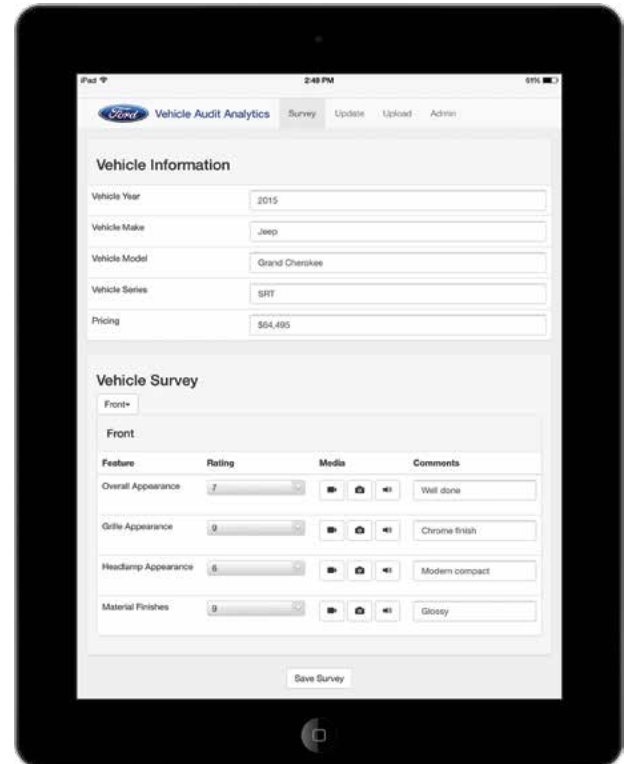
Our Vehicle Audit Analytics software automates and simplifies the vehicle audit process with an easy-to-use mobile web app. Ford designers compare Ford and Lincoln products against those of their competitors using their mobile devices.

Vehicle audit analytic data is generated by responding to survey questions simply with the touch of a finger. Users can augment responses by adding video, photos and audio.

By automating and simplifying the audit process, our Vehicle Audit Analytics application decreases audit and analysis time. All of the audit data is consolidated into a central location, which results in better data and faster audits.

Our web app works seamlessly both with and without an Internet connection.

Our Vehicle Audit Analytics software uses HTML5, Bootstrap, AngularJS, and Java, SQL Server 2012 and Apache Tomcat.



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# General Motors

## Productivity Toolbar (aka Fast App Launcher)

General Motors is one of the world's foremost designers and manufacturers of cars and trucks sold in more than 120 countries. Headquartered in Detroit, Michigan, GM's 212,000-plus employees work in 396 facilities spanning six continents.

GM employees depend heavily on desktop and web applications including hundreds developed by GM. With so many applications, finding and launching those most important to a particular person's work is challenging.

Our Productivity Toolbar, also known as Fast App Launcher, enables GM employees to find and launch the computer applications most important to their work quickly and easily.

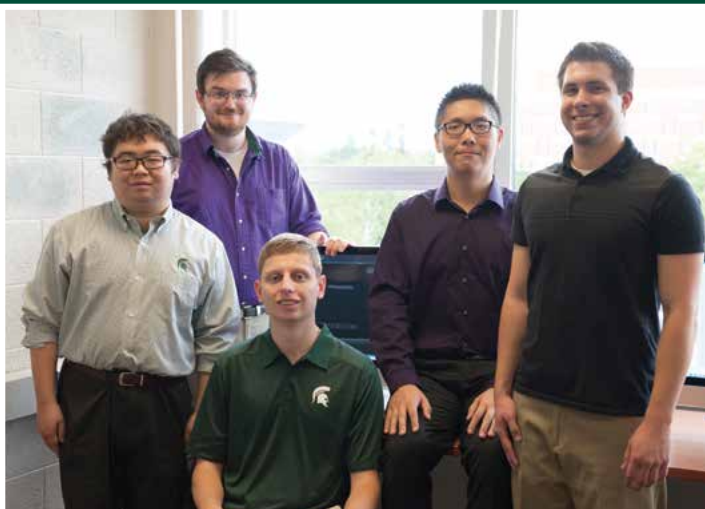
Using the Productivity Toolbar, employees create personalized pages displaying icons of their most used apps. The toolbar is used to launch both desktop apps and web apps.

In addition to launching apps, the Productivity Toolbar can be used to personalize the location and appearance of the apps.

Applications written by GM are added to the Productivity Toolbar from the General Motors Application Store. Employees use the toolbar to search for apps by name, category and tags, and then add them to their personalized launcher.

Our Productivity Toolbar runs both as a native desktop app on Windows 7 and as a web app in Internet Explorer.

Application information is maintained in a MySQL database. The desktop app is scripted in C#; the web app is written in JavaScript with AJAX.



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# Meijer

## Mobile Location-Based Product Promotion

With over 200 stores, Meijer serves the Midwest as one of the largest supermarket chains in the country. Having created the first modern supercenter in 1963, Meijer is known for customer service and continual innovation.

Meijer is revolutionizing today's shopping experience in many ways including the way that product promotions are delivered to its customers.

Our Mobile Location-Based Product Promotion system features an iPhone app that shows product promotions based on a customer's location within any Meijer store. For example, when walking down the cereal aisle, a customer may be alerted that their favorite cereal is on sale.

Our iPhone app determines a customer's location in a store using strategically placed devices called iBeacons, which communicate with iPhones using Bluetooth. When a customer walks within range of an iBeacon, a notification appears on their phone showing all nearby product promotions and sales.

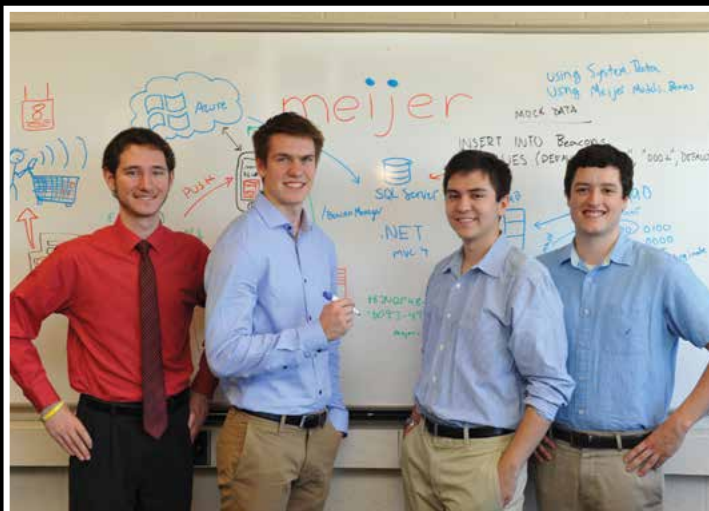
In addition to our iPhone app, our system includes a web app with which Meijer team members create, edit and delete iBeacon product promotions and sales.

Our web app also displays customer analytics enabling Meijer and its vendor partners to evaluate the impact of location-based promotions on buying decisions.

Our iPhone app is written in C# while our administrator interface is built with HTML, CSS and AngularJS. Microsoft Azure hosts the administrator website and database which uses SQL Server 2012.



# meijer®



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# MSU Federal Credit Union

## Refer A Friend Website and Mobile App

Michigan State University Federal Credit Union (MSUFCU) is the world's largest university-based credit union, offering a full range of personal and business related financial services to Michigan State University and Oakland University faculty, staff, students, alumni association members, and their families worldwide.

Maintaining and growing membership is a priority for MSUFCU. Our Refer a Friend Website provides a means to keep current members happy while also growing the MSUFCU family by encouraging new individuals to join.

Our Refer a Friend Website assigns each existing MSUFCU member a unique referral code, which they can share quickly and easily through Facebook, Twitter and email.

When the referrer's friends or family members click through the shared link, they are presented with the choice either to print out the referral code to bring into a local credit union branch or to begin the process of opening an account online.

After a referred account is created, both the existing member and the new member are given their reward.

Referring members are able to track how many of their referrals result in new accounts and the reward they receive on the main page of the referral website.

Our Refer a Friend Website is responsive and works well on both mobile and desktop browsers. It is written in PHP, HTML, JavaScript, and uses the Bootstrap framework. It runs on an Apache webserver and uses MySQL database.



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# Quicken Loans Enterprise Architecture Visualizer

Quicken Loans, headquartered in Detroit, Michigan, is the largest online retail mortgage lender and the second largest overall retail lender in the US. With almost 30 years of experience, their customers include over 2 million American families.

The term “enterprise architecture” refers to the components that make up an enterprise’s information technology (IT) system, and the relationships and dependencies between those components. For large organizations, enterprise architectures are very complex and often difficult to grasp.

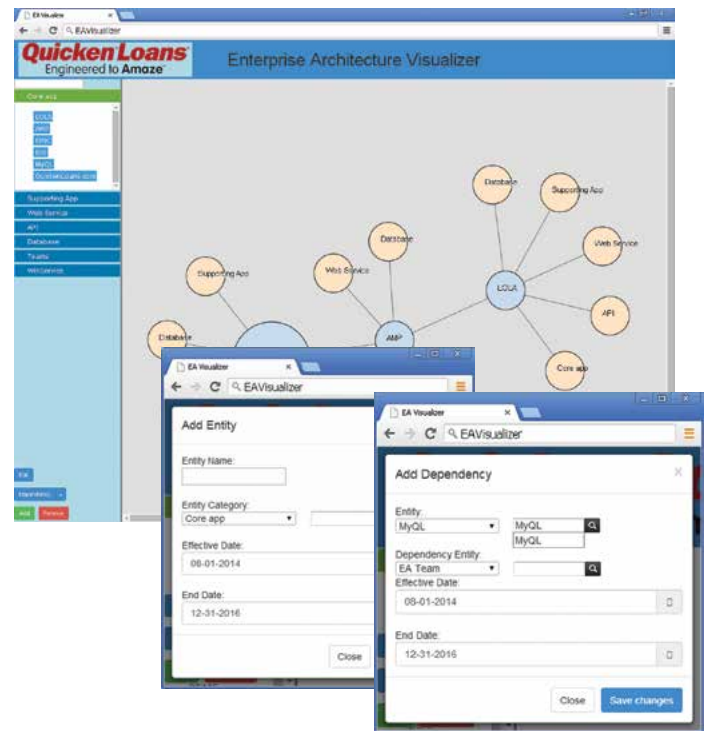
Our Enterprise Architecture Visualizer displays the enterprise architecture of Quicken Loans using an intuitive graphical user interface, making it easier to understand, maintain and grow.

Each IT component, such as a server or an app, is represented by a graphical icon. Once selected, a component is centered in the window and displayed with its dependencies, showing its place within the overall IT system.

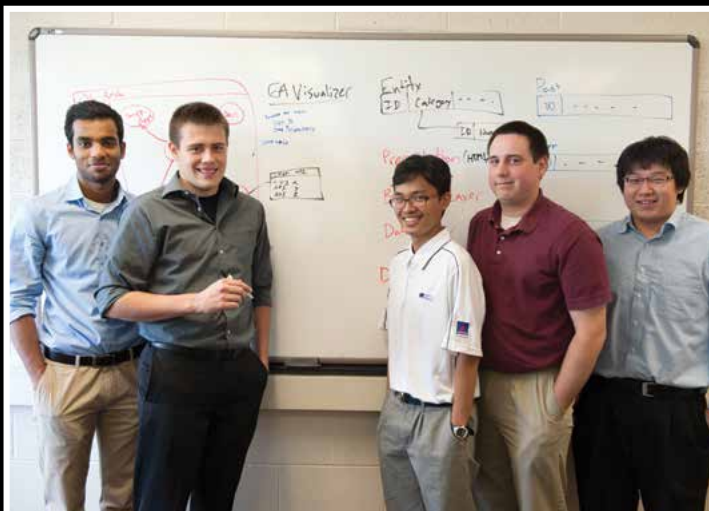
Administrative users can add, remove and edit components along with their dependencies as changes are made or planned. Snapshots of the entire enterprise architecture can be saved and retrieved by date including future dates for envisioned plans.

Our Enterprise Architecture Visualizer is a web app targeted for Google Chrome on desktops and laptops.

Our system is written using Visual Studio 2012. The backend database is Microsoft SQL Server 2008 R2. The website is hosted using Microsoft Internet Information Services.



**Quicken Loans®**  
Engineered to Amaze®



## Michigan State University Team Members (left to right)

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# Spectrum Health

## Employee Discount Mobile App

Spectrum Health is a not-for-profit health system, based in Grand Rapids Michigan, offering a full range of care throughout the Spectrum Health Hospital Group, which is comprised of 11 hospitals, 170 ambulatory service sites, and over 1080 employed physicians.

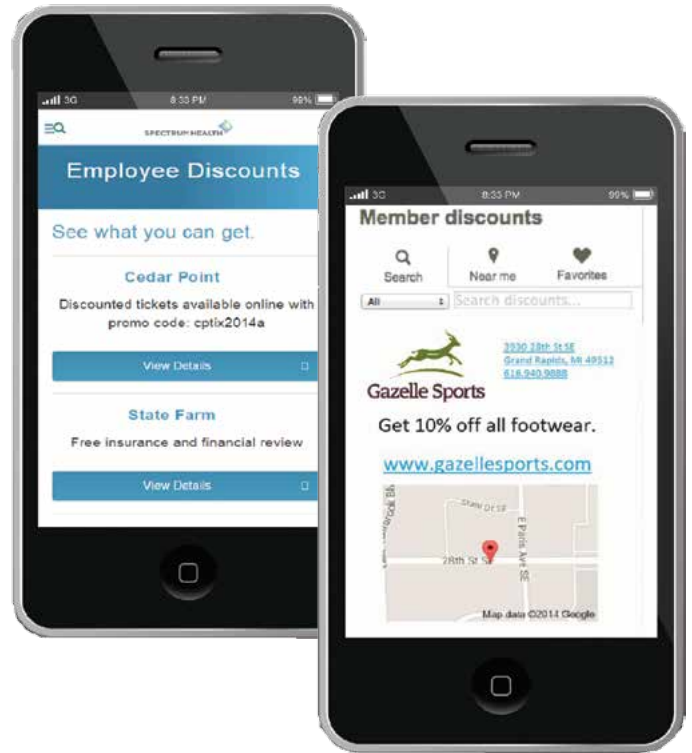
Spectrum Health employees enjoy discounts on goods and services from a variety of vendors. While previously only accessible using a website at work, our Employee Discount Mobile App now gives Spectrum Health employees access to these discounts from anywhere using their mobile devices.

Spectrum Health employees start at the Employee Discounts landing page shown in the left iPhone image. A task bar allows a user to search through all the discounts either by name or by category.

After selecting a particular discount, a user is given more information than the original snippet found on the landing page. This additional information, shown in the right iPhone image, may include the address of the location offering the discount and sometimes a special discount code.

By providing a mobile way of searching and viewing discounts, Spectrum Health employees can now take better advantage of the employee discount system.

Our Employee Discount Mobile App runs on all phones and tablets of varying sizes. The back end of our system is written in C#, with ASP.net MVC 4.0. The front end uses AngularJS, HTML and CSS.



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# TechSmith

## GroupWork for Google Chrome

Based in Okemos, Michigan, TechSmith provides over 180 countries around the world with computer screen capture and recording software. TechSmith's tools are designed to work across multiple devices and locations.

GroupWork for Google Chrome provides a quick and seamless way for groups of people to work collaboratively using TechSmith software, most notably Snagit and Camtasia.

GroupWork users create groups of workers and projects on which to collaborate. Groups are assigned to projects and tasks are assigned to group members.

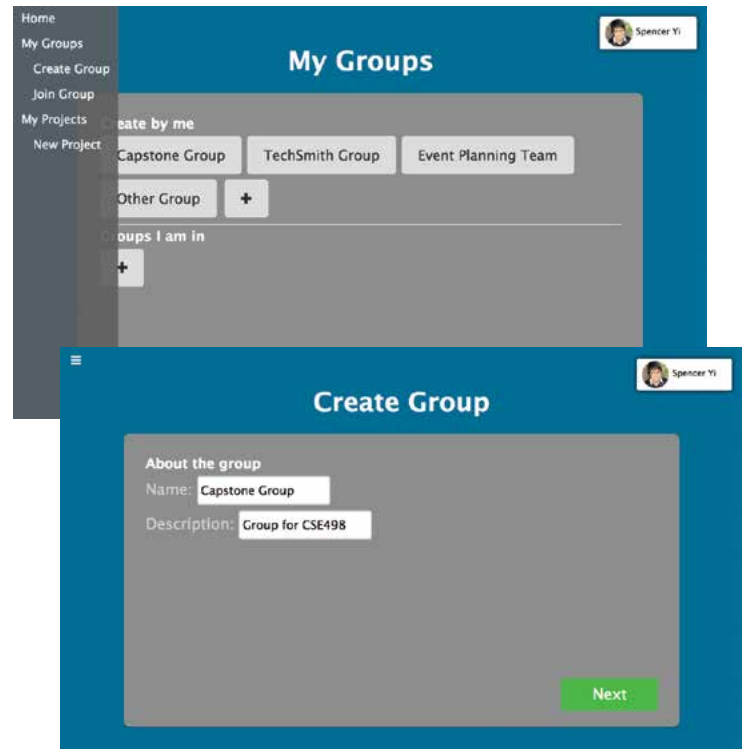
Group members communicate by posting comments and receiving notifications within the group. GroupWork tracks upcoming deadlines by placing events on group members' calendars.

Tracking progress is essential for any group effort. Group members can peruse through all of the tasks within a project, checking which tasks are complete and which are pending including an estimate of the time required to complete them.

GroupWork is integrated with Snagit for Chrome, a TechSmith tool used for capturing and sharing content within the Chrome web browser. GroupWork, together with Snagit for Chrome, creates an easy way to share feedback quickly and effectively.

Since GroupWork is a Chrome app, it runs on any computer that supports the Chrome web browser.

GroupWork is written in JavaScript, HTML and CSS, and utilizes AngularJS. Google Drive provides the backend.



### Michigan State University Team Members (left to right)

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**Bill Scanlon**  
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# Urban Science

## HR Matters

Urban Science is a business-solutions company focused on supporting the sales and marketing needs of the automotive industry. They leverage a scientific methodology to help their client partners sell more vehicles, improve profitability, and increase customer loyalty.

Employees at automobile dealerships fill many roles such as salesperson or service advisor. People successful in a particular role often share a similar set of behavioral competencies such as having self-confidence or being a good communicator.

HR Matters is a software tool that enables dealers to assess the behavioral competencies of their employees. Managers rate each behavioral competency on a scale from one to five. To assist managers in this process, HR Matters displays a standard list of key behavioral indicators for each competency that corresponds to each of the possible ratings from one to five.

By knowing which behavioral competencies are shared by successful people in particular roles, automobile dealerships use these key behavioral competencies in a variety of ways.

For example, a behavioral area of weakness of an existing employee may be identified for improvement. HR Matters includes historical records of each employee's behavioral evaluations for tracking progress over time.

In addition, HR Matters can be used to screen potential dealership employees for their suitability for particular roles.

HR Matters is a web-based application that is optimized for both tablets and desktops. It is written in C# using ASP.NET MVC and Bootstrap with a Microsoft SQL back-end database.



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**Chris Welch**  
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# Whirlpool Corporation

## Windows 8 Apps for Smart Appliances

**W**hirlpool Corporation is the world's leading manufacturer and marketer of home appliances. Headquartered in Benton Harbor, Michigan and operating in more than 130 countries, Whirlpool has over 69,000 employees worldwide.

Connected to the Internet, Whirlpool's line of Smart Appliances can be monitored and controlled by customers from anywhere using mobile devices. Currently, Whirlpool provides Smart Appliance apps for Android devices and iOS devices, which include iPhones and iPads.

Our Windows 8 Apps for Smart Appliances complete the suite of apps by enabling customers to monitor and control their Smart Appliances using any Microsoft Windows 8 device, from phones to desktops. Sharing a common look-and-feel, the mobile and desktop versions provide customers with a seamless experience across multiple devices.

Our Windows Live Tiles, which are pinned to the start screen of Windows 8 devices, provide dynamic, at-a-glance information about connected Smart Appliances without requiring the apps to be open.

Cortana, the speech synthesis and recognition software for Windows Phones, is integrated with our Windows Phone app, allowing for hands-free commands and notifications.

Our Windows 8 Apps for Smart Appliances use the Windows Universal Applications framework provided by Microsoft and is written in C# and XAML.



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# Design Day Awards

CSE 498, Collaborative Design, is the senior capstone course for students majoring in computer science. Teams of students design, develop, and deliver a significant software system for corporate clients. The CSE capstone teams compete for four prestigious awards. The winners are selected on Design Day by a panel of distinguished judges.

### Auto-Owners Exposition Award



CSE 498 capstone teams present their projects on Design Day in a variety of ways. Teams create and set up an exhibit where they demonstrate their software systems and answer questions from Design Day attendees. Each team plays their project videos and answers questions for a panel of judges.

The CSE capstone team with the best overall Design Day performance is honored with the Auto-Owners Exposition Award, which is sponsored by Auto-Owners Insurance Company of Lansing, Michigan.

Team Urban Science  
Dealer Improvement Recommender System



Ty Jones, Collin Myers, Ben Mastay  
Presented by Scott Lake and Bob Buchanan

### General Motors Praxis Award



One of the hallmarks of CSE 498 capstone projects is that of praxis, the process of putting theoretical knowledge into practice. Teams apply a wide variety of information technologies to produce solutions to complex problems in areas such as business, engineering, computing, and science.

The CSE capstone team that engineers the software system that is the most technically challenging is recognized with the General Motors Praxis Award, which is sponsored by General Motors of Detroit, Michigan.

Team Boeing  
Flight Simulator Suite



Mike Marinetti, Stephi Stumpos, Chris Ek  
Presented by Fred Killeen and Christian Stier

# Spring 2014

## Design Day Judges

Samantha Amburgey  
MSU Federal Credit Union

Mike Drazan  
Toro

Fred Bellio  
Whirlpool

E. J. Dyksen  
Mutually Human

Barb Dawson  
Michigan State University

Rich Enbody  
Michigan State University

Louise Hemond-Wilson  
IBM

Vandy Johnson  
XRS Corporation

Fred Killeen  
General Motors

Brian Loomis  
Microsoft

David Mysona  
Blackstone Technology  
Group

Marty Strickler  
Rose Packing Company

Karen Wrobel  
Chrysler

## TechSmith Screencast Award



Each CSE 498 capstone team produces a video that describes and demonstrates their software product. Starting with a storyboard and a script, teams use Camtasia Studio to synthesize screen recordings, video, audio and other multimedia to produce their project videos.

And the TechSmith Screencast Award goes to... the CSE capstone team with the best project video. The award is sponsored by the creators of Camtasia Studio, TechSmith of Okemos, Michigan.

Team GM  
The Matrix: Vehicle Simulator System



Duncan Young, Sam Moore, Matt Wein  
Presented by Dean Craven

## Urban Science Sigma Award



The CSE 498 experience represents the capstone of the educational career of each computer science major. An intense semester of teamwork produces impressive deliverables that include a formal technical specification, software, documentation, user manuals, a video, a team web site, and Design Day participation. The resulting sum, the capstone experience, is much greater than the parts.

The capstone team that delivers the best overall capstone experience is recognized with the Urban Science Sigma Award, which is sponsored by Urban Science of Detroit, Michigan.

Team Quicken Loans  
Mobile RFID Inventory Tracking System



Jacob Riesser, Josh Rasor, K.P. Patel  
Presented by Mike DeRiso, Steve Kansa and Kathy Krauskopf



# SUCCESS:

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CHRYSLER

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## Introduction to Electrical and Computer Engineering Final Projects; Fall 2014

**Dr. Dean M. Aslam**

**Professor of Electrical and Computer Engineering**

### Problem statement

ECE 101 is an elective course introducing freshman students to Electrical and Computer Engineering through a series of innovative hands-on laboratory experiments linked to new research and teaching areas. These experiments relate to (a) computer switches, (b) C programming of robots based on MSP430 microcontrollers and NXT LEGO controllers, (c) pH measurement using NXT sensors, (d) maple-seed robotic fliers (MRF) with onboard electronics, (e) location of bio-molecules using RFID, (f) renewable energy resources using windmill and solar cells, and (g) nanotechnology study using a LEGO gear-train.



**This semester's projects include:**

Teams	Project Title
<b>Team #1:</b> Robert Brindley Johnny Qi Yu Liangmai Jorge Ramirez Lovepreet Singh	Using Brainwaves in Real Life.
<b>Team #2:</b> Sean Evans Thomas Humphrey Rebecca Reneker	NXT Robot to Sort Different Colored Objects
<b>Team #3:</b> Timothy Dickey Randi Dortch Jessica Reeling	Chemical Disposal System Using pH Sensor
<b>Team #4:</b> Jesus Hernandez-Bustos Yuankun Hong Chen Zhao	Renewable Energy Resources Using Windmill and Solar Cells

## The Capstone Projects



**Dr. Timothy Grotjohn**  
Professor of Electrical and  
Computer Engineering



**Dr. Lalita Udpa**  
Professor of Electrical and  
Computer Engineering

### Presentation Schedule – Engineering Building, Room 2250

Time	Team Sponsor	Project Title
8:00 a.m.	Bekum America Corp.	Bottle Orientation Interface System (BORIS)
8:25 a.m.	Whirlpool	Dispenser Cup Contents Detection
8:50 a.m.	Great Lakes Controls and Engineering	Automated Lathe Tool Condition Monitoring
9:15 a.m.	Asante Solutions, Inc., Marathon & MSU Resource Center for Persons with Disabilities	Blind User Accessible Insulin Pump Design
9:40 a.m.	Break	
10:00 a.m.	ArcelorMittal	“Smart” Camera
10:25 a.m.	MSU College of Engr.	A Point of Sale Grocery Cart
10:50 a.m.	MSU ECE Department	Compact DC/AC Power Inverter
11:15 a.m.	MSU Solar Car	Maximum Power Point Tracker



To view these presentations live please visit the Design Day website: <http://designday.egr.msu.edu> and click the *Watch Live* tab in left side menu bar.

## ECE 480 Senior Design

ECE 480 is required of all electrical engineering or computer engineering majors at MSU. It prepares students for the workplace, or for graduate school, including:

- Putting into practice the technical skills learned in the classroom, on industrially sponsored team projects, under faculty guidance, doing open-ended design, giving them experience in teamwork, project management, product life cycle management legal intellectual property, accommodation issues and entrepreneurship.
- Polishing their communication skills – individual and team – on proposals, reports, resumes, evaluations, posters, web pages, and oral presentations.

Team sponsors are local and national, including ArcelorMittal, Asante Solutions, Inc., Bekum America Corp., Great Lakes Controls and Engineering, MSU ECE Department, MSU Resource Center for Persons with Disabilities, MSU Solar Car Team and Whirlpool. Thank you to each of these team sponsors.



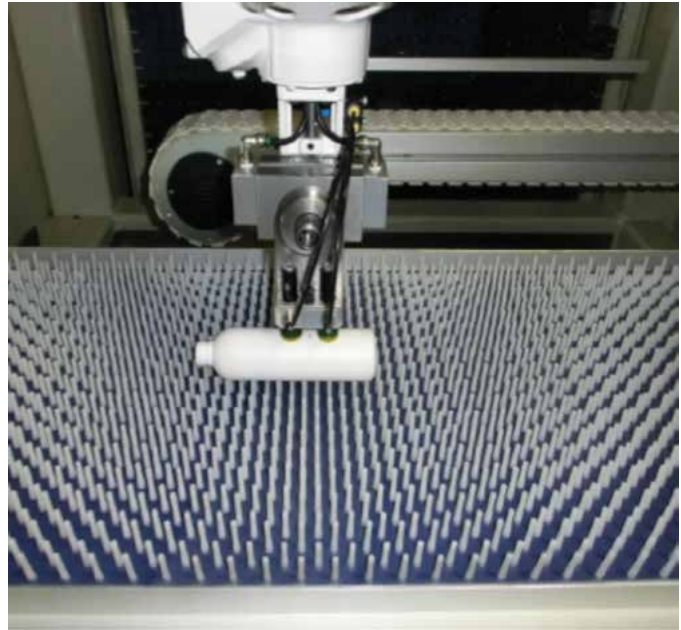
# Bekum America Corporation

## Bottle Orientation Interface System (BORIS)

The world around us is becoming increasingly intertwined with new technology systems. As technology progresses and becomes more complex, it is becoming increasingly more important for companies to present user interfaces that are unambiguous and easy to use.

Bekum's Bottle Orientation System has the capability of visually identifying the orientation of bottles and using a robotic arm to pick up and place these bottles accordingly on a conveyor belt to the next phase of production. Currently, the user must navigate complicated and time-consuming menus in order to configure new bottles for production. In order to improve efficiency and make their product more attractive, Bekum must provide a more user-friendly interface with fewer steps.

A solution to this problem is automating parts of the process for the user. Using a touch-screen, the machine operator would be presented with simple instructions and no longer have to navigate through menus that require no user input. With fewer steps to cycle through, the process becomes more efficient and less confusing for the machine operator and makes a more attractive product to sell in the bottling industry.



### Michigan State University

#### Team Members (left to right)

**Sam Saia**  
White Lake, Michigan

**Emily Skipton**  
Troy, Michigan

**Zain Syed**  
West Bloomfield, Michigan

**Gurwinder Singh**  
Lansing, Michigan

**Alec Joiner**  
Lansing, Michigan

### Bekum America Corp.

#### Project Sponsors

**Kirk Myers**  
Williamston, Michigan

**Ben Sterling**  
Williamston, Michigan

# Whirlpool Corporation

## Dispenser Cup Contents Detection

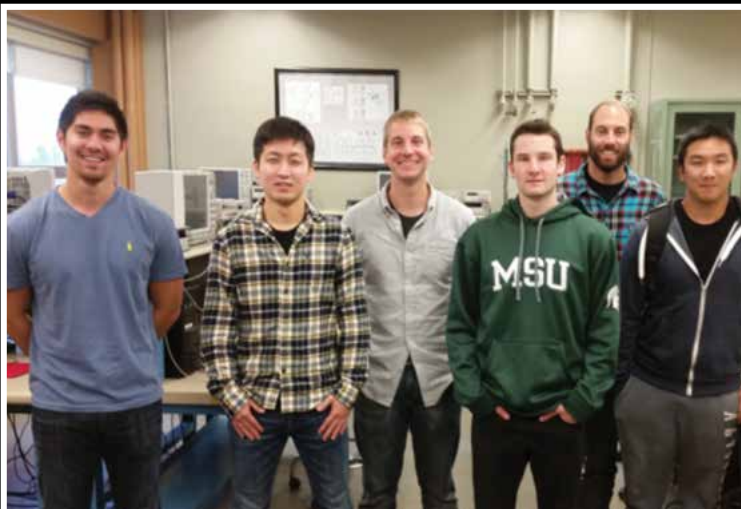
Whirlpool has been an Energy Star partner since 1998. Energy Star is a U.S. Environmental Protection Agency voluntary program which creates energy efficiency standards for companies to strive for in their consumer products.

Whirlpool has developed high-efficiency washing machines which save water and energy. A method they use to improve efficiency is to determine if the detergent is a liquid or powder and if bleach or fabric softener is being used. The wash cycle process is optimized by using this information.

Currently, consumers manually input information regarding detergent type and whether bleach or fabric softener is being used. Whirlpool has identified that consumers usually do not take full advantage of the energy optimization offered by this method. This is due to either consumer negligence or incorrect input. Whirlpool wants to automate this process by detecting dispenser cup contents automatically.

To detect the contents of a cup, a light has to emit through the cup to be received by a sensor. If the content is a powder, no light will be sensed. If the content is a liquid, some light will pass through to the sensor. If the cup is empty, most of the light will be received by the sensor.

A microcontroller will be used to receive sensor information and output it to an application that emulates a washing machine. The application will display washing machine dispenser cup contents information that can be used to automate the wash cycle process.



### Michigan State University Team Members (left to right)

**Raymond Acker**  
Annandale, Virginia

**Sung Gun Lee**  
Daegu, S. Korea

**Jacob Stanczuk**  
Clarkston, Michigan

**Trevor Eckler**  
South Lyon, Michigan

**Nolan Holmes**  
Ypsilanti, Michigan

**Doddy Jonathan**  
Jakarta, Indonesia

### Whirlpool Project Sponsors

**Michael Jackemeyer**  
Benton Harbor, Michigan

**Nathan Kesto**  
Benton Harbor, Michigan

# Great Lakes Controls and Engineering

## Automated Lathe Tool Condition Monitoring

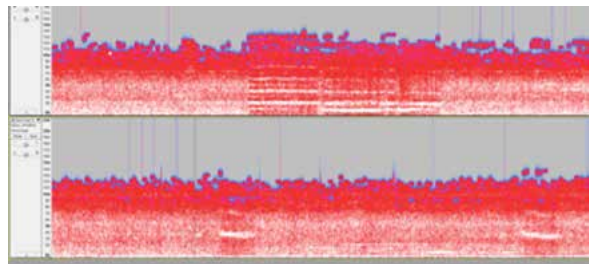
Great Lakes Controls and Engineering is a new engineering firm that was founded in 2014. They specialize in machine refurbishment, robotic integration, and troubleshooting and repair in industrial applications. Their latest project is the integration of a Fanuc robot with two super-finish grinders, which allows the grinders to be in nearly constant operation.

Our project focuses on tool wear detection on a specific machine serviced by Great Lakes Controls and Engineering. This machine is an automated lathe and is used to make transmission valves for automotive companies such as The Ford Motor Company.

A solution to this problem is to develop a sensor capable of measuring the audible emissions from the tool as it performs its cutting operations. Once measured, the data can be analyzed by the on-board microcontroller to determine if the tool is acceptably sharp, or needs to be sharpened or replaced.

This system will provide the machine's operator with information on the state of the current cutting tool. This information will be relayed through the existing programmable logic controller and displayed on the machine's monitor.

Pictured on right (top to bottom): a transmission valve inside the automated lathe that has finished being machined, the unique frequency spectrum of a sharp tool, and the unique frequency spectrum of a dull tool.



### Michigan State University

*Team Members* (left to right)

**Kun Yang**

Hangzhou, Zhejiang China

**Zeb Baldwin**

Clarkson, Michigan

**Crystal Caddell**

Detroit, Michigan

**Connor Boss**

Charlevoix, Michigan

**Eric Hinkle**

Grand Rapids, Michigan

### Great Lakes Controls and Engineering

*Project Sponsor*

**Justin Wulz**

Stockbridge, Michigan



# Asante Solutions, Inc.

## Blind User Accessible Insulin Pump Design

In the United States, approximately 40% of diagnosed diabetics have a form of diabetic retinopathy, which leads to decreased vision and blindness. This represents a significant portion of diabetics, resulting in an increasing need for an insulin pump that can communicate its data to someone who cannot readily read a screen. Currently, Asante Solutions, Inc. and Michigan State University's Resource Center for Persons with Disabilities are working with our team to create possible solutions to this ongoing problem.

Insulin pumps are small electronic devices that deliver insulin to the patient. The doses can be delivered in one of two ways: in a steady continuous dose or as a surge dose around mealtime. Pumps can be programmed by the user for either dose deliveries, depending on user preference. A patient will interact with his or her insulin pump at least four times a day, making communication between user and pump essential.

Due to a growing demand for an insulin pump that can be controlled by a blind user, companies are seeking new ways to provide this service to their customers. Stephen Blosser of RCPD and our team have developed a case that will surround the Snap insulin pump. Using a text to speech integrated circuit, the additional case allows users to plug in their headphones and listen to their insulin pump. The circuitry within the case attains to be intuitive and noninvasive to the current circuitry of the Asante Snap insulin pump as it reports all necessary information from the viewing screen to its user.



Resource Center for  
Persons with Disabilities



### Michigan State University Team Members (left to right)

**Michael Greene**  
Grand Rapids, Michigan

**Caitlin Ramsey**  
Vernon Hills, Illinois

**Jianwen Lu**  
Shanghai, China

**August Garrett**  
Canton, Michigan

### MSU RCPD Marathon Oil Asante Solutions, Inc. Project Sponsors

**Stephen Blosser**  
East Lansing, Michigan

**Mark Estes**  
Sunnyvale, California

**Jin Jiang**  
Sunnyvale, California

# ArcelorMittal

## “Smart” Camera

ArcelorMittal needs a reliable and robust way to measure large coils of cold-rolled steel coming off their production line. The proposed solution is to use the Axis Communications P1355-E Camera to capture live high quality video of the steel as it is being coiled at the end of ArcelorMittal’s line. A dedicated computer will process the image produced by the Axis camera. This computer will be connected to the Axis camera and current system using Ethernet cables.

The software we will develop will use the high definition video from the camera to detect the edge of the mandrel (spindle) and the outer diameter of the coil of steel. The edge of the steel within the image will be detected using the Sobel method. The coil will reflect much more light and is thus brighter than the much darker surroundings. The program will take the image and, using the Sobel method, it will determine where rapid changes in the pixel color occur. By looking at these changes, it becomes apparent where the edges are because the image will have a large change in color between two pixels. The measurement of the coil will be a pixel distance, which can then be converted and calibrated to a physical diameter.

The computer will be able to communicate with the existing system over an Ethernet network. The software will be able to take inputs from the existing computer system and communicate with ArcelorMittal’s current Programmable Logic Controllers to provide a more accurate diameter to make appropriate coil sizes based on the needs of customers of ArcelorMittal.



Axis Communications P1355-E Camera



### Michigan State University

#### Team Members (left to right)

**Poyuan Han**  
Taipei, Taiwan

**Joe McAuliffe**  
Plymouth, Michigan

**James Quaglia**  
Novi, Michigan

**Ian Siekkinen**  
Novi, Michigan

**Petros Taskas**  
Novi, Michigan

**Matthew Wesolowski**  
Troy, Michigan

### ArcelorMittal

#### Project Sponsors

**Carlos Forjan**  
East Chicago, Indiana

**William Sammon**  
East Chicago, Indiana

# MSU College of Engineering

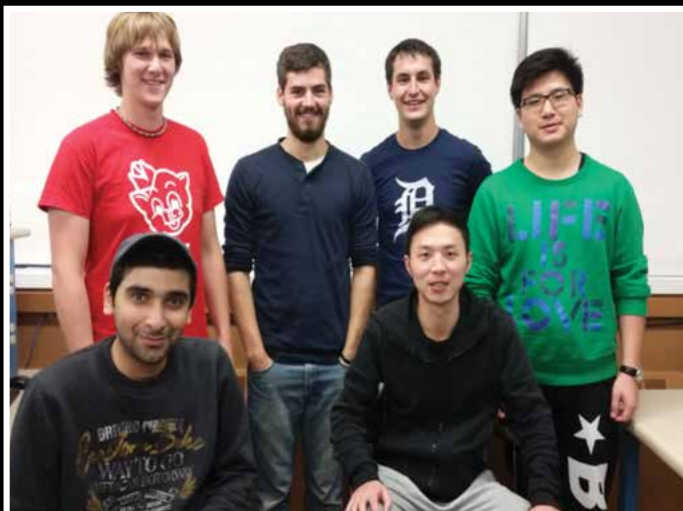
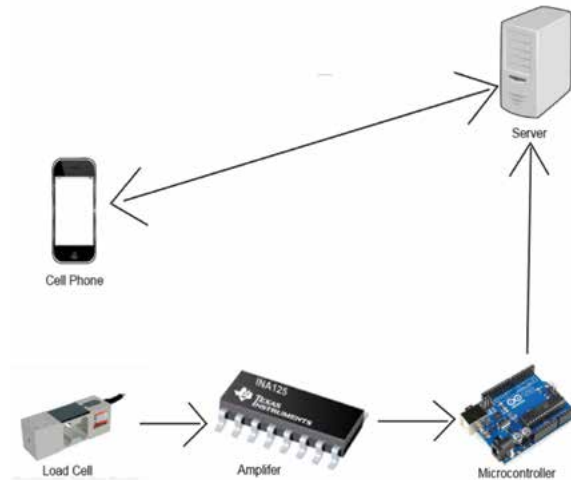
## A Point of Sale Grocery Cart

The goal of the point of sale grocery cart is to create an easier system for shoppers to use, while cutting down on the costs for the store. This new system involves placing the scanner normally wielded by the cashier into the hands of every shopper. As a patron of the store travels between aisles and gathers items, they can use their smartphone to scan the items as they put them into their cart.

Once an item has been scanned, the cart, which is equipped with a set of load cells, reads the weight of the item added to the cart and verifies it with the store's database. This helps confirm the correct item was placed in the cart. In some cases an image of the item will be taken to identify it. When finished shopping, the shopper will be able to use a credit card to checkout directly from their phone. This means they can skip the long checkout lines for good. The carts will be able to leave the store once the customer has checked out. If the customer leaves without paying, an alarm will sound.

In addition to the changes to the way a shopper checks out, the system can also automatically apply electronic coupons to the cart to avoid the chance of the user forgetting them. Lastly, the final product can recommend items to the shopper based on purchasing history and offer incentives, such as coupons, for purchasing these items again.

The current checkout system is in desperate need of an update to save time and money for both sides of the grocery store.



### Michigan State University Team Members (left to right)

**Steven Hartz**  
Cottage Grove, Minnesota

**Matt Rasmussen**  
Rochester, Michigan

**Ben Lauzon**  
Grosse Ile, Michigan

**Shuangfei Liu**  
Shanghai, China

**Husain Aleid**  
Qatif, Saudi Arabia

**Taoping Zhao**  
Suzhou, China

### MSU College of Engineering Project Sponsor

**Dr. Satish Udpa**  
East Lansing, Michigan



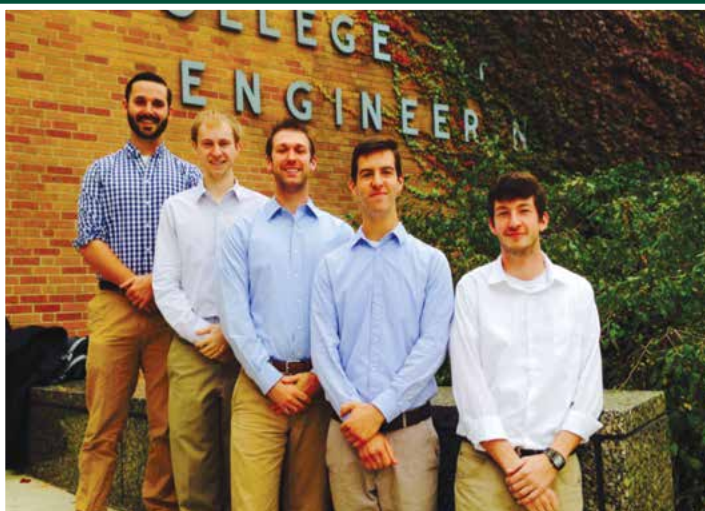
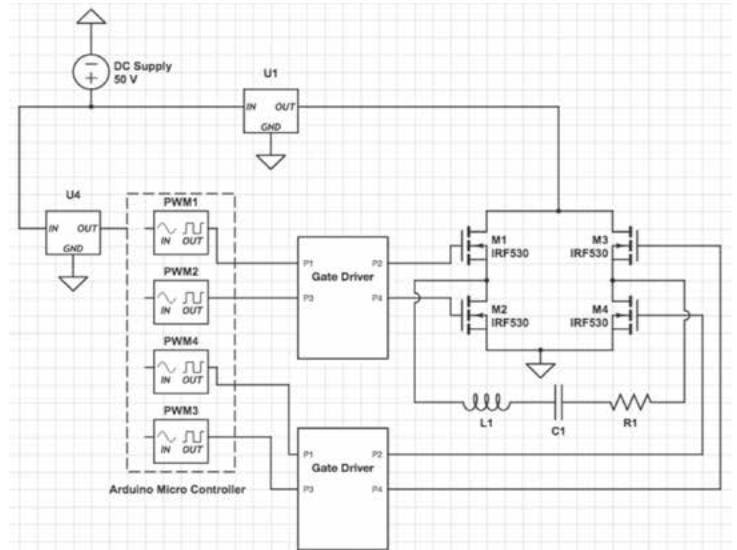
# MSU Electrical and Computer Engineering

## Compact DC/AC Power Inverter

Power inverters are used to convert direct current, such as that from a battery, to alternating current, such as what can be drawn from a standard wall outlet. These devices are used in a large number of applications, including conditioning energy derived from solar cells into usable power and supplying electricity to household appliances during power outages. These devices are usually large; around the size of a cooler.

Team 7 will design and build their own power inverter inspired by the Little Box Challenge, a contest hosted by Google and IEEE. The idea of this challenge is to create an inverter both very small, 40 cubic inches, and also powerful enough to rival the output of its larger counterparts. Accomplishing this small form factor would be an important step in attaining widespread high power inverter utilization. This would also increase the feasibility of solar power generation for the masses in the future.

The goal is to achieve a 1 kilo-volt-amp power output. The process involves inputting direct current, stepping the voltage to the alternating current peak value, and using pulse width modulation from a microcontroller to drive transistors. This will create a 60 Hz sinusoid, which is the set frequency standard for wall outlets in the United States. Harmonic filtering is required before the output to comply with FCC regulations. Any inefficiency in the inverting process results in excess heat, so close attention will be paid to the efficiency of components and heat dissipation.



### Michigan State University

*Team Members* (left to right)

**Philip Beard**  
Midland, Michigan

**Jacob Brettrager**  
Midland, Michigan

**Jack Grundemann**  
Saline, Michigan

**Stanley Karas**  
Lowell, Michigan

**Travis Meade**  
Lowell, Michigan

### MSU Department of ECE

*Project Sponsors*

**Inspired by the Google/  
IEEE Little Box Challenge**

Coordinating with  
Professor Timothy Grotjohn  
East Lansing, Michigan

# MSU Solar Car

## Maximum Power Point Tracker

The Michigan State Solar Car Racing Team tasked us with creating a new Maximum Power Point Solar tracker for their new solar car.

A maximum power point tracker is the device that connects the solar array of the solar car to the battery. This device is necessary because the solar array has a relatively low voltage. The MPPT device is used to match this low voltage to the high voltage of the battery.

The MMPT device maximizes the power of the solar array by finding the point at which the voltage is highest without the current dropping.

Maximum Power Point Tracking is used in any device that contains a solar array. It is used in cars, buses, landscaping, chargers, pools, boats, etc.

Our team has one main requirement while creating the MPPT and that is to achieve 95% efficiency for our device. Once that goal is achieved, we will focus on making our design as small, light, and cost-effective as possible.



### Michigan State University Team Members (left to right)

**Luis Kalaff**  
Project Manager

**Jacob Mills**  
Webmaster

**Brenton Sirowatka**  
Document Preparation

**Yue Guo**  
Lab Coordinator

**Daniel Chen**  
Presentation Prep

### Texas Instruments Project Sponsors

**Prof. Bingsen Wang**  
Facilitator

**Ian Grosh**  
MSU Solar Car

**Scott O'Connor**  
MSU Solar Car

**Steve Zajac**  
MSU Solar Car

# Design Day Awards Spring 2014

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## Electrical & Computer Engineering Prism VentureWorks Prize & Winners, Spring 2014

The Prism VentureWorks Prizes (\$1,500, \$1,000 and \$500, respectively), are awarded each semester to the most outstanding teams in the Electrical and Computer Engineering Senior Capstone Design Course, as judged by a panel of engineers from industry. A team with members from both ECE and another engineering major (mechanical engineering, for example) is also eligible, if the team's project is administered through ECE 480. The prizes are sponsored by Prism VentureWorks, a Boston-based venture capital firm, and Mr. William Seifert, an ECE alumnus, who is a partner in that firm. The faculty and students of Electrical and Computer Engineering are very grateful for this generous support.

---

### Prism VentureWorks First Prize: Michigan State University Solar Car Team: Battery Management System

Left to right

Dr. Timothy Grotjohn, Albert Ware, Auez Ryskhanov, Michael Burch, Matthew Gilbert-Eyres ,  
and Gerald Saumier



### Prism VentureWorks Second Prize: MSU Resource Center for Persons with Disabilities:

Left to right

Dr. Timothy Grotjohn, Michael Wang, Daniel Olbrys, Kodai Ishikawa, Terry Pharaon, and  
Steven Chao



### Prism VentureWorks Third Prize: Texas Instruments: Electronic Parachute Deployment System

Left to right

Dr. Timothy Grotjohn, Michikazu Aono, Pedro Rodriguez, Max Cooper, Zane Crawford,  
Qiaosen Huang, and Jessica Shelby







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MICHIGAN STATE  
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Pre-college Programs

# summer camps, competitions & events

## Spartan Engineering 2015 Summer Camps

### Spartan LEGO® Robotics

Open to students entering 4th-8th grade in Fall 2015  
Session 1: June 8 - 12, Commuter; Session 2: June 15 - 19, Commuter; Session 3: June 22 - 26, Commuter

### Spartan Engineering for Teens

Open to students entering 8th-9th grade in Fall 2015  
June 14 - 18, Residential

### High School Engineering Institute (HSEI)

Open to both U.S. and International students entering 10th-12th grade in Fall 2015

Session 1: June 21-25, Residential; Session 2: June 28-July 2, Residential; July 12-16, Residential

### Spartan Girls in Engineering

Open to students entering 7th-8th grade in Fall 2015

June dates to be determined. Commuter;

For future dates and additional information, go to:

[www.egr.msu.edu/wie](http://www.egr.msu.edu/wie)

### Engineering and Science Summer Academy (ESSA)

Late June - early August, Residential

(Incoming first-year MSU students)

For future dates and additional information, go to:

[www.egr.msu.edu/dpo/programs/summer-residential-programs](http://www.egr.msu.edu/dpo/programs/summer-residential-programs)

### Introduction to Robotics Engineering at MSU

Open to both U.S. and International students entering 10th-12th grade in Fall 2015

July 19 - 23, Residential

### Introduction to RADAR for Student Engineers

Open to both U.S. and International students entering 11th-12th grade in Fall 2015

July 26 - August 6, Residential

### Girls in Computing

Open to students entering 7th-8th grade in Fall 2015

July dates to be determined. Commuter;

For future dates and additional information, go to:

[www.egr.msu.edu/wie](http://www.egr.msu.edu/wie)

### Teen Engineering Experience at Michigan State (TEEMS)

Session I: July dates to be determined, Residential (Open to students entering 8th grade in Fall 2015)

Session II: July dates to be determined, Residential (Open to students entering 9th grade in Fall 2015)

For future dates and additional information, go to:

[www.egr.msu.edu/dpo/programs/summer-residential-programs](http://www.egr.msu.edu/dpo/programs/summer-residential-programs)

### Lady Spartans: Women in Engineering (WIE)

Open to both students entering 9th-12th grade in Fall 2015

July dates to be determined. Commuter;

For future dates and additional information, go to:

[www.egr.msu.edu/wie](http://www.egr.msu.edu/wie)

## Winter/Spring/Fall 2015

### VEX® Robotics State Championship at MSU

February 22, 2015 (Middle and High School VEX® Robotics teams)

### Spartan Engineering Preview Day

Fall. For future dates and additional information, go to:

[www.egr.msu.edu/future-engineer](http://www.egr.msu.edu/future-engineer)

(High school juniors, seniors, transfer prospective students and their families; school groups and teachers)

## Teacher Enrichment Experiences

### USDOT Center funded NGSS Compliant

### Introduction to Engineering Teacher Workshop

May 1, 2015

(Middle & high school science, technology, engineering and math [STEM] teachers)

### NSF-Funded RET Site -

### Robotics Engineering for Better Life & Sustainable Future

(STEM partner school district teachers)

For additional information, go to:

[www.egr.msu.edu/future-engineer/ret](http://www.egr.msu.edu/future-engineer/ret)

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## ME 371 Mechanical Design I



**Dr. Farhang Pourboghrat**  
Professor of Mechanical  
Engineering



**Dr. Brian Thompson**  
Professor of Mechanical  
Engineering

### Thrills for Pre-collegiates: Mechanisms that Fascinate, Captivate, Stimulate and Entice

Teams of students were required to design and manufacture mechanisms that would thrill an audience of pre-collegiate students. The constraints imposed upon this assignment were that each mechanism must incorporate at least one linkage, one gear set and one cam-follower combination. These engineering marvels will be demonstrated, and displayed with a complementary poster explaining the subtleties of each mechanism. The ME 371 teams will also be interviewed and rated by the pre-collegiate students. The most highly-rated team will be awarded the Sparty Plaque, which was designed and fabricated by students at Holt Junior High School over a decade ago.

#### Teams and members

##### Section 1: Dr. Brian Thompson

<b>Team 1</b> Patrick Frahm Peter Howes William Kang Ha Le Hiroya Miyoshi	<b>Team 2</b> Maxwell Bennett Graham Goble Matthew Marchetti Hayden May Nick Scibilia	<b>Team 3</b> Scott Matthews Jacob Pusheck Andrew Slatin Aleks Vartanian	<b>Team 4</b> Alexandria Allman Julia Briggs Danielle Heger Ben Yancho Louis Yun	<b>Team5</b> Kevin McCarty Elizabeth Schaepe Brad Seegert Aaron Smith Scott Welburn	<b>Team 6</b> Jeff Hall Richard Harrington Rachel Horstman Katie Landwehr Qin Liu
<b>Team 7</b> Lindsay Clark Lucia DeVillano Michael Doa Rachel Geary Zachary Graves	<b>Team 8</b> Leo McLaughlin Mitch O'Brien Michael Sanchez Jiayi Shi Andrew Stanny	<b>Team 9</b> Abigail Livingston Michael Schwartz Darby Spiegel Alexander Taylor	<b>Team 10</b> William Burek Alex Friedman Reace Head Jason Vismara Robert Warfield	<b>Team 11</b> Trevor Gilmartin Andrew Kalina Jessica O'Brien Harsh Patel Lisa Vogel	

##### Section 2: Dr. Farhang Pourboghrat

<b>Team 1</b> Abdulmajeed Alotaibi Dingyu Hu Katy Sabo Patrick Vaughan	<b>Team 2</b> Katie Arends Matthew Knudtson Jun Sheng Jay Thanedar	<b>Team 3</b> Sanders Aspelund Junhun Gong Kevin Pugh Robert Wygant	<b>Team 4</b> Angel Begov Jennifer Jones Greg Peterson Cody Thon	<b>Team5</b> Dan Bowers Yan Li Alan Richards Xuelai Wang	<b>Team 6</b> Kane Clark Jay Gersonde Ying-Hung Lou Yijia Zhang	<b>Team 7</b> Keegan Connolly Andrew Gregg Feny Patel HaoCheng Sun
<b>Team 8</b> Katherine Donnay Matthew Klooster Dan Seiderman Michael Thelen	<b>Team 9</b> Dominique Dubay Kyle Medrano Lee Teasley Libin Ye	<b>Team 10</b> Max Dunigan James Leung Andrew Stieber Shane Toreki	<b>Team 11</b> Dylan Etheridge Philip Lecznar Logan Springgate Shenquan Wang	<b>Team 12</b> Kimberly Fortenberry John Gillis Heng Yun Wan Kevin Wilberding	<b>Team 13</b> Daniel Ignatowski Melanie Mullett Steven Ward Robert Zuerlein	<b>Team 14</b> Miriam Chege Jacob Vymazal Kyle Witgen Nick Youngerman



## ME 412 Heat Transfer Laboratory

**Dr. André Bénard**  
Associate Professor of Mechanical Engineering

### The Amazing Heat Transfer

A heat pipe is a device with no moving parts and no external power supply. Its function is to cool a contained liquid by having it flow in a self-perpetuating cycle, in which the liquid evaporates, rises, condenses/cool, and falls before repeating the cycle. Each team is to design, model, build, and test a heat pipe to operate at a low pressure. The goal is to achieve the greatest reduction in the temperature of 1 liter of boiling water in 15 minutes using a single heat pipe. The heat pipe must be manufactured by the project team. A vacuum pump will be available to lower the pressure inside the heat pipe. There are no maximum dimensions for the pipe, but it must have a minimum height of 20 cm. Each team will be allowed 5 minutes to set up its pipe and must demonstrate its operation for 15 minutes by extracting as much thermal energy as possible from the hot water. Cooling is provided by ambient air. Teams are evaluated according to the thermal energy their pipe extracts from the water and the weight of their heat pipe (lower is better). Each team also prepares a YouTube video for presentation to the audience during the competition, which explains the operating principles of its device.

### Competition Schedule

Time	Team Name	Team members		
8:30	#Hot Tub	Nicholas Garneau	Kyle Griffiths	Shenli Pei
	CRH Corp.	Gabrielle Colby	Joshua Haneline	Michael Ray
8:50	Glad It's Not a Hot Dog Cooker	Emma Drenth	Benjamin Lindemulder	Jamie Steinberger
	The Water Gate	Theodore Linabury	David Torres	Alexander Williams
9:10	Hot E's	Nicholas Chase	Seium Teshome	Mitchell Williams
	Local Pipe Layers Union No. 1855	Brett Close	Anthony Kazenko	Grant Ridley
9:30	P-Diddy Stompers	Danielle Lapointe	Cody Little	Jason Seely
	The Heat of the Moment	Aidan Hunter	Travis Schafer	Jason Wagnitz
9:50	High Voltage Club	Scott Oldham	Kyle Wright	
	The Three Musketeers	William Freed	Sean Hand	Lauren Marino
10:10	Dream Team	Craig Cline	Mohammed Itani	Carl Kaspari
	Heat Transfer Innovators	Reema Aldhaneem	Scott Belonge	Joshua Gann
10:30	"Couldn't Think of One..."	Justin Fauntleroy	Thomas Parshall	Charles Whiteside
	J3	Jay Heribacka	Joshua Hubert	Jacob Sparks
10:50	Spartan Dawgs	Darius Barrett	Juntai He	Daniel Schwartz
	Hot 'N' Ready	Stephen Jurewicz	Benjamin Rittinger	Barrett Winrick
11:10	Dream Pipe	Samuel Bekkers	Geoffrey Giese	
	Lienhard and Lienhard	Benjamin Carruthers	Matthew Heimonen	Kyle Sherman
11:30	What Does a Ninja Drink?	Robert Hyatt	Conner Koester	John Multer
	Hot 'N' Steamy	Brianna Hogan	Adam Kluz	Adam Lyman
11:50	Team Bernouilli	Joseph Aljajawi	Christopher Brady	Steven Hilliard



## ME 471 Mechanical Design II

**Dr. Ron Averill**

**Associate Professor of Mechanical Engineering**

*This ME 471 design project was  
generously sponsored by US Steel*



**U. S. Steel**

## Design of a Horizontal Motion Conveyor

Students in ME 471 were challenged to design, build and test a small scale horizontal motion conveyor system to transport cereal during processing. The design scope includes (1) the drive mechanism, (2) the pan, (3) the supports, and (4) all associated hardware.

The system should be designed and manufactured so that:

- Energy usage and system costs are minimized. For the most part, these goals are accomplished simultaneously by minimizing the mass of the pan and ensuring smooth motion.
- Product flows rapidly along the length of the pan to maximize throughput.
- Product is distributed uniformly across the width of the pan (to enhance cooling, drying and distribution of the product).
- All metallic structural components are designed to have infinite fatigue life.

- The operation of the system is safe for all personnel and intended products.
- The system is easily maintained, including cleaning, aligning and general maintenance.
- The system is easily assembled and disassembled for use in different configurations and lengths.

The total design performance determines 50% of the final grade and the other 50% is determined by a final written report that details the concept development and selection process, kinematic analysis, finite element structural analysis, failure analysis, fatigue analysis, cost analysis, integration of marketing elements, and recommendations for future improvement of the design.

## Competition Schedule

Team	Times & (Stations)			Design Team
1	8:00 (1)	8:10 (2)	8:20 (2)	Kyle Corey, Andrew Gates, James Hargrove, Yousib Kammo
2	8:10 (1)	8:20 (3)	8:30 (3)	Eric Bambach, Ryan Glynn, Tianlun Liang, Eric Peters
3	8:20 (1)	8:30 (2)	8:40 (2)	Matthew Korolewicz, Kevin Licata, Duan Ni, Seth Rohr
4	8:30 (1)	8:40 (3)	8:50 (3)	Angela Bertolini, Nicholas Theis, Mariya Titova, Kevin Viguilla
5	8:40 (1)	8:50 (2)	9:00 (2)	Grant Ridley, Madeline Roe, William Weiland, David Zilinskas
6	8:50 (1)	9:00 (3)	9:10 (3)	Yuhao Chen, Alexander Gore, Shadi Jammoul, Jacob Sparks
7	9:00 (1)	9:10 (2)	9:20 (2)	Toby Buckley, Arric McLauchlan, Travis Packer, Megan Simpson
8	9:10 (1)	9:20 (3)	9:30 (3)	Austin Daugherty, Bradley McCauley, Shannon Pinner, Manmit Singh
9	9:20 (1)	9:30 (2)	9:40 (2)	Tyler Finses, Jill Furness, Jeremiah Manning, Cody Neal
10	9:30 (1)	9:40 (3)	9:50 (3)	Michael Campbell, Jinbo Chen, Michael Cieslik, Saurabh Sinha
11	9:40 (1)	9:50 (2)	10:00 (2)	Daehee Park, Joseph Savage, Karan Takkallapally, Stephen Town
12	9:50 (1)	10:00 (3)	10:10 (3)	Ryan Jacobs, Anthony Lacross, Anna Nham, Alexander Schuen
13	10:00 (1)	10:10 (2)	10:20 (2)	Nicholas Decker, Garrett Dunn, Tianyi Fu
14	10:10 (1)	10:20 (3)	10:30 (3)	Bara Aldasouqi, David Drake, Shenyu Gao, Steven Lund
15	10:20 (1)	10:30 (2)	10:40 (2)	Brandon Ogbonnaya, Adam Polack, Mitchell Williams, Alex Zettler
16	10:30 (1)	10:40 (3)	10:50 (3)	Taylor Gilliland, Amelia Karaba, Trevor McSween, Thomas Stevenson
17	10:40 (1)	10:50 (2)	11:00 (2)	Jessica Buschman, Travis Collings, Ravin Kelser, Basil Thurston
18	10:50 (1)	11:00 (3)	11:10 (3)	Benjamin Carruthers, Ryan Ferguson, Noelle Kahunguba, Christoffer Sehling
19	11:00 (1)	11:10 (2)	11:20 (2)	Alex Hock, Andrew Shih, Geoffrey Todd, Chunlei Zhao
20	11:10 (1)	11:20 (3)	11:30 (3)	Stephanie Black, Austin Condra, Travis Tehlirian, Steven Utz
21	11:20 (1)	11:30 (2)	11:40 (2)	Lauren Grigg, Trevor Laskowski, Ashley Pomaville, Pengjie Zhuang
22	11:30 (1)	11:40 (3)	11:50 (3)	Tina Isaac, Gregory Lott, Elisabeth Warner, Tong Wu





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# The Capstone Projects



**Dr. Giles Brereton**  
Associate Professor of  
Mechanical Engineering

## Presentation Schedule – Engineering Building, Room 1208

Time	Team Sponsor	Project Title
8:30 a.m.	Marathon	Tool for Extracting Seized Pump Seals
9:00 a.m.	Eaton	Door Actuator Design for Multiple Tolerances
9:30 a.m.	Bosch	Fixture for Disassembly of Large Fuel Injectors
10:00 a.m.	Bosch	Dynamometer for DC Motor Testing
10:30 a.m.	General Motors	Multifunctional Floor Mats for Vehicles
11:00 a.m.	Meritor	Composite-Material Axle-Bowl Cover
11:30 a.m.	Whirlpool	Design of Appliances for Recyclability

## Presentation Schedule – Engineering Building, Room 1220

Time	Team Sponsor	Project Title
8:30 a.m.	Heartwood School	Multi-Purpose Ball-Launching Mechanism
9:00 a.m.	Heartwood School	Floor-to-Seat Personal Elevation System
9:30 a.m.	Heartwood School	Classroom Chair with Proprioceptive Feedback
10:00 a.m.	U.S. Steel	Hydraulic Wrench for Large Retaining Nuts
10:30 a.m.	ArcelorMittal	On-Site Treatment of Caustic Wastewater
11:00 a.m.	General Motors	Apparatus to Test Vehicle Fuel Fill Pipes
11:30 a.m.	Ingersoll Rand	Optimization of a Commercial HVAC System



To view these presentations live, please visit the Design Day website: <http://designday.egr.msu.edu> and click the Watch Live tab in the left-side menu bar.

# ME 481 Mechanical Engineering Design Projects

Mechanical engineers make the world move and provide the energy for it to do so. One goal of the MSU Mechanical Engineering Program is to educate engineers who are prepared to Lead, Create, and Innovate as their professional or graduate careers evolve. The Mechanical Engineering Design Program is the key element of the curriculum that supports this goal. There are five required design courses in the program which provide our students with eight hands-on, team-based, 'design, test and build' projects, and numerous opportunities to practice and refine their written, oral, poster, and video presentation skills. The Design Program in Mechanical Engineering has attracted national recognition on many occasions and helps to distinguish the ME program as one of the best in the country.

The faculty advisers for these projects are: Seungik Baek, Giles Brereton, Patrick Kwon, Dahsin Liu, Alfred Loos, Farhang Pourboghra, Rodney Tabaczynski, Elisa Toulson, Indrek Wichman, Neil Wright and George Zhu.



# Marathon Petroleum

## Tool for Extracting Seized Pump Seals

**M**arathon Petroleum is the nation's fourth largest transportation fuels refiner and the largest in the Midwest. Marathon Petroleum has the capacity to refine and transport 1.7 million barrels per day over 8,300 miles of pipeline across North America. In order to ensure their products are transported efficiently through pipelines, pumping stations are placed every 30 to 50 miles. While carrying out a program to replace single pump seals with a more efficient dual seal, Marathon has found that some seals seize to the pump shaft and are difficult to remove. Marathon Petroleum envisions an industry-wide benefit for a universal tool to remove seized mechanical seals effectively, to ensure technician safety, and to reduce costly pump downtime during seal replacement.

The MSU team aims to create an ergonomic tool for this task that is an improvement on a pry bar--the current method of removal which can endanger technicians. This new tool will apply a uniform load across the mechanical seal for optimal grip and improved stability, while being lightweight and easy to use. The tool will be built and tested on a fabricated pump fixture at MSU and then at Marathon Petroleum's training facility.



### Michigan State University

#### Team Members

**Justin Fauntleroy**  
Lincolnshire, Illinois

**Scott Oldham**  
Long Island, New York

**Thomas Parshall**  
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**Cody Paupert**  
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**Kyle Wright**  
Kalamazoo, Michigan

### Marathon

#### Project Sponsors

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**Ross Dundgeon**  
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**Rebecca Forbes**  
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**Dave Foulke**  
Findlay, Ohio

**Steven Mikula**  
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**Craig Miller**  
Findlay, Ohio

**Ross Simons**  
Findlay, Ohio

**Russ Tindall**  
Findlay, Ohio

# Eaton Corporation

## Door Actuator Design for Multiple Tolerances

Eaton Corporation is one of the world's premier suppliers of aerospace, electrical, automotive and hydraulics systems. In the aerospace industry, Eaton has specialized in designing and assembling actuation equipment for commercial and military applications. Actuation equipment is used for a variety of purposes in aircraft, and Eaton products are responsible for the reliability of multiple actuation devices on each aircraft. One type of actuator that Eaton has designed is called an In-Flight Refueling Receptacle (IFRR). This actuator opens and closes the refueling door to the Lockheed Martin F-35 Lightning II and can be deployed for extended periods during flights.

The goal of this capstone project is to design and verify a 'go, no-go' gauge to validate six critical dimensions of the IFRR so that overall designs can be certified to be within required tolerances. Eaton has proposed a potential IFRR design and has asked the MSU team to authenticate its functionality through a series of Geometric Dimension & Tolerance (GD&T) stack-ups. When the design has been authenticated in this way, a working prototype will be fabricated.



### Michigan State University

#### Team Members

**Sam Bekkers**  
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**Craig Cline**  
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**Mohammed Itani**  
Grand Rapids, Michigan

**Carl Kaspari**  
Shelby Township, Michigan

**Paul Petrous**  
Novi, Michigan

### Eaton Corporation

#### Project Sponsor

**David Peterson**  
Byron Center, Michigan

# Bosch

## Fixture for Disassembly of Large Fuel Injectors

Robert Bosch is a multinational engineering company headquartered in Stuttgart, Germany, with innovative products in the automotive, consumer, and industrial sectors. Within Bosch's US diesel technology division, a support team conducts testing and investigative studies of large-engine diesel injectors. These devices are used to inject fuel into the cylinders of engines, in applications ranging from heavy industrial equipment to locomotives. They can be over two feet long and weigh over 25 pounds. Currently, the large-engine diesel fuel injectors have to be returned to Austria to be disassembled for investigative studies because specialized equipment is needed to support and take apart the injectors, which can require torques of up to 1100 ft-lbs.

The goal of this project is to design and fabricate a prototype fixture that will be used to disassemble and reassemble a large-engine diesel fuel injector to a specified torque and angle, with the adjustability required for many sizes of large-engine diesel fuel injectors. The fixture will be tested on a range of injectors prior to delivery to Bosch.



**BOSCH**  
Invented for life



### Michigan State University Team Members

**Vito Balsamo**  
Macomb Township, Michigan

**Robert Jakubowski**  
Lambertville, Michigan

**Stephen Jurewicz**  
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**Frank Kmet**  
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**Ben Rittinger**  
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### Bosch Project Sponsors

**Art Bousquette**  
Farmington Hills, Michigan

**Greg Gartland**  
Farmington Hills, Michigan



# Bosch

## Dynamometer for DC Motor Testing

Bosch is a leading global supplier of technology and services and is headquartered in Stuttgart, Germany. The company is comprised of four distinct sectors: Automotive Technology, Energy and Building Technology, Industrial Technology, and Consumer Goods. Within the Automotive Technology sector, Bosch manufactures a number of engine control components, such as, the throttle body of an engine's air-intake system. Inside the throttle body, a small DC motor opens and closes the throttle plate and ensuring that each motor functions correctly is an important part of this component's testing process. Bosch is interested in using a low-cost, reliable dynamometer to measure both the torque and the efficiency of each motor in an effort to find a method of testing that is faster and less expensive than its current one.

The primary goal of this project is to design and manufacture a robust, low-cost dynamometer for small DC motor testing. Using a combination of mechanical, electrical, and data acquisition concepts, an optimal design will be selected to best satisfy the constraints of ease of use, safety, and reliability.



**BOSCH**  
Invented for life



### Michigan State University

#### Team Members

**Joe, Aljajawi**  
Troy, Michigan

**Chris Brady**  
Palatine, Illinois

**Steve Hilliard**  
Monroe, Michigan

**Bri Hogan**  
Sterling Heights, Michigan

**Adam Kluz**  
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### Bosch

#### Project Sponsor

**Ryan Smith**  
Farmington Hills, Michigan

# General Motors Corporation

## Multifunctional Floor Mats for Vehicles

**G**eneral Motors is one of the largest automotive manufacturers in the world and is based in Detroit, Michigan. In addition to automobiles, the company also sells accessories to protect the interior of the vehicle from damage, such as all-weather floor mats and trunk liners. While these accessories are ordinarily designed to protect vehicle interiors from snow, ice, and salt, many customers wish to have their vehicles more personalized to match their individual tastes. General Motors is interested in combining these two functions into a single custom floor mat or liner that would serve both purposes and could be ordered when purchasing a new vehicle.

The objective of this project is to create a customized floor-mat and liner design that will stand up to the rigors of different weather conditions and day-to-day wear and tear, such as digging sharp heels into mats while driving, etc. The new mat and liner design must be able to be customized to the consumer's taste, while being much more durable than currently available products, and manufacturable on demand rather than far in advance. The new design also must not increase the production cost of each mat significantly.



### Michigan State University

#### Team Members

**Nicholas Garneau**  
Lansing, Michigan

**Kyle Griffiths**  
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**Robert Hyatt**  
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**John Multer**  
Plainwell, Michigan

**Shenli Pei**  
Shanghai, China

### General Motors

#### Project Sponsors

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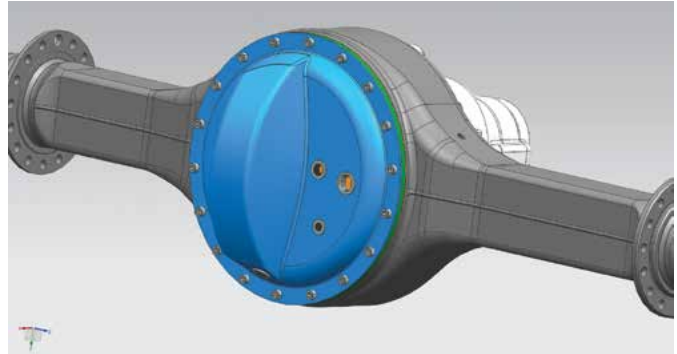
**Dave Nevitt**  
Warren, Michigan

# Meritor Inc.

## Composite-Material Axle-Bowl Cover

**M**eritor, Inc. is a US based corporation headquartered in Troy, Michigan, and is a leading global supplier of drivetrain, mobility, braking and aftermarket solutions for commercial vehicles and industrial markets. With a long legacy of providing innovative products that offer superior performance, efficiency and reliability, the company serves commercial truck, trailer, defense, specialty and aftermarket customers around the world. In an effort to offer its customers more options while minimizing overall cost, Meritor is interested in incorporating composite materials into the design of future products such as axle-bowl covers.

The goal of this project is to develop a prototype composite axle-bowl cover for a commercial heavy-axle vehicle. Composite designs offer advantages over traditional steel axle-bowl covers such as reduction in volume of the lubricating fluid and lower weight. A molded composite cover offers improved serviceability of drivetrain components and seamless integration of other features. To achieve this design goal, composite design and finite element analysis techniques will be performed to achieve the required structural integrity and ease of manufacturing, with the least weight and lowest material cost.



### Michigan State University

#### Team Members

**Brett Close**  
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**Anthony Kazenko**  
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### Meritor

#### Project Sponsors

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**Dale Kwasniewski**  
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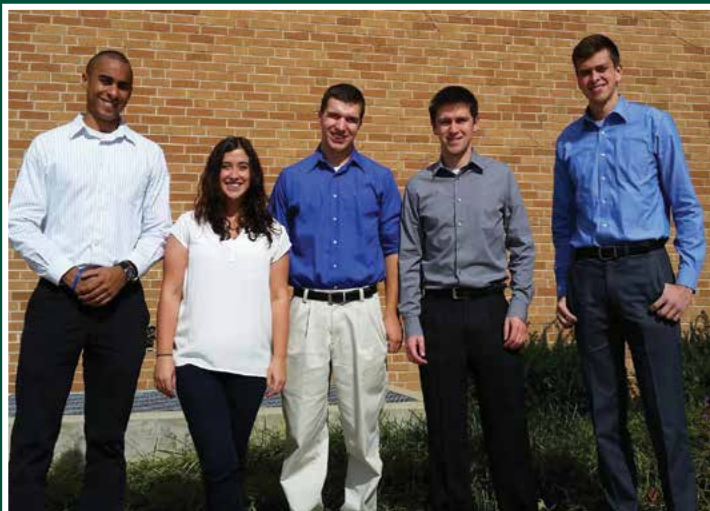


# Whirlpool Corporation

## Design of Appliances for Recyclability

**W**hirlpool Corporation, headquartered in Benton Harbor, Michigan, is the leading producer and marketer of home appliances in the world. It employs nearly 70,000 people worldwide, with 23,000 in the United States. Whirlpool manufactures washers, dryers, dishwashers, cooking ranges and ovens, as well as tabletop appliances, such as standing mixers, under various brands including Whirlpool, Maytag, and KitchenAid. Whirlpool has recently adopted a broader environmental focus for its products, concentrating on increased energy efficiency and their environmental sustainability, as well as on customer needs and satisfaction.

The MSU team has been asked to evaluate the design of a popular brand of cooking range from the perspective of end-of-life recyclability and efficiency of disassembly, for retirement and recycling of the unit. It will examine existing material selections and designs for recycling and disassembly and create an optimized design for environmental sustainability.



### Michigan State University

#### Team Members

**Josh Gann**  
Traverse City, Michigan

**Josh Haneline**  
Holly, Michigan

**Danielle LaPointe**  
Central Lake, Michigan

**Cody Little**  
Haslett, Michigan

**Jason Seely**  
Haslett, Michigan

### Whirlpool Corporation

#### Project Sponsors

**Dave Kortebein**  
Benton Harbor, Michigan

**Nagapooja Seeba**  
Benton Harbor, Michigan

# Heartwood School

## Multi-Purpose Ball-Launching Mechanism

Heartwood School is located in Mason, Michigan, and serves students in Ingham County between the ages of 3 and 26 with cognitive impairments, multiple impairments, autism and traumatic brain injuries. It works with local school districts and families to provide programs and student services, with a curriculum focused on activities that increase the independence of students to maximize their potential and improve their future quality of life. In order to increase the level of student engagement during sports activities, Heartwood has requested that MSU's design team create a multi-purpose ball-launching mechanism that may be quickly loaded by instructors and is simple to operate for all students.

The team plans to provide energy required to propel the ball in the form of rotational inertia powered by electrical motors with a rotary mechanism for launching. The launch angle will be adjustable so that the device may launch volleyballs over a net, pitch during a game of kickball, or shoot a ball into a basketball hoop with a simple push of a button.



### Michigan State University

#### Team Members

**Joshua Boerger**  
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**Zhechany Dong**  
Zhejiang, China

**Juntai He**  
Guangdong, China

**Daniel Schwartz**  
Kalamazoo, Michigan

**Mariah Truttling**  
East Chicago, Indiana

### Heartwood School

#### Project Sponsor

**Cheryl Meyer**  
Mason, Michigan

# Heartwood School

## Floor-to-Seat Personal Elevation System

**H**earthwood School in Ingham Intermediate School District specializes in education and lifestyle improvements of students with moderate to severe mental and physical complications. Students typically take part in classroom and gymnasium activities and therapeutic treatments. One of the main educational goals of Heartwood School is to promote the independence of their students. Heartwood's facility has a variety of mechanisms used to hoist, maneuver, and relocate students but would benefit enormously from a device that could lift a student from the ground, where some activities take place, to a sitting height where many others are carried out.

The MSU team will design an automated lift that allows the Heartwood staff to raise disabled students from the ground to a sitting height. Preliminary designs for the lift mechanism will be based on those of an elevator but will employ additional specially-designed assistance mechanisms. The final device will have additional built-in features that can be enabled by both Heartwood staff and students for transferring students from the floor to standing/seating positions.



### Michigan State University

#### Team Members

**Darius Barrett**  
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**Frank Luchini**  
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**Luke Steele**  
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### Heartwood School

#### Project Sponsors

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**Joanne Janicki**  
Mason, Michigan

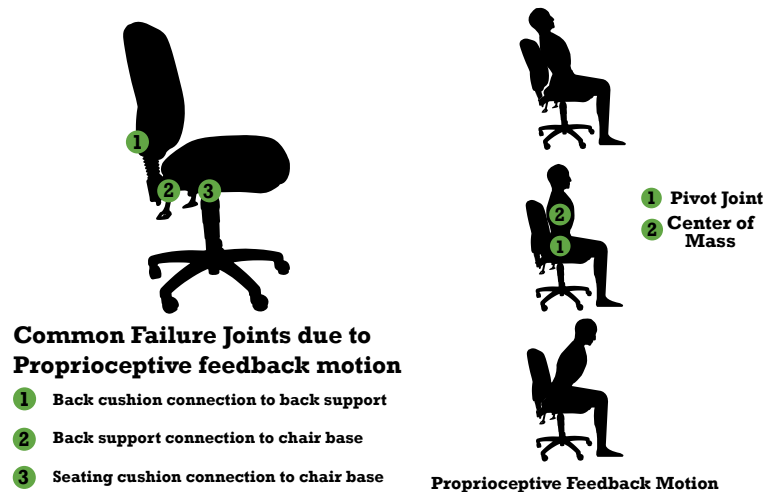


# Heartwood School

## Classroom Chair with Proprioceptive Feedback

Heartwood School serves students in Ingham County with moderate to severe cognitive impairments, severe multiple impairments, autism and traumatic brain injuries, working with local school districts and families to provide center-based programs and student services. One educational device that would benefit Heartwood's educational mission is a specialized chair for students that would be able to withstand large repetitive loads and stresses, yet function with the comfort and ease of adjustment of a standard office chair.

The MSU team plans to design such a chair with proprioceptive feedback---the reaction from changing the body's orientation with respect to gravity---which can help maintain the physical stress in a person with a low-level autistic spectrum disorder. The general design strategy is to reinforce a standard office-like chair to be able to withstand this repetitive behavior by strengthening the main joints of the chair's back and base parts while retaining the chair's overall aesthetics.



### Michigan State University Team Members

**Florian Cherdron**  
Brighton, Michigan

**Gabrielle Colby**  
Mason, Michigan

**Ted Linabury**  
Kalamazoo, Michigan

**Michael Ray**  
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**Charles Whiteside**  
Brighton, Michigan

### Heartwood School Project Sponsors

**Elizabeth Couturier**  
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**Joanne Janicki**  
Mason, Michigan

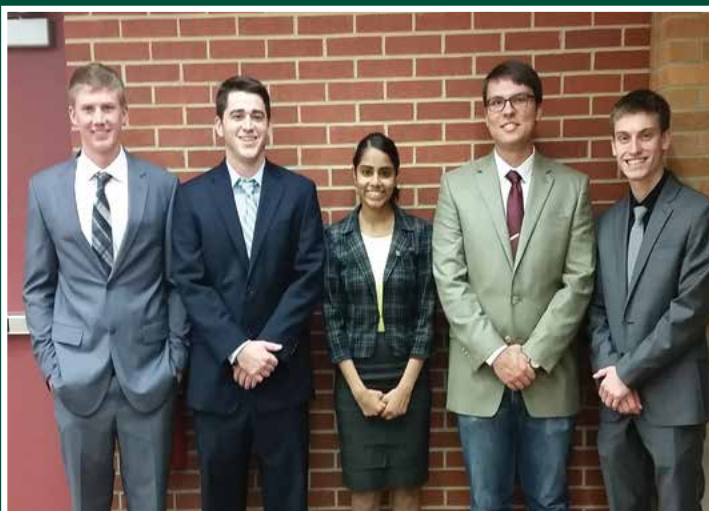
**Katie Staton**  
Mason, Michigan

# US Steel

## Hydraulic Wrench for Large Retaining Nuts

US Steel was founded in 1901 and is the largest integrated steel producer headquartered in the United States. US Steel has facilities to carry out hot and cold rolling operations to shape steel at their Great Lakes Mill in Ecorse, Michigan. These rolling operations require the use of 'back-up' rollers, which are special kinds of rollers that are held in place by bearings known as a Morgoil bearings. In order for the rollers to be retained correctly in the bearings, they must be secured around the roller with a large retaining nut. US Steel has custom hydraulic wrenches for the removal and tightening of these retaining nuts. However, the nearest is located in the Granite City Mill and is not perfectly suited to the needs of the Great Lakes Mill.

The goal of this project is to redesign US Steel's existing hydraulic wrench to meet the needs of the Great Lakes facility. The improved wrench will be adaptable to steel rollers of different diameters and lengths and for different rolling processes. The MSU team will deliver their final design as a set of 2D drawings for subsequent fabrication by US Steel.



### Michigan State University

#### Team Members

**Evan Bryant**  
Peoria, Illinois

**Geoff Giese**  
Novi, Michigan

**Evan Nordquist**  
Stevensville, Michigan

**Bansari Patel**  
Canton, Michigan

**Ryan Volkman**  
Marine City, Michigan

### United States Steel

#### Project Sponsor

**Martin Beaver**  
Ecorse, Michigan

# ArcelorMittal

## On-Site Treatment of Caustic Wastewater

ArcelorMittal is the world's leading steel and mining company and supplies quality steel products to the automotive, construction, and machinery industries, employing over 239,000 people worldwide. Because of the polluting nature of their industry, steel manufacturers must meet strict environmental regulations to mitigate the impact of waste products on the environment. The East Chicago plant utilizes sulfur dioxide wet scrubbers that absorb the harmful chemicals used in producing round and hexagonal cross-sectioned steel rods. A consequence of this process is the production of caustic wastewater which must be properly treated to meet environmental standards for water discharged into the Indiana Harbor Ship Canal.

Currently, the East Chicago plant has caustic wastewater trucked to an off-site hazardous water treatment center at a high cost. ArcelorMittal has asked the Michigan State University design team to develop a system which would allow the caustic wastewater to be treated on-site. The design team will create a comprehensive design plan that will minimize the cost of the water treatment process while satisfying environmental regulations and allow ArcelorMittal to become more self-reliant with its water treatment methods.



### Michigan State University Team Members

**Elizabeth Brandon**  
Williamston, Michigan

**Louis Dionise**  
Lansing, Michigan

**Jessica Doody**  
Lansing, Michigan

**Travis Reinhart**  
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**Jamie Steinberger**  
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### ArcelorMittal Project Sponsors

**Cliff Barnett**  
**ArcelorMittal**  
East Chicago, Indiana

**Tom Mazzacavallo**  
**Nalco**  
East Chicago, Indiana



# General Motors Corporation

## Apparatus to Test Vehicle Fuel Fill Pipes

**G**eneral Motors (GM) is an automotive manufacturing corporation that designs, manufactures, markets, and distributes vehicles all over the world. Founded in 1908, the company produces vehicles in 37 different countries and has 13 different brands. It is important to GM that the fill pipes leading to the fuel tank can withstand the loads applied by customers refueling their vehicles over their entire lifetimes. During the refueling process, customers may lean against the nozzle while filling so the fill pipe must be designed to support this applied force. The global fuel lab in Lansing tests GM's North American products, their global products and some competitors' products. The objective of this project is to help the Global Fuel Lab test the durability of fuel fill pipes on vehicles so that they may be certified for production.

The MSU team is to create a testing fixture that allows General Motors to test fuel fill pipes for a variety of vehicles for their quality and durability. A device will be designed and built to simulate the expected loads a fill pipe might endure during its expected lifetime. The tests are intended to meet EPA and CARB certification requirements and to assure that fuel filling pipes meet or exceed customer expectations.



### **Michigan State University** *Team Members*

**William Freed**  
Addison, Michigan

**Sean Hand**  
Farmington Hills, Michigan

**Canden Harp**  
Midland, Michigan

**Lauren Marino**  
Harrison Township, Michigan

**Arthur Paquier**  
Midland, Michigan

### **General Motors** *Project Sponsor*

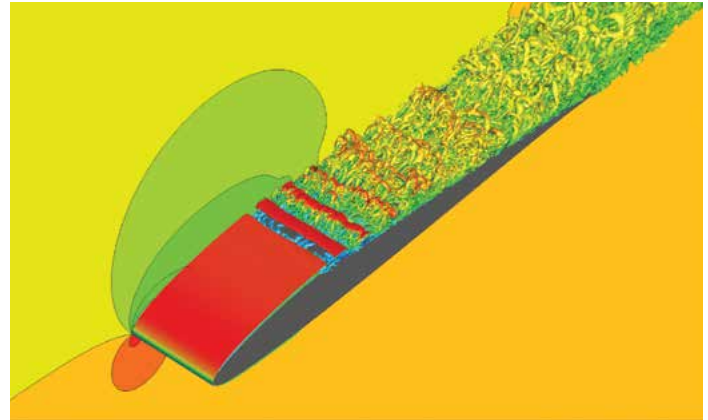
**Marvin Miller**  
Lansing, Michigan

# Ingersoll Rand

## Optimization of a Commercial HVAC System

Trane Inc., a division of Ingersoll Rand, is a global provider of heating, ventilation, and air conditioning (HVAC) systems, services, and solutions. Trane provides and supports systems for both residential and commercial buildings, focusing on innovation, energy efficiency, and sustainability. In current commercial HVAC systems, an energy wheel is used to recover and transfer heat energy between intake and exhaust airflows, and to control humidity, thereby preconditioning the air to reduce the energy needed for subsequent heating and cooling processes. If exterior air is already at the desired state, energy is saved by turning the wheel off and allowing the flow to bypass it through vents. Because of space limitations, these bypass vents are offset from the wheel, which increases the system cost through both parts and labor. Trane wishes to reduce the cost of these systems while retaining their functionality and quality.

The MSU team will design prototype bypass vents to be more compact than existing ones and which will not need to be offset. The most promising designs will be evaluated with analytical software. When the optimal design has been chosen, the team will work with Trane to produce a prototype for physical testing and submit it to Trane for further evaluation.



### Michigan State University

#### Team Members

**Scott Belonge**  
Holt, Michigan

**Nicholas Chase**  
Holt, Michigan

**Brandon Keener**  
Dewitt, Michigan

**Seium Teshome**  
Grand Rapids, Michigan

**Jason Wagnitz**  
Pinckney, Michigan

### Ingersoll Rand

#### Project Sponsor

**Mike Lewis**  
Lexington, Kentucky

# Design Day Awards

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### ME 481 Thomas Alva Edison Undergraduate Design Award

The Edison Undergraduate Design Award is given to the ME 481 Design Team that is judged to have produced the most outstanding technical design project. Last semester's winning Edison Scholars were Garrett Baughman, Brandon Cameron, Todd Sabotta, Justin Sagorski and Jonathan Woo. They carried out a project sponsored by Chrysler Group of Auburn Hills, MI in which they designed a prototype surface texture that satisfies Chrysler's constraints to further reduce aerodynamic drag in vehicles it manufactures.



ME 481 Edison: Chrysler Group LLC: Aerodynamic Drag Reduction of Automobiles

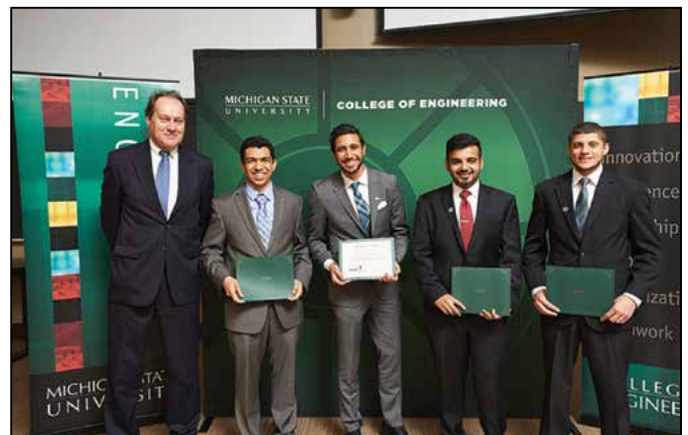
Left-to-right: Giles Brereton, Jonathan Woo

Not pictured: Garrett Baughman, Brandon Cameron, Todd Sabotta, Justin Sagorski

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### ME 481 Project Presentation Award

The ME 481 Project Presentation Award is given to the ME 481 Design Team that is judged to have given the best technical project presentation. Last semester's winning team comprised: Mohammed Alsinan, Hassan Alyousef, Abdulrahman Bafaraj, and Deonte Childress.



ME 481 Project Presentation Award: U.S. Steel Corporation: Redesigned Automatic Scraper for Steel Galvanizing

Left-to-right:  
Giles Brereton, Hassan Alyousef, Mohammed Alsinan, Abdulrahman Bafaraj, Deonte Childress

Not shown: Tom Hotari



# Spring 2014

## ME 471 Machine Design Award: The Leonardo da Vinci Award

The Leonardo da Vinci Award is given to the winning team in the ME 471 machine design competition on Design Day. Last semester's winners were Nicholas Chase, Benjamin Rittinger, Davis Torres, and Jason Wagnitz.



ME 471 Leonardo daVinci Machine Design Award

Left-to-right: Giles Brereton, Jason Wagnitz, Nicholas Chase, Davis Torres, Benjamin Rittinger

## ME 412 Heat Transfer Design Award

The student team members winning the ME 412 competition at Design Day are given the Heat Transfer Design Award. The award winners were Louis Dionise, Ryan Thompson and Peter Woodbridge.



ME 412 Heat Transfer Design Award

Left-to-right: Giles Brereton, Peter Woodbridge, Louis Dionise, Ryan Thompson

# ME 491 International Humanitarian Engineering



**Dr. Brian Thompson**  
**Professor of Mechanical Engineering**

W. H. Welch, MD (1850 – 1934) founder of the School of Public Health at The Johns Hopkins University in Baltimore, Maryland, wrote, 'It is a well known fact that there are no social, no industrial, no economic problems which are not related to health.'

Dr Welch's profound remark buttresses the vision that sustains an international educational initiative launched over a decade ago when box ovens, heated by solar thermal energy, were developed for Tanzanian families. The subsequent Humanitarian Engineering Program was born of hope and ignorance, sustained by good fortune and steadfast determination, and consummated by accomplishments that were unimaginable at the genesis, but upon reflection and further cogitation appear to be almost inevitable.

Authentic semester-long interdisciplinary humanitarian projects motivate and accelerate undergraduate learning much more poignantly than traditional hypothetical academic classroom exercises. This assertion is clearly evidenced this semester by a student team continuing their development of a human-powered pigeon-pea thresher that was initiated in the 2014 Spring Semester. Poverty-stricken smallholder farmers will use the thresher in January 2015 after it has been delivered to the NGO Semilla Nueva in the town of Quetzaltenango, Guatemala.

The fabric of this design-intensive interdisciplinary ME491 course is woven from a thread of ideas on humanitarian societal development that address the pressing needs of the 80 percent of the world's population living on less than \$2.00 each day, intertwined with a second orthogonal thread comprising a triumvirate of fundamental ideas on interdisciplinary problem-solving processes, entrepreneurship, and the diffusion of innovations that are relevant to every nation sharing our small planet. This warp and weft of interlaced fibers constitute the tapestry defining

the scaffolding for the solution of the biggest challenge confronting humanity today.

Students enrolled in this enthralling ME491 course are the visionaries and the bold ones. The dreamers and the doers. The explorers and the discoverers. The achievers of the amazing. But these risk-takers must maintain paradoxical balances. They are committed to the traditional engineering practice of creating revolutionary new products that enhance the lives of the poor, yet they display personal panache; they are prepared to stand steadfastly alone while clinging to their own personal convictions, yet they are willing to unite philosophically because of their commitment to teamwork; and they are relentlessly driven to create waves of positive change in international marketplaces, yet they are also cognizant of social, cultural and ethical responsibilities. Yes, this is indeed a complicated convoluted conundrum!

So please pause to review the spectacular human-powered thresher developed by these ME491 students. Converse with them, marvel at their dedication to serving the poor, the marginalized, and also the under-represented at the base of the socio-economic pyramid. Be transformed by this emotive exchange to join them in serving the billions of men, women and children living in abject poverty.

In September 2014, the United Nations Goodwill Ambassador Emma Watson delivered a speech in New York City and concluded with the following words, "I'm inviting you to step forward, to be seen, and to ask yourself: If not me, then who? If not now, then when?" Will you step forward? Will you join the throng to serve the poor? Really, will you?

# Semilla Nueva: Portable Pigeon-pea Thresher

**S**emilla Nueva is a non-governmental organization (NGO) in Quetzaltenango, Guatemala, dedicated to helping rural farmers discover a path to prosperity, health, and sustainability through sustainable agriculture technologies and farmer-to-farmer education. One of their more recent projects is the introduction of a potential new industry featuring a crop native to India: pigeon-pea. This legume is being introduced to the local culture to serve as a permaculture crop which has the potential to have both nutritional and economic impacts. Pigeon-pea is extremely rich in protein, fibers and essential micronutrients to help combat malnutrition problems. Economically, a new crop will provide an enhanced income stream for struggling smallholding farmers in addition to their traditional produce such as corn.

Current harvesting practices are both brutally labor intensive and time-consuming as the crop is beaten by hand in order to break open the pods to release the peas for collection. The objective of this rigorous humanitarian engineering project is to provide impoverished farmers in Guatemala with an innovative, low-cost, human-powered portable thresher that increases current pigeon-pea production as well as to develop a device that is not only affordable to smallholder farmers but is easily manufacturable.

While the engineering development of the threshing machine has been crucial, the 2014 Fall semester's focus also encompassed the diffusion of this innovation in Latin America. The latter objective entailed collaboration between the College of Engineering and other colleges, most notably the College of Agriculture, to aid in the support of this international multidisciplinary project and its success in Guatemala. Financial support was also a key for the team's international travel and shipping costs. Being awarded a competitive grant has helped with the latter objective. The realization of this project has been a direct result of the overwhelming dedication by all involved and the overall objective of using our knowledge and skills for the betterment of the world.



## Michigan State University

**Team Members** (left to right)

**Tyler Jezowski**  
Linwood, Michigan

**Adam Lyman**  
Dewitt, Michigan

**Adam Kluz**  
Wixom, Michigan

**Joe Aljajawi**  
Troy, Michigan

## Semilla Nueva

**Project Sponsor**

**Curt Bowen**  
Quetzaltenango, Guatemala



# PROBLEM *Solved.*

On Design Day you'll showcase all of the skill, logic and knowledge that you've amassed as a Spartan to solve a real-world problem. And you'll look good because MSU has prepared you well for this day.

You never know what problems you'll encounter after you leave East Lansing. But no matter what you face, the MSU Alumni Association is here to help you stay connected to the resources and people that keep Spartan Nation strong.

**JOIN OUR NETWORK OF  
PROBLEM SOLVERS TODAY.**

**ALUMNI.MSU.EDU**



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