MICHIGAN STATE UNIVERSITY

MICHIGAN STATE UNIVERSITY

Design Day

Spring 2016

COLLEGE OF ENGINEERING

MICHIGAN STATE UNIVERSITY FEDERAL CREDIT UNION

Executive Partner Sponsor

Welcome to MSU College of Engineering Design Day!

On behalf of Michigan State University Federal Credit Union (MSUFCU) in partnership with the College of Engineering, and Michigan State University, we would like to welcome you to MSU's campus and this extraordinary program.

MSUFCU is proud to partner with MSU on many programs, especially those that highlight the talents of MSU's outstanding students. Today, you will experience the work of MSU students demonstrating their abilities to be creative, innovative, and problem solve — traits that we all seek in our next generation of employees.

Design Day showcases the students' unique skills exhibited in their intellect, ingenuity, teamwork, and core engineering knowledge learned during their academic tenure in the MSU College of Engineering. As we observed the students' projects this semester, they provided insight into their inspiring solutions to the real-world challenges presented. As a result, we have great confidence in their futures as engineers and leaders in our global workforce.

We wish everyone in attendance our congratulations on your successes and accomplishments. And, a special thank you to the parents, families, faculty, and staff that have supported the students as they achieve their dreams.

Sincerely,

April M. Clobes
President/CEO, Michigan State University Federal Credit Union

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Mark Your Calendars!! It's time to save the date for Fall 2016 Design Day!

Join us December 9 2016, for another energetic celebration showcasing talented engineering students

Check our website often for updates during the semester: http://designday.egr.msu.edu/day

GO GREEN!!

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. This term, all ten academic departments are participating in Design Day.

We are pleased to acknowledge the MSU Federal Credit Union as our Design Day Executive Partner Sponsor and Ford as our Design Day Directing Partner Sponsor. Our Design Day Supporting Partner Sponsors include Blackstone Technologies, Bosch, Dow, General Motors, the MSU Innovation Center, and Spectrum Health. 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.

Dr. Leo Kempel

Dean of the College of Engineering

Professor of Electrical and Computer Engineering

Michigan State University

Events Schedule Friday, April 29, 2016

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 Rm 2228 8:00 a.m. – Noon					
Engineering Student Organizations		1st Floor West Lobby 8:00 a.m. – Noon					
ECE 101 Presentations			2nd Floor 2200 Hallway 9:00 a.m. – Noon				
ECE 410 Presentations			2nd Floor 2200 Hallway 9:00 a.m. – Noon				
EGR 100 Presentations			2nd Floor 2300/2200 Hallway 9:00 a.m. – Noon				
ME 371 Demonstrations			1st Floor Rooms 1230 & 1234 9:00 a.m. - Noon				
ME 412 Competition		1st Floor Room 1252 8:00 a.m. - 11:20 a.m.					
ME 471 Competition			1st Floor Room 1345 8:30 a.m. - 11:50 a.m.				
ME 478 Presentations				1st Floor West Main Lobby/Stairwell 9:00 a.m. - 10:00 a.m.			
ME 497/MKT 420 Presentations		1st Floor Room 1240 8:00 a.m. - 11:00 a.m.					

CAPSTONE COURSES							
All Capstone Posters for most projects, including BE485/487, ChE 434 and MSE 466		1st Floor 1200/1300 Hallway 8:00 a.m. - Noon for most. ChE on 2nd Floor 2200 Hallway MSE 466 will be on 1st Floor, Room 1145 8:00 a.m. - 11:45 a.m.					
AESC 410 Project Presentations			1st Floor Rooms 1257 and 1260 Anthony Hall 7:35 a.m. - 11:45 a.m.				
CE 495 Project Presentations		First & Third Floors – Rooms 1538, 3400 & 3540 8:00 a.m. - Noon					
CSE 498 Project Presentations			3rd Floor, Room 3405 7:30 a.m. - Noon				
ECE 480 Project Presentations			2nd Floor Rooms 2205 and 2250 8:10 a.m. - 11:45 a.m.				
ME 481 Project Presentations			1st Floor 1200 Hallway/Rooms 1202, 1208 & 1300 8:30 a.m. - 12:30 p.m.				

OPENING AND AWARDS							
High School Opening			1st Floor Anthony, Room 1279 8:00 a.m. - 8:40 a.m.				
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:

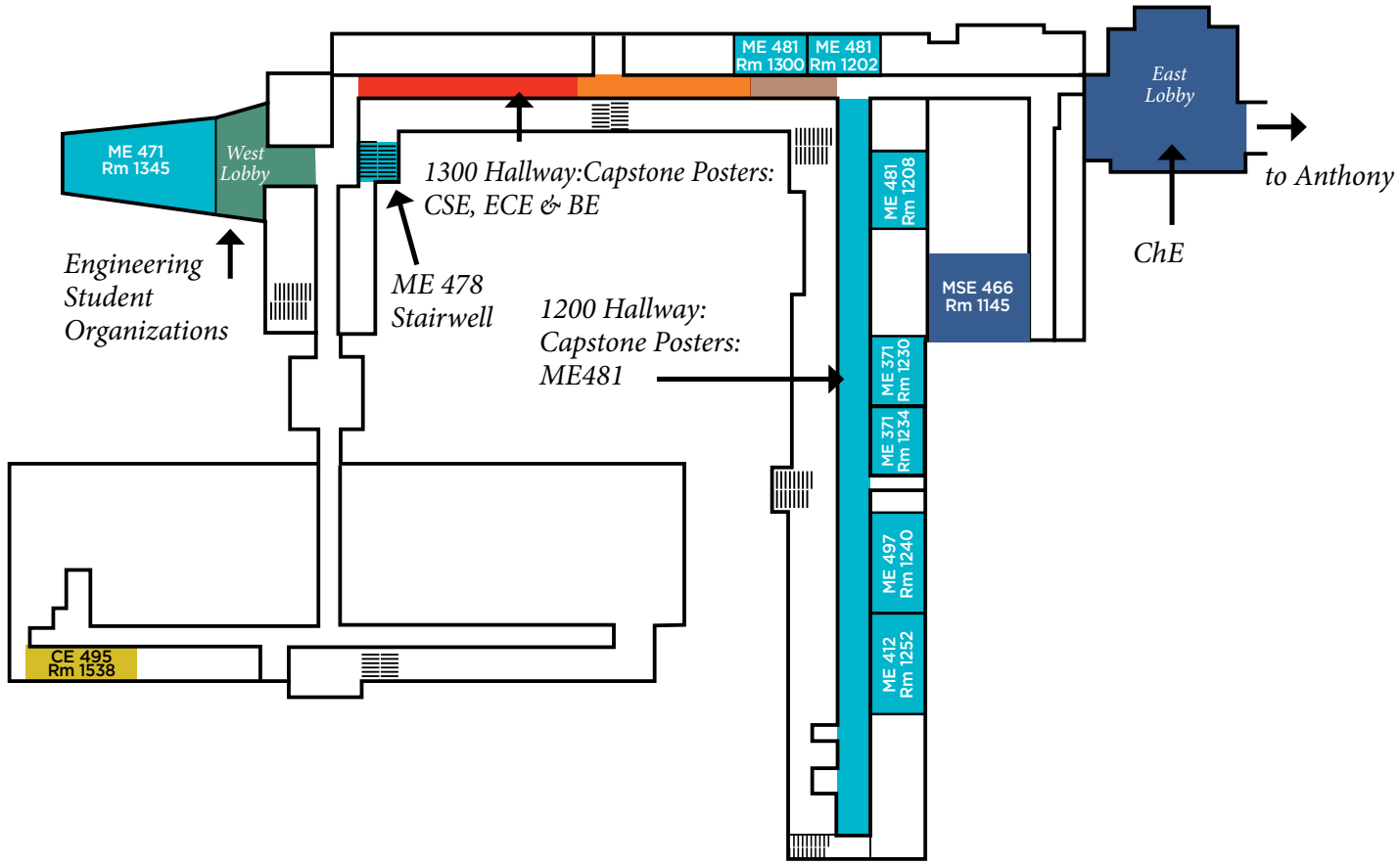
"Like" the College: https://www.facebook.com/SpartanEngineering "Follow" the College: https://twitter.com/msu_egr_news

To stay up to date w/Careers in Engineering:

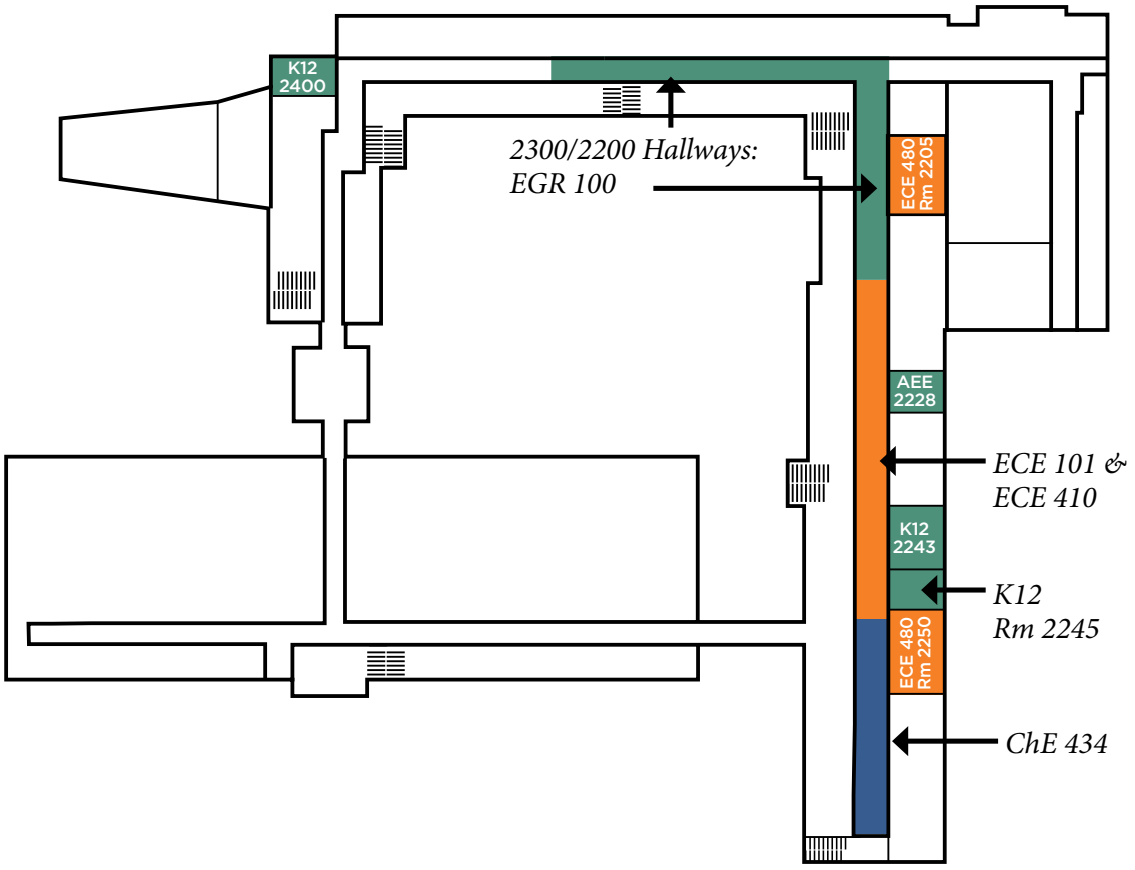
"Like" Us http://www.facebook.com/pages/The-Center-for-Spartan-Engineering/226159694117936

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

1st Floor Engineering

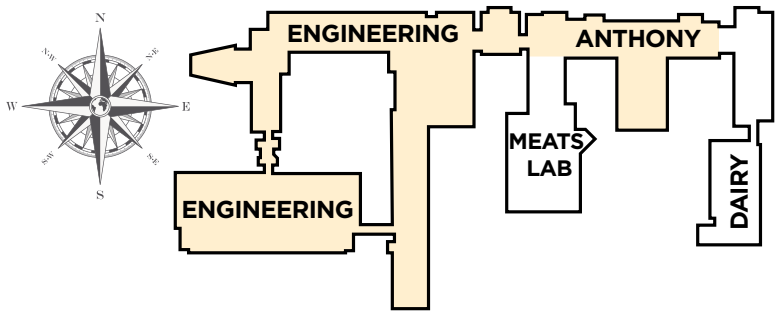


2nd Floor Engineering

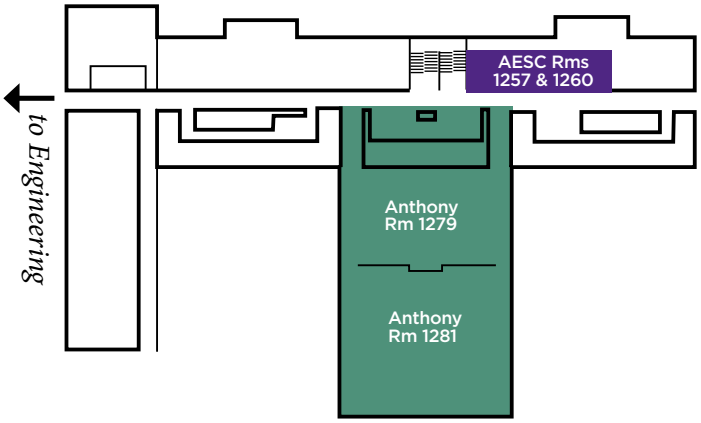


Design Day Floor Plans of the MSU Engineering Building

Overview



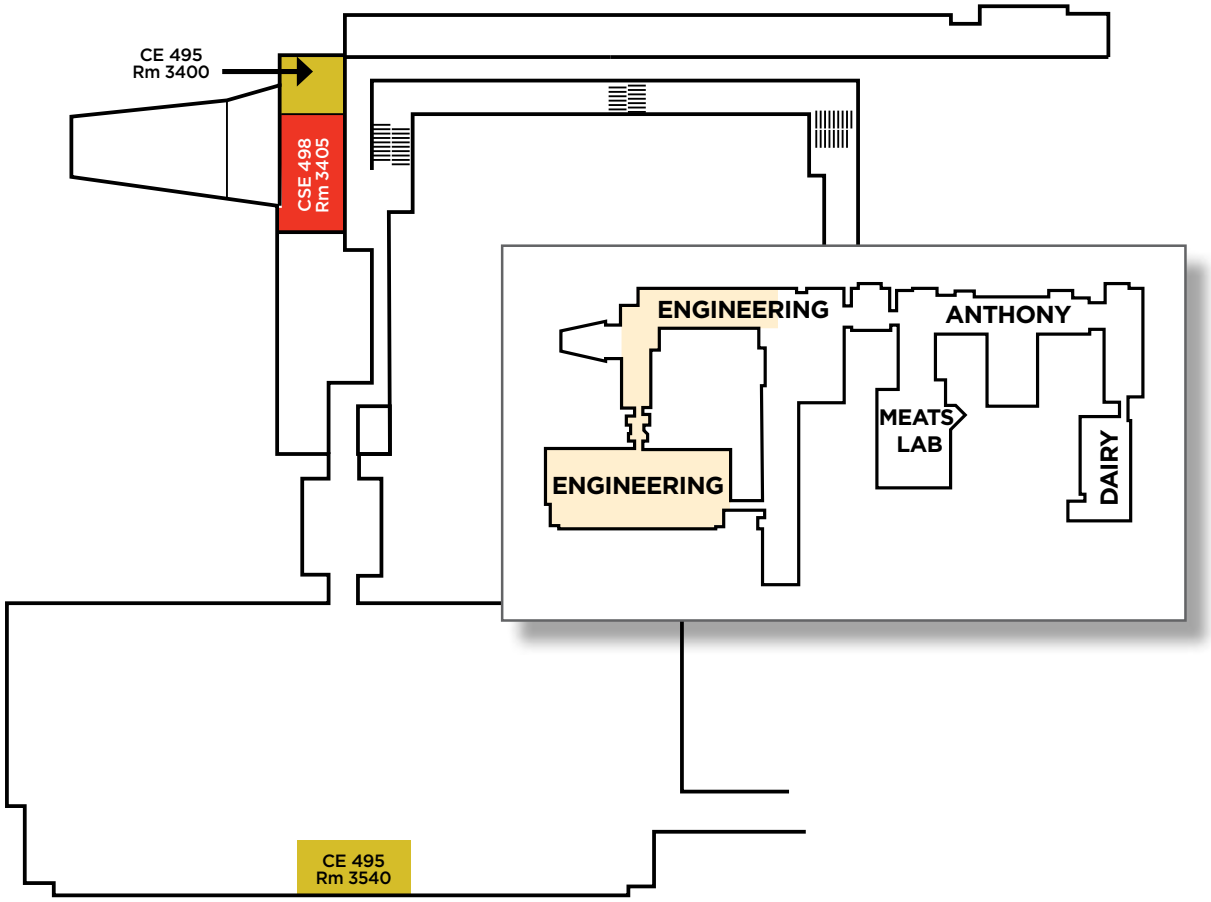
1st Floor Anthony



Color Legend:

- AES
- CSE
- BAE
- ECE
- CEE
- ME
- ChE & MSE
- Joint/ Other

3rd Floor Engineering



MSU Federal Credit Union is a proud supporter of the 2016 MSU College of Engineering Design Day!

Financial Tip #21

What are your plans after college? Will you be moving to another state, purchasing a car, or upgrading to a new apartment? It's never too early to start planning for your future. Try setting short-term savings goals by setting aside $25 each month into a sub-savings account. At the end of the year, you will have $300 to put toward your next adventure.

Join Today

It's our mission at MSUFCU to help you achieve your financial goals. Join today and learn more great tips from our Financial 4.0 team. By visiting us online at msufcu.org/financial40 or downloading the Financial 4.0 app, you will have access to budgeting tools, financial calculators, blogs, contests, and more.

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Michigan State University
FEDERAL CREDIT UNION
Building Dreams Together

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

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.

	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 SPRING 2015

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

Dean Buggia
Instructor and Technology Teacher, Okemos High School

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

Rachel Esch
K-12 Outreach Secretary

Alexandria Fisher
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

K12 Awards Fall 2015

High School Vex Robotics Competition

Winners: Women in Engineering
Instructor: Mr. Bob Watson

ECE 480 Design Award

Winners: St. Mary Star of the Sea Historic Building Video Monitoring
Advisors: Dr. Timothy Grotjohn and Dr. Lalita Udpa

ME 371 Best Project Awarded by High School Student Visitors

Winners: Ice Cream Dispensing Machine
Advisor: Dr. Assaad Alsahlani

K'Nex Bridge Build and Deflection Test

Winners: Sexton High School
Instructor: Mr. Dean Buggia

High School Catapult Competition

Winners: East Lansing High School
Instructor: Mr. John Plough

EGR 100 Design Project

Winners: Solar Car
Advisor: Mr. Tim Hinds

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 693 students enrolled in EGR 100 this semester.

For the final course project, the student teams selected from seven project types: (i) Solar Car Competition, (ii) Cell Phone App Inventor, (iii) Robotics Tournament, (iv) Engineers Without Borders (EWB) Design, (v) MSU Adaptive Sports and Recreation Club Project, (vi) Residence Education and Housing Services (REHS) Design, and (vii) CoRe industry-sponsored projects. The EWB project involved the design of a bridge system. The Adaptive Sports and Recreation Club project was the design of an athletic walker. The REHS project addressed improvements to the residence hall move-in / move- out process. CoRe industry-sponsored projects were collaborations with ArcelorMittal, Delphi and Tenneco. 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.

Fall 2015 EGR 100 Project Poster Award Winners:

l-r: Pat Walton, Holly Iglewski, Brendan Czarnecki, Lucy Angers, Aric Thorne, Dean Kempel, Emily Matthews, Neeraj Buch
Not Pictured: Dawson Mortensen-Chown

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

Athletic Wheelchair Toe Guard

Ford Community Corps

MSU Adaptive Sports and Recreation Club

Consumers Energy Count on Us

ArcelorMittal

MICHIGAN STATE UNIVERSITY | Residential College in the Arts and Humanities

Michigan State University - Engineers Without Borders

TENNECO

PECKHAM QUALITY • DIVERSITY • PERFORMANCE

UNION PACIFIC

RESIDENCE EDUCATION AND HOUSING SERVICES
RESIDENTIAL AND HOSPITALITY SERVICES

DELPHI

BOSCH Invented for life

Applied Engineering Sciences

Capstone Project Sponsors

We gratefully acknowledge Judy S. Jacobs, Director, Corporate & Student Relations Office, Michigan State University, Department of Supply Chain Management for her assistance in securing projects. We thank the following sponsors for their generous support of the Applied Engineering Sciences senior capstone course.

AbbVie
Chicago, Illinois

Android Industries
Auburn Hills, Michigan

Asahi Kasei Plastics North America
Fowlerville, Michigan

ArcelorMittal
East Chicago, Indiana

Cisco
San Jose, California

Dow Chemical
Midland, Michigan

Fiat Chrysler Automobiles
Auburn Hills, Michigan

Ford
Dearborn, Michigan

Great Lakes Wine & Spirits
Highland Park, Michigan

Hess
Houston, Texas

Intel
Chandler, Arizona

Microsoft
Redmond, Washington

MSU Infrastructure Planning & Facilities
East Lansing, Michigan

MSU Office of Sustainability
East Lansing, Michigan

Ranir
Grand Rapids, Michigan

Applied Engineering Sciences

Dr. Laura J. Genik
Director of Applied Engineering Sciences

Dr. Srinivas (Sri) Talluri
Professor of Operations and Supply Chain Management

Graduate Teaching Assistants Supply Chain Management

Dmitri Alexandrov
MBA (2016)

Gregg Marschner
MBA (2016)

Ellen Kellner
MBA (2017)

Presentation Schedule – Anthony Hall, Room 1257

Time	Company	Project Title
7:35 a.m.	AbbVie	Operations Brand Team- Creating the "Perfect Brand"
8:00 a.m.	AbbVie	Process Review for Safety Stock and Order Quantities Analysis
8:25 a.m.	Cisco	Electrostatic Discharge (ESD) Packaging End-of-life Options
8:50 a.m.	Cisco	Digital Rights Management Solutions
9:15 a.m.	Cisco	Analysis of Cisco's Integrated Business Planning
9:40 a.m.	Fiat Chrysler	Assembly Plant Vehicle Releasing Study
10:05 a.m.	Hess	Master Logistics Plan Optimization for Well Wastewater
10:30 a.m.	Ford	Automotive Component Transportation, Import and Duty Costs in a Global Economy
10:55 a.m.	Asahi Kasei Plastics	Bulk Truck Utilization and Sequencing Optimization
11:20 a.m.	Dow Chemical	Optimization of Dow Chemical Shipping Rail Networks

Presentation Schedule – Anthony Hall, Room 1260

Time	Company	Project Title
7:35 a.m.	ArcelorMittal	Micropelletize Iron Oxide Dust for Beneficial Reuse
8:00 a.m.	Ranir	Packaging Optimization Project
8:25 a.m.	Android Industries	Assembly Line Variability Reduction
8:50 a.m.	Microsoft	Efficient Use of Packaging, Pallets and Ramps
9:15 a.m.	MSU Sustainability	Akers Hall Material Diversion Strategy
9:40 a.m.	MSU Sustainability	Evaluation of Personal Hydration Sources On Campus
10:05 a.m.	MSU Sustainability	Evaluation of Bottled Water Procurement at MSU
10:30 a.m.	MSU Infrastructure Planning & Facilities	Analysis Tool Development for Air Filtration System Optimization
10:55 a.m.	Intel	Alternate Design for Assembly Test Factory Network
11:20 a.m.	Great Lakes Wine & Spirits	Increase Efficiency Through Automation

AESC 410 Capstone Course
Senior Capstone Project

The culmination of course work in engineering and business, the Capstone course for Applied Engineering Sciences focuses on a semester-long project from a sponsor (industry or non-profit) typically at the confluence of modern business operations and engineering or technical issues. The course is interdisciplinary with Supply Chain Management.

AESC 410 Anthony Hall, Room 1257 | 1st Floor **7:35 a.m.**

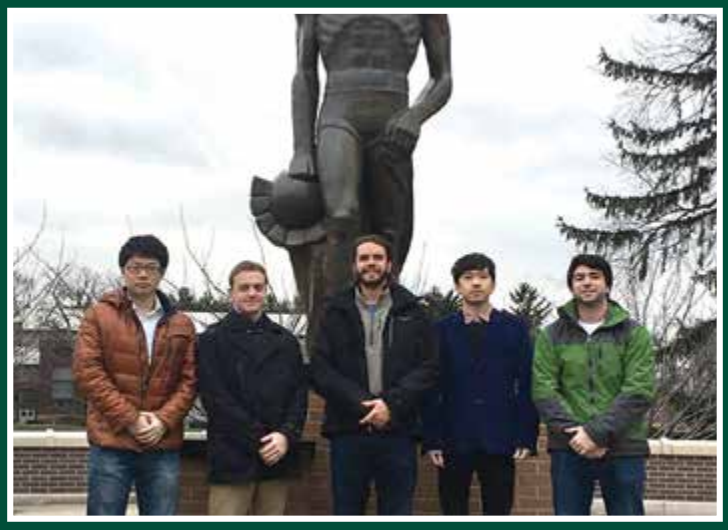
AbbVie

Operations Brand Team – Creating the "Perfect Brand"

AbbVie is a research focused biopharmaceutical company headquartered in North Chicago, Illinois with global operations. AbbVie is considered a patient-first company that will go out of their way to ensure customer satisfaction. There are many supply chains that are required for end-to-end product development and delivery. AbbVie increases value in their supply chains by implementing Brand Teams. Currently, AbbVie has 14 Brand Teams that operate under the company's direction. Our goal was to simplify the interaction between Brand Teams in order to have a cross-functional supply chain.

After two conference calls with AbbVie, we were given the task of evaluating their Brand Team. This entailed completing a SWOT analysis of a few specific brand teams, followed by comparing our SWOT to the analysis done by the manager of all the Brand Teams. Furthermore, we developed a method for AbbVie to rate the performance of each of their Brand Teams, for example a scorecard, to see if they are progressing and are worth continuing in the future. Currently, AbbVie has no uniform standards for all of the Brand Teams nor a way to judge their effectiveness and performance. It was necessary to create a process and scorecard to check Brand Team performance and determine standards that will be used for all Brand Teams.

abbvie



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Steven Palmeri
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AbbVie

Process Review for Safety Stock & Order Quantities Analysis

Recently spun off from Abbott, AbbVie is a world leader in the research and development, and production of pharmaceutical drugs. As of 2014, with revenue over $20B, they are 11th largest pharmaceutical company in the world. This project has two main focuses: MOQ and Safety Stock.

MOQ (minimum order quantity) is the minimum amount of product the supplier/distributor determines economically viable to sell. AbbVie would like us to review their current MOQ process and find ways to improve it. There are many factors to consider when dealing with MOQ in the pharmaceutical industry that will need to be addressed in our recommendation.

The second part of the project is Safety Stock. Safety Stock is the reserve inventory to reduce stock outs. AbbVie wanted the team to look over their current safety stock process and recommend how to improve it. The team also reviewed and updated their safety stock numbers based on the recommendations. AbbVie currently has a large sum of assets in safety stock, which the team sees as an opportunity to save them money. The pharmaceutical industry poses unique challenges when dealing with safety stock that must be addressed, such as extreme demand uncertainty, risks in stock outs, government regulations, and short product lifecycles.

abbvie

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Teaching Assistant
Gregg Marschner
Trenton, Michigan

Cisco
ESD Packaging End-of-life Options

For more than 30 years Cisco Systems, Inc. has changed the way the world works, lives, plays, and learns through the development of networking technologies. Cisco designs a broad range of routing, switching, and other networking-based technologies. The technology and services are then delivered to customers as integrated solutions including cloud, video, mobility, security, collaboration, and analytics.

Cisco employees are constantly challenged and empowered to "connect everything, innovate everywhere, and benefit everyone." The CEO of Cisco Systems, Chuck Robbins, once said that "what is good for the world and good for business are more closely connected than ever before." Mr. Robbins recognizes that in order to benefit everyone on a global scale, everyone must constantly maintain and improve the environment in which they live.

Cisco's Supply Chain Greenhouse Emission Reduction Program strives to eliminate the waste and costs associated with packaging, while also improving the customer experience. The "Pack It Green Initiative" focuses on optimizing packaging and order fulfillment and has recently taken an interest in Electrostatic Discharge (ESD) bags/packaging.

To date, end-of-life management of ESD bags has generally been limited to landfill disposal. The goal of this project is to investigate non-disposal options, such as recycling and repurposing, for the end-of-life management of ESD packaging.

The solution(s) to finding a method to repurpose or recycle ESD bags will be of benefit to not only Cisco but to the entire electronics industry. Diverting waste from landfill at multiple points along the product manufacturing life cycle will have an extremely positive impact on the environment.

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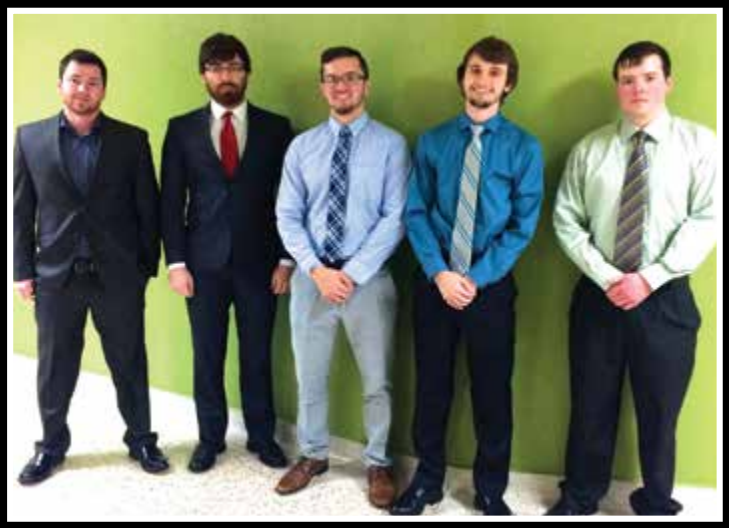
Cisco
Digital Rights Management Solutions

Cisco, a worldwide leader in IT, helps companies seize the opportunities of tomorrow by proving that amazing things can happen when you connect the previously unconnected. Headquartered in San Jose, California, Cisco designs, manufactures, and sells networking equipment. With over 70,000 employees, Cisco aims to shape the future of the Internet by creating unprecedented value and opportunity for customers, investors, and ecosystem partners.

Imagine a world where households can purchase digital content, such as blueprints for a product design from a digital distribution center, and print it off on their own 3D printer for manufacturing. How is the design protected? How are designers compensated? How are owners' rights protected? These are some of the questions Cisco's Digital Rights Management (DRM) team and the MSU team are trying to answer.

The team is to explore Cisco's Digital Rights Management, and find a solution that supports Cisco's next-generation supply chain models. The digital rights management solution, when applied to a supply chain model, will manage both the rights to use and the compliance of use for the intellectual property, while protecting Cisco's competitive advantage, revenue, and brand management.

The MSU team is to determine the form of the DRM entity. Is it physical or virtual? Is it distributed or centralized? In addition, the MSU team is to find a way to monitor and manage the DRM, as well as how to notify when legality is compromised. The project's end goal is to protect digital rights and intellectual property throughout the entire supply chain stream.



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Cisco
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Benny Yap
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Teaching Assistant
Ellen Kellner
Grass Lake, Michigan

AESC 410 Anthony Hall, Room 1257 | 1st Floor **9:15 a.m.**

Cisco

Analysis of Cisco's Integrated Business Planning

Cisco is a global company with nearly 72,000 employees worldwide. One of the leading manufacturers of network equipment, Cisco's primary business is in internet working products, such as routers, bridges, and switches. Our project will focus on performing a current state analysis and giving future state recommendations to help Cisco advance the maturity of their Integrated Business Planning services.

IBP is an overarching decision-making process that aligns all business functions to support the company's primary strategy. IBP is an extension of traditional Sales & Operations Planning, which typically relies on market supply and demand data. This information is extended to the rest of the corporation with IBP, forming a comprehensive business plan to drive higher customer satisfaction and profitability.

The first phase of the project is to assess the current maturity state of IBP services in all market segments of Cisco. In order to do this, we will utilize internal customer-focused questionnaires and conduct virtual interviews with Cisco stakeholders. This information will then be used to complete a SWOT analysis of IBP services. This analysis will help us discover the current maturity and plan future state recommendations for IBP services within Cisco. Lastly, this will pave the way for an actionable roadmap for Cisco to advance IBP's maturity in the next 12 months, and determine how IBP maturity can be incorporated into existing services.

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Fiat Chrysler Automobiles

FCA Assembly Plant Vehicle Releasing Study

Fiat Chrysler Automobiles (FCA) is one of the largest manufacturers of automobiles in the world. Headquartered in Auburn Hills, Michigan, FCA US product brands include Chrysler, Dodge, Jeep, Ram, and FIAT, as well as the SRT performance vehicle designation. FCA has eight operating manufacturing facilities in the United States and Canada. These plants currently use outsourced vehicle releasing services, which are responsible for transporting and managing the finished vehicles from the assembly line and within the assembly plant vehicle shipping yard.

By analyzing the current cost structure for the vehicle releasing services and utilizing historical and industry trends, a recommendation will be made to install the most cost-effective operational structure. This can be specifically adjusted for each plant's operations and services. Optimizing the vehicle releasing operations will reduce inventory costs and improve efficiency in the plant shipping yards.

FCA
FIAT CHRYSLER AUTOMOBILES

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AESC 410 Anthony Hall, Room 1257 | 1st Floor **10:05 a.m.**

Hess

Master Logistics Plan Optimization for Well Wastewater

Hess Corporation, a global exploration and production company, is extracting crude oil and natural gas, worldwide. Throughout the United States, areas of operation include North Dakota, West Texas, and Ohio. The Bakken Shale area of North Dakota contains 1,380 Hess operated wells, grouped into 584 different locations, or pads.

At these wells, water is used for lubricating the drill bit, and carrying the cuttings back to the surface for safe disposal. This water byproduct is then filtered away from the hydrocarbons, and brought to holding tanks at each pad. Third-party vendors transport the hazardous water to saltwater disposal wells throughout the Bakken region, and safely inject it back into the earth, to minimize environmental impact.

The objective of this project was to create a Master Logistics Plan, optimizing travel routes for Hess's vendors, and minimizing total cost of ownership. Hess has a vested interest in vendor logistics, as pricing depends on barrels per load, which is influenced by transportation factors such as distance traveled. Several issues need to be researched throughout this process. Because wastewater production varies by pad, a schedule to increase efficiency and utilization will be created by analyzing past water production data. Further investigation into the numbers will allow us to score vendors and gain visibility into cost structures. Finally, Hess employs cutting edge LEAN methodologies to analyze performance of operations, with attention to safety, quality, delivery, and cost, all of which will play an integral part of the final Master Logistics Plan.

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Ford Motor Company

Automotive Component Transportation, Import and Duty Costs in a Global Economy

Ford Motor Company is a world-class automobile manufacturing company, producing a wide range of vehicles globally. To optimize part costs, many vehicle components are imported from low-cost manufacturing regions such as India, China, Thailand, Mexico, North Africa, Eastern Europe (Poland, Czech Republic, Hungary, Romania) and Turkey. In many cases, reasonably accurate transportation, import and duty costs are not readily available when making sourcing decisions.

Currently, many purchasing professionals have resorted to creating their own data repository to consider the costs and complete the required business case analysis needed for developing a sourcing recommendation. This method of analysis is no longer efficient or conducive to optimizing Ford Purchasing leverage.

This project seeks to analyze global transportation by examining import and duty costs from critically low-cost manufacturing regions. Research is to be conducted in order to provide a tool that generates an estimated cost per unit for shipping a vehicle part to a Midwest-based manufacturing facility. The tool should take into consideration a vehicle part's country of origin, mode of transportation, part parameters, and any other pertinent information.

No matter what part is being shipped, whether it be a steering wheel or a front bumper, this tool will be capable of providing an output. With this ability, it will help ensure that Ford Purchasing is optimizing its sourcing leverage by awarding business in the region that offers the most optimal delivered cost to Ford's manufacturing facilities.

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AESC 410 Anthony Hall, Room 1257 | 1st Floor **10:55 a.m.**

Asahi Kasei Plastics

Bulk Truck Utilization and Sequencing Optimization

Asahi Kasei Plastics is a leading manufacturer of high performance plastic compounds that provides for multiple suppliers globally in industries such as automotive, furniture, and pools. The assignment provided by Asahi Kasei Plastics to its Michigan State University Applied Engineering Sciences 410 team is to assess and help improve the company's bulk truck utilization and overall supply chain operations, productivity and effectiveness at their manufacturing and distribution site in Fowlerville, Michigan. The team will design a simulation of truck loading which will compare the different methods of storing and transporting the product and analyze the results to help the company determine any optimizations that can be made. One benefit the team's finding will produce is improving idle times and on-time percentages. The analysis will account for variables such as integrated customer demand schedules, transit and loading times, as well as resultant customer satisfaction.

The challenges that the MSU team faces include determining the proper sequence of bulk truck loads and when to prepare the trailers to transport new types of plastics based on costly changeover procedures. Additions of the quantity of customers and bulk trucks to serve these customers are supplementary factors that will be incorporated into the data and models. The team will be using both Arena Simulation Software and Microsoft Excel to build and analyze the systems to determine the areas most in need of improvement. It is imperative to expand upon the original model design to include new silos and consider alternative bulk loading options.

ASAHI KASEI PLASTICS

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Dow Chemical

Optimization of Chemical Shipping Rail Networks

Dow Chemical is a Fortune 500 company. As of March 2014, Dow Chemical's market value stood at approximately 69 billion U.S dollars and they employed 53,000 people worldwide. Dow creates value through its diversified, market-driven portfolio and leveraging its cost advantages driven by scale and geographic presence. Our work with Dow means collaborating with innovators and solutions providers that are enhancing the quality of life for current and future generations.

Rail transportation allows Dow to ship large quantities of product to create efficiency, economy, and sustainability within the Supply Chain. According to the U.S Department of Transportation, "The $60 billion industry consists of 140,000 rail miles." The benefits of rail include reductions in road congestion, fuel consumption, greenhouse gasses, and logistics costs.

The primary objective was to identify and optimize the most effective routes to improve asset utilization.

The Dow plant position affords the opportunity to evaluate the transit performance of two Gulf Coast Railroads and identify alternate routing options vs. the railroad protocol for specific routes. The performance metrics to be considered are railroad transit time, mileage, and routing to major interchange points. This project exemplifies the challenges of "Big Data," utilizing data mining techniques to analyze numerous patterns and relationships. In addition, a risk assessment was included to identify potential railroad system issues on specific rail routes that could delay or prevent effective transit. The end decision was to select between two Gulf Coast Railroads from specific plant origins resulting in an impact to Dow's total rail cost.

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AESC 410 Anthony Hall, Room 1260 | 1st Floor **7:35 a.m.**

ArcelorMittal

Micropelletize Iron Oxide Dust for Beneficial Reuse

Steel is used in all of the world's most essential industries including construction, transportation, energy, and many others. ArcelorMittal is a steel company that provides steel for these industries. However, there are some downfalls to the company's steelmaking process. During the process, there is some excess material created, a fine iron-oxide powder, that needs to be transported to a landfill and disposed of, if not reused. This comes at a cost to ArcelorMittal. Furthermore, since the powder is so fine, it creates a plume of dust when handled incorrectly. The plumes of dust create a safety risk for any person managing it due to concerns of inhaling the dust.

As of now, there is not an efficient way to reuse this material, however there is an opportunity to use the material that would not only reduce the need to dispose of the waste, but would also provide revenue to the company. This opportunity comes in the form of cement manufacturing.

In the process of manufacturing cement, there is a need for a small amount of iron in each batch of cement processed. The primary goal for the team is to find an affordable process in which the fine powder can be formed into micropellets, or another shape. In this form, the powder would be easier to transport and more easily used by a cement company. Selling the micropellets would provide a revenue to ArcelorMittal, reduce safety risks of inhaling the dust, and reduce the environmental impact of disposing of the powder.

ArcelorMittal

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Ranir LLC
Packaging Optimization Project

Ranir LLC is a private label producer of oral health care products based out of Grand Rapids. A current manual toothbrush packaging line is in need of improvement. This line includes the manual loading of toothbrushes into a pad printer which applies a customer's brand and transports brushes to a machine where they are manually loaded into a blister pack. By assessing the current operation layout, packaging strategies, labor usage and overall line function, the goals of our group are to:

- Cut cost
- Maximize efficiency
- Reduce waste
- Lower complexity

This will be accomplished by working directly with Ranir's engineering department, suppliers, operations, supply chain and the executive team. Upon successful completion, Ranir plans to assess deliverables for implementation in other facilities.

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Android Industries
Assembly Line Variability Reduction

Android Industries is a tier one automotive supplier to General Motors. For more than 40 years, Android has assembled complex vehicle systems, producing more than 400 million in total. They are strategically located near the GM Delta Plant, which produces the Buick Enclave, GMC Acadia, and Chevrolet Traverse.

Android Industries is extremely customer focused. They strive for overwhelming customer satisfaction with both their internal customers and their external customers. They achieve this by working to produce a quality product free of defects, deliver it exactly on time in correct quantities, and do this as efficiently as possible. They pride themselves in their supply chain expertise, and have done substantial work in their Lansing plant to create an efficient, lean production system. They are focused on many aspects of continuous improvement, including ergonomics for their production workers, and reduction of waste in the plant.

While they have developed an incredibly efficient process, Android Industries is now encountering some variance on their Instrument Panel assembly line at their Lansing facility. Currently, it cannot consistently achieve the Jobs-per-hour (JPH) rate based on their Planned Cycle Time (PCT) due to variability on the line.

The goal of this collaboration is to create a line that can consistently achieve the JPH rate, which would allow the plant to operate more efficiently and meet labor-cost budget. The first step toward a solution is to determine what is causing this variance on the line using tools like time trials and process flow mapping. The next step is to develop solutions for the areas that are found to be causing bottlenecks or other issues on the line, and finally to determine how to implement these solutions.

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Microsoft

Efficient Use of Packaging, Pallets and Ramps

The Microsoft Cloud Infrastructure and Operations (MCIO) group is an exciting and fast evolving engineering group within Microsoft. MCIO is the operational and supply chain footprint that supports an $8B cloud business as of 2015, with plans to grow to a $20B business by 2018. MCIO's mission is to optimize and deliver industry leading cloud infrastructure and foundational technologies for Microsoft's online services. The organization is responsible for strategy and delivery of the foundational platform for all Microsoft Online Services including demand and capacity forecasting, supply chain, data centers, networking, bandwidth, operations, and incident management. MCIO supports over 200 online businesses including Bing, O365, OneDrive, Xbox and Windows Azure branded services.

Microsoft's data centers are located throughout the world. The shipping of pre-racked hardware used in these data centers often comes from several suppliers, each with their own packaging standards. The pre-racked hardware is a large rack that contains the computer servers, storage nodes, switches, etc. Our standard packaging solutions will help unify and simplify the delivery of the hardware into the data centers.

Accelerating the unloading process can save Microsoft money as well as cut down on delivery times. Speeding up the process on every level allows for quicker usage of data storage as well as increasing Microsoft Online Service's speeds.

In addition to a faster connection process, safety will be greatly improved for those transporting the hardware. Due to the weight of the hardware, safety is a major concern. When there are many different ways to unload the racks, confusion over the correct process and mistakes can lead to severe, if not life-threatening, injuries. Having one understood process to remove the hardware from the packaging allows for less confusion and fewer mistakes.

Microsoft

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AESC 410 Anthony Hall, Room 1260 | 1st Floor **9:15 a.m.**

Michigan State University Sustainability
Akers Hall Material Diversion Strategy

Recycling offers a diverse range of benefits, from being economically viable and improving the community image to its positive, and necessary, impact on our environment. While Michigan State University has an established recycling program that excels in this field, MSU Recycling has set an ambitious goal to increase recycling in the coming years. By the end of 2017, MSU strives to increase the recycling rate in buildings to at least 50% and divert 70% of its total waste stream.

The residence halls make up a significant portion of the waste generated on campus. Akers Hall is the perfect starting point in the effort to reach the recycling goals, as it is a recently renovated residence hall housing mostly underclassmen. By developing improved practices for this living facility, the current and future residents will develop better recycling habits that they will carry with them to make a positive impact globally.

The aim of this project is to improve upon the existing recycling system in Akers Hall, and to both identify and divert recyclable materials from the landfill. This will be achieved by working with MSU Sustainability and MSU Recycling, together with residents and staff of Akers Hall, to analyze the current system in place and determine where the opportunities for improvements are. Once the opportunities are identified, improvements can be made. This will, in turn, create best practices that can be implemented in other residence halls across campus and throughout the nation.

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Michigan State University Sustainability

Evaluation of Personal Hydration Sources On Campus

The topic of this project is Water Consumption at Michigan State University. The goal of the project is to develop a strategy to increase the consumption of tap water on campus. The analysis and recommendations from this project will feed into multiple other initiatives and will inform MSU's water policies and practices.

The team and sponsor designed a suggested plan of action for the project. First, the team is to assess the current system of filtered water bottle filling stations on campus. After the current assessment, the team is to identify design-centric solutions to provide water for personal hydration that meets quality standards of the end user. The team is to determine high use and high impact locations that would benefit from water filtration systems and analyze the Triple Bottom Line costs of installing such stations. After identifying a viable solution to increase the consumption of tap water, we will develop a marketing campaign to encourage the MSU community to drink filtered tap water and provide a guide to bottle filling stations.

Assessing the costs of maintaining the bottled water supply on campus versus investing in filtered fill stations or other treatment options will be the major decision moving forward for Michigan State University Sustainability. Recommended solutions in regards to decreasing the consumption of bottled water will be provided by the team after the completion of their research.

be green spartan

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AESC 410 Anthony Hall, Room 1260 | 1st Floor **10:05 a.m.**

Michigan State University Sustainability
Evaluation of Bottled Water Procurement at MSU

Michigan State University is a national public university founded in 1855. Since then it has grown to be one of the largest public universities with over 50,000 graduate and undergraduate students. With a growing student body, its water consumption is growing as well.

MSU has its own utility company that utilizes wells and surface water to supply water for various sources such as power plants and residence halls. The water they produce also meets all federally regulated standards for water consumption. Although the water is drinkable, students are still choosing bottled water instead, leading to increased pressure on its recycling centers and landfill costs.

The project analyzed the supply chain of the bottled water procurement at MSU to try to find deficiencies in the system. After that, different companies were assessed and then recommendations were made for the best vendors based on social, environmental, and economic factors.

Separately, an analysis was done on the added costs of bottled water on the landfill and recycling processes. This information was collected from surrounding stores to get a better estimate of how many bottles are potentially coming into MSU outside of the data available. With all of the information available at hand, recommendations were made to encourage people to use tap water instead of bottled water.

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Michigan State University - IPF

Analysis Tool Development for Air Filtration System Optimization

This project improves the overall efficiency of MSU air-handling systems. As part of continuous optimization efforts, MSU Infrastructure Planning and Facilities (IPF) saw that the many air-handling systems across campus offered ample opportunity for improved energy efficiency. There are several aspects that were considered, which included analysis of the current system structure, data collection, improvement of the structure, cost calculation, and experimentation. By following these procedures, an improved air filtration system was designed and tested. Operating costs under different circumstances were calculated and compared in order to select the most economical option. Feedback was continuously collected and analyzed during the project.

IPF currently maps, tracks and programs all air-handling systems on campus. Each system can accommodate various configurations of filters. Currently, low-cost pre-filters are used in line with higher cost bag filters. There are other methods of filtration on the market, including other higher efficiency membrane filters and electrostatic attraction filters that collect particles, odors and contaminants. It is necessary to keep in mind replacement, disposal and labor costs while investigating alternative methods of filtration. Data collection on the current system and comparison with third-party test results of alternative systems will be necessary to determine if a new system is necessary.

The primary objective for the team was to develop an analysis tool that could be used to simulate filter configuration effects on system static pressure, frequency of filter replacement, cost of materials, and filter replacement labor. Once the system has been tested and verified by MSU IPF, it will be implemented as an optimization tool for daily operations to reduce costs and environmental impact.

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Intel

Alternate Design for Assembly Test Factory Network

Intel Corporation is an American multinational technology company headquartered in Santa Clara, California. Intel is one of the world's largest and highest valued semiconductor chipmakers that supplies processors for companies such as Apple, Samsung, HP, and Dell.

The objective of this project is to investigate and recommend a solution for an alternative raw material to convert into a component. The alternative raw material is required to meet all Intel technical, quality, environmental, social and governance (ESG) requirements. Examples of requirements include, but are not limited to, component drawing dimensions and tolerances, raw material mechanical and thermal properties, component finish and visual requirements, allowable defects per million (DPM), and raw material sourcing to meet all ESG standards.

The second aspect of the project is to develop an optimized beginning-to-end worldwide supply line for Intel's next generation CPU package technology. The optimized supply line will encompass a sourcing solution to procure the identified raw material, location(s) for the conversion process to the component specifications, inspection, packaging, and delivery of a total 1.5 million units (Mu) to Intel's Assembly Test factory networks which are located primarily in Southeast Asia. Attributes of this supply line should include, but should not be limited to, optimized placement of inventory and carrying costs within the supply line, achieving availability requirements including factory service level agreement (SLA), exhibiting speed and agility from the procurement of the raw material to receipt of the component at factories, having a business continuity plan (BCP), and compliance to all ESG standards.

If commercialized, this solution will deliver 5% lower total supply line cost to include unit price (raw material, conversion, inspection, packaging and applicable margins), transportation, and inventory carrying.

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Great Lakes Wine & Spirits

Increase Efficiency Through Automation

Great Lakes Wine and Spirits is Michigan's largest wine and spirits distributor and has grown continuously since its conception in 1935. The company has grown to nearly 1,000 employees, operates in nine facilities around Michigan, and has an ever-expanding global supply chain network. The current environment for the facility is very labor-intensive. All bottles and cases are picked by hand each night, based on the demand that flows in from customers, to guarantee that they meet the 24-hour delivery window. On average 150,000 individual bottles and 50,000 cases are handpicked and loaded into more than 100 trucks each night.

In order to keep up with growing orders, as well as maintain its marketplace and competitive edge, the labor-intensive aspect of the current process needs to be optimized. To do so, Great Lakes Wine and Spirits is looking into increasing throughput and their space utilization by introducing automation to their current distribution centers. The goal of this project is to identify key processes that will benefit from automation while providing Great Lakes Wine and Spirits with a detailed plan of implementation for potential changes, supported by both technical and financial data.

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Great Lakes Wine & Spirits
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AESC Awards 2015

Dr. Philip L. Fioravante is the longstanding sponsor of the Applied Engineering Sciences Capstone Awards. Dr. Fioravante is an alumnus (BS '84) of our program, winner of the 2004 AES Distinguished Alumni Award, winner of the 2013 College of Engineering Claud R. Erickson Distinguished Alumni Award and current Chair of the College of Engineering Alumni Board. Design Day award winners are selected based on both final written project reports and on oral presentations at Design Day. We thank Dr. Fioravante for his generous and continuing support of the Applied Engineering Sciences Design Day awards.

The 2015 Most Impactful Award:

The winners are team MSU Office of Sustainability "Spartan Treasure Hunt – Finding Energy though Occupant Engagement"

Left to right: Kyle Sims, Ben Roberts, Phil Fioravante, Howard Liou, Gordon Ewald. Not pictured: Patrick Kurtz

The 2015 Most Sustainable Award:

The winners are Team Asahi Kasei Plastics "Bulk Truck Capacity Utilization Analysis"

Left to right: Brad Noorman, Nathaniel Ross, Phil Fioravante, Jeff Jorgensen, Timothy Jacque

Dr. Dana Kirk, PE
Asst. Professor

Department of Biosystems & Agricultural Engineering

Dr. Luke Reese
Assoc. Professor

Department of Biosystems & Agricultural Engineering

About the Program

The Biosystems Engineering (BE) undergraduate program prepares graduates who will integrate and apply principles of engineering and biology to a wide variety of globally important problems. To achieve that purpose, the primary objectives of the BE program are to prepare graduates to:

- Identify and solve problems at the interface of biology and engineering, using modern engineering techniques and the systems approach, and
- Analyze, design, and control components, systems, and processes that involve critical biological components.

Additionally, the Biosystems Engineering program is designed to help graduates succeed in diverse careers by developing a professional foundation that includes vision, adaptability, creativity, a practical mindset, effective communication skills for technical and non-technical audiences, the ability to work in diverse, cross-disciplinary teams, and a commitment to sustainability, continuing professional growth, and ethical conduct.

BE 485 / BE 487 Courses

Biosystems Engineering student teams, enrolled in the two-semester biosystems design capstone experience, BE 485/487, develop, evaluate, and select design alternatives in order to solve real world problems. Projects are diverse, but each reflects systems thinking by integrating interconnected issues affecting the problem, including critical biological constraints. The engineering design process is documented in a detailed technical report. Teams present project designs to engineering faculty and a review panel of professional engineers for evaluation. Each BE 485/487 capstone design team prepares and presents a design solution in report, poster and oral formats to industry, faculty, peers and the public that:

- Requires engineering design
- Combines biology and engineering
- Solves a real problem
- Uses a holistic approach
- Interprets data
- Evaluates economic feasibility

Industry Advisory Board & Project Evaluators

The purpose of the Industry Advisory Board is to facilitate the exchange of ideas between Board members, faculty, and students of the BE program. Its function is to improve continuously the BE program quality by keeping it current and relevant to industry needs. Regular and adjunct board members also serve as external project evaluators.

Board

Mr. Kevin Blue - Meijer
Ms. Lisa Buchholz - Dow AgroSciences
Ms. Michelle F. Crook, PE - MDNR
Ms. Cassaundra Edwards - Bimbo Bakeries, USA
Mr. Bryce Feighner, PE - MDEQ
Mr. Gene Ford - Nestlé Nutrition
Mr. Andrew Granskog, PE - USDA-Rural Development
Ms. Ashley Julien, EIT - MDARD
Mr. Andrew Knowles - JBT FoodTech
Mr. Jeffrey Mathews, PhD - PepsiCo Global Beverage R&D
Mr. Mitch Miller - General Mills-Yoplait
Mr. Steve Richey - Kellogg
Mr. Larry D. Stephens, PE - Stephens Consulting Serv., P.C.
Mr. Kirk Walter - Perrigo
Mr. Richard Woodford, PE - USDA-NRCS
Mr. Rob Yoder - BDI, Inc.

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Mr. Shane Bennett, PE - Dow Chemical Company
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Mr. Dylan Comer - JBT FoodTech
Mr. Thomas Cornish - Perrigo
Mr. Ben Darling - MSU Land Management
Ms. Danielle Habitz - Kellogg
Mr. Tim Krause, PE - Granger
Ms. Sara Linder - Dow AgroSciences
Dr. Erik Petrovskis, PE - Meijer
Mr. Chris Rivard - Perrigo
Mr. Keith Tinsey - Walther Farms
Mr. Nick Tipper, PE - Techmark
Dr. Jim Wallace, PE - McLanahan Corp.
Ms. Amy Yoder - Anuvia Plant Nutrients

Biosystems BE 485/487 First Floor | 1300 Hallway 8:00 a.m. – Noon

Industrial Biosolids Digestion Project

Team Name – WasteWater Warriors
Sponsor – Dow Chemical (project under non-disclosure agreement agreement)
Faculty Advisor – Dr. Steve Safferman, P.E.

The Dow Chemical Company operates an aerobic digester to reduce the mass of the biosolids removed from their secondary clarifiers. Due to the high cost of operation, Dow has asked the "WasteWater Warriors" to improve their biosolids digestion system. The team generated design alternatives with the goal of increasing system performance while simultaneously lowering operational costs. The final deliverable was an engineering design report describing and comparing the proposed solutions. An economic analysis, process flow diagram, and a summary of expected improvements were completed in order to select the optimal design.

(L to R) Christine Isaguirre, Michal Mulik & Alexander Bricco

Food Waste Management: Generating a Waste-to-resource Product

Team Name – Waste Watchers
Sponsor – Meijer (project under non-disclosure agreement)
Faculty Advisor – Dr. Ajit Srivastava, P.E.

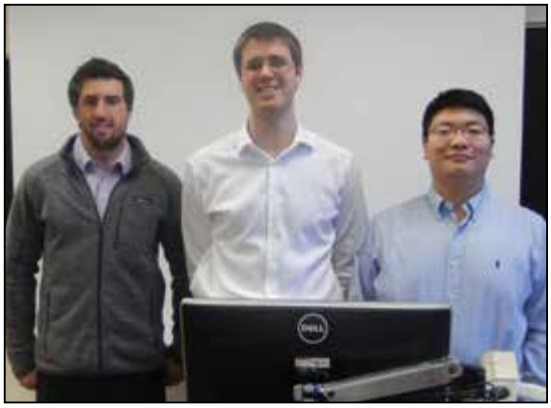
Meijer is a regional supermarket chain interested in reducing their environmental impact. This project involves designing a food waste management system at one of Meijer's distribution centers capable of producing a waste-to-resource product. The Waste Watchers conducted an environmental and cost analysis to determine the current impact of the project sponsor's food waste disposal practices and recommended alternative systems. The team also designed a complete composting system to manage the company's food waste and generate a finished compost product. The final design included a feedstock recipe and end product quality, as well as a cost analysis.

(L to R) Larry Buckner, Austin Wissler, Nathan Sobczak & Lauren Strange

Pilot-scale Compost Unit Design: Monitoring Chemical Degradation

Team Name – Compost Kings
Sponsor – Dow AgroSciences (project under non-disclosure agreement)
Faculty Advisor – Dr. Dawn Reinhold

Dow AgroSciences is a leader in the production of common herbicides used in both the public and private sectors. Residuals of these chemicals in the environment can result in negative effects, including inadvertent plant injury and more. Understanding how these chemicals degrade in natural systems, such as composting, is important to ensure these residuals are non-threatening. An in-vessel composting system was designed, built, and tested in order to give Dow AgroSciences a method to perform future chemical life-cycle tracking tests. This in-vessel unit monitors important characteristics of compost through sensor technology, and serves as a base for process sampling. Samples can be analyzed to understand how herbicides degrade during a typical composting cycle.



(L to R) Joshua Boucher, Benjamin Bailey & Yifeng Hu

BE Showcase Award Banquet - April 16, 2015

Industry Evaluation

Optimizing Heat Transfer for Food Industry Application

Team Name – Efficientneers
Sponsor – Major Food Manufacturer
(project under non-disclosure agreement)
Faculty Advisors – Dr. Kirk Dolan and Mr. Phil Hill

The Efficientneers are working on creating a new design, for the shape and the material of a metal heating element that will yield a ten percent reduction in cooking time for a packaged food product while maintaining a more homogenous heat transfer across the heating element. This will be done on a computer model (COMSOL) that will show the optimization of the new design alternative compared with the original model. Project deliverables include these simulations on COMSOL, a sensitivity analysis on a range of material properties, and an economic analysis with an investment return rate of the final design.

(L to R) Natsuki Ikeda, Brendan Cloonan, Christopher Walker & Michael Conklin

Label Quality Vision Inspection System

Team Name – Envision Engineering
Sponsor – Perrigo (project under non-disclosure agreement)
Faculty Advisor – Dr. Dan Guyer

Perrigo is a leading global healthcare supplier. They use vision systems as a quick and reliable inspection tool during manufacturing processes. Inconsistencies with the vision systems used to inspect packaging cause downtime, create excess re-work, and utilize unplanned maintenance resources. Envision Engineering has been tasked with designing a solution to Perrigo's vision system problems pertaining to label quality (wrinkles, tears, bubbles, etc.), and label presence (e.g., missing label). By designing a comprehensive solution, Envision Engineering aims to increase product quality and decrease risk associated with flawed pharmaceutical packaging.

(L to R) Anna Brunsman, Paige Crosset, Alexis Baxter & Kyle Brunsman

Optimizing Purified Water Use for Pharmaceutical Tank Cleaning

Team Name – PharmaCleanse
Sponsor – Perrigo (project under non-disclosure agreement)
Faculty Advisors – Dr. Susie Liu and Dr. Jade Mitchell

Perrigo, a leading global healthcare supplier, is working to reduce plant-wide water use. The purpose of this project is to improve water efficiency while cleaning and sanitizing tanks used for pharmaceutical manufacturing. The team, Pharma Cleanse, is working to identify areas associated with tank cleaning that could be improved upon to save water. In doing so, the team will provide the client with a detailed analysis regarding economics, testing procedures, testing results, and a scaling plan. After testing and data analysis, the team will also provide the client with a set of recommendations going forward.

(L to R) Joseph Commane, Sydney Preston, Jacob Vankeulen & Jason Petros

BAE Showcase Public Presentations

BAE 2014_15 Industry Advisory Board

Biosystems BE 485/487 First Floor | 1300 Hallway 8:00 a.m. – Noon

Ultrafiltration of Anaerobic Digestion Effluent for Sustainable Management

Team Name – Nutrient Moo-vers
Sponsor – MSU Land Management
Faculty Advisors – Dr. Wei Liao, P.E. and Dr. Tim Harrigan

MSU Land Management operates an anaerobic digester. Effluent is drained from the digester daily and it is stored in a holding tank. A few times a year the holding tank is drained for application on agricultural lands. However, not all of this effluent can be land-applied due to runoff potential and odor. Remaining effluent must be exported at a high cost. The "Nutrient Moo-vers" team has designed a system to separate some of the liquid from the effluent so that it can be better managed. The remaining nutrients can be land-applied for plant growth.

(L to R) Robert Munro, John Everett, Shane Peterson & Charlotte Thomas

Designing a Sustainable Conveyor System: A Frozen Food Application

Team Name – Froz-hen
Sponsor – JBT FoodTech
(project under non-disclosure agreement)
Faculty Advisor – Dr. Brad Marks, P.E.

JBT's SuperCONTACT freezer is designed to freeze a thin layer of tissue at the base of marinated poultry products prior to their discharge into a spiral freezer, which completes the freezing process. Currently, a disposable polyethylene film is used to convey products across the system's cold plates to the next freezing step, which creates unnecessary waste and downtime. Froz-hen was assembled to design a reusable solution that will improve economic efficiency, maintain the production and quality of the SuperCONTACT system, and promote sustainable operations by reducing landfill waste and the environmental costs associated with producing the polyethylene film.

(L to R) David Olson, Austin Ebeling, Jacqueline Thelen & Nicholas Niedermaier

Bio-oil Upgrading Through Continuous Electrocatalytic Hydrogenation

Team Name – R-Oil
Sponsor – Tenneco
Faculty Advisor – Dr. Chris Saffron

This project is coordinated with Tenneco, an automotive ride control and emissions products company. This project aims to electroreduce bio-oil produced through fast pyrolysis. Successful reduction of the bio-oil will increase energy content and decrease unwanted properties, such as reactivity. Electroreduction of bio-oils has primarily focused on neat model compounds and their mixtures in batch-divided hydrogen fuel cells (H-cells). These cells are characterized by high voltages and unwanted molecular hydrogen production. Configuring a continuous hydrogen fuel cell will minimize voltage and hydrogen production, improve efficiencies and reduce capital cost.

(L to R) Stephen Wilson, Angela Hoang, Aubrey Proctor & Jack Stephan

If you are interested in sponsoring a BE 485/487 capstone project for the 2016-17 Senior Design teams, please contact Dr. Dana Kirk at kirkdana@msu.edu or Dr. Luke Reese at reesel@msu.edu.

The Capstone Projects

Faculty Advisors:
Professors Chatti, Haider, Hashsham, Ingle, Kruth, and Li


Chatti


Haider


Hashsham


Ingle


Kruth


Li

Presentation Schedule – Room 1538

Time	Team	Room
8:00 a.m.	Team 1 – Ingenium International LLC	First Floor Room 1538 EB
9:20 a.m.	Team 2 – River Trail Associates	First Floor Room 1538 EB
10:40 a.m.	Team 3 – Superior Engineering Consulting, Inc.	First Floor Room 1538 EB

Presentation Schedule – Room 3400

Time	Team	Room
8:00 a.m.	Team 4 – Thinking Green Engineering	Third Floor Room 3400 EB
9:20 a.m.	Team 5 – Very Good Engineering & Consulting Co.	Third Floor Room 3400 EB
10:40 a.m.	Team 6 – B.I.L Associates	Third Floor Room 3400 EB

Presentation Schedule – Room 3540

Time	Team	Room
8:00 a.m.	Team 7 – Spartan Design Group	Third Floor Room 3540 EB
9:20 a.m.	Team 8 – Eighteen55 Sustainable Solutions	Third Floor Room 3540 EB
10:40 a.m.	Team 9 –R&R Best Value Engineering	Third Floor Room 3540 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

Michigan State University Shaw Lane Power Plant Renovation

Michigan State University is in the process of implementing components of its campus master plan. As a part of the 2020 Vision: Campus Master Plan Report, a new academic building was envisioned at the location of the now decomissioned Shaw Lane Power Plant. A recent update to the campus master plan suggested the option to renovate the existing building and add a substantial expansion to the building footprint. In conjunction with this project, the segment of Shaw Lane between Chestnut Rd and Red Cedar Rd will be reconstructed. Both the street reconstruction and the academic building expansion must be congruent with the overall campus master plan.

The project emphasizes implementation of green infrastructure. Green infrastructure refers to systems and practices that use or mimic natural processes to infiltrate, evapotranspire, or harvest stormwater at its source. The competition requires proof-of-concept level designs that examine how green infrastructure could be integrated into an on-campus site to meet multiple environmental, educational, and economic objectives.

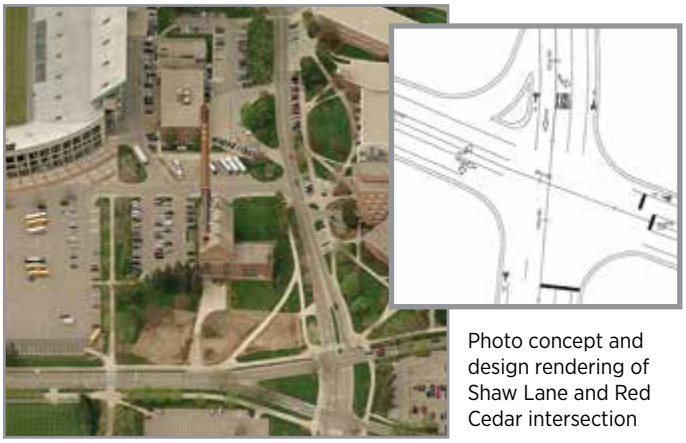
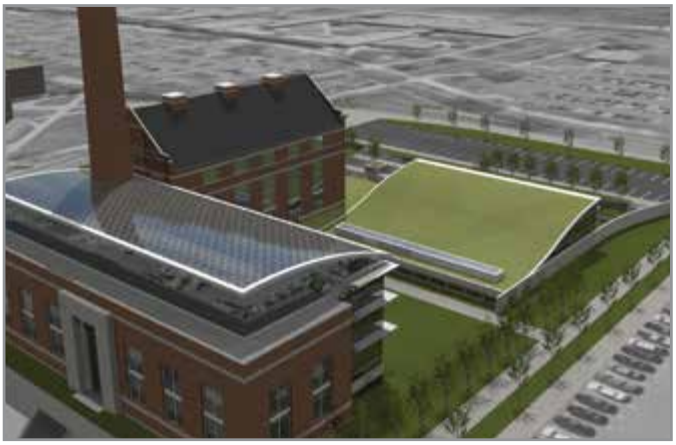
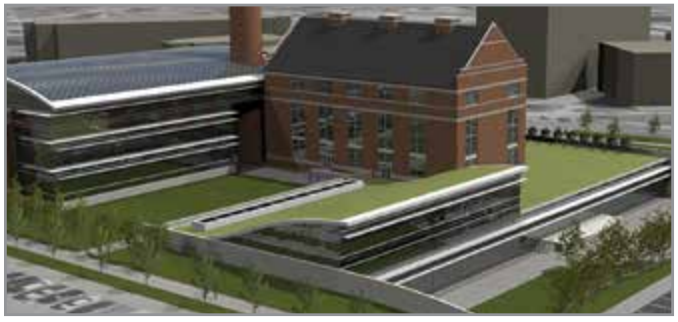


Photo concept and design rendering of Shaw Lane and Red Cedar intersection





Integrated Architecture

Shaw Lane project for 2020 Vision Campus Master Plan. Concept rendering courtesy of Integrated Architecture, Grand Rapids, MI.

Team 1: Ingenium International LLC

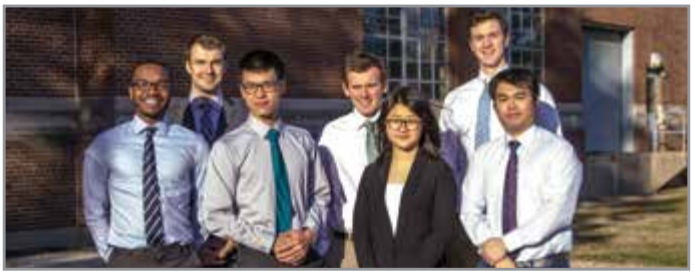
Left to Right: Smerald Xhaferllari (T), Longhao Chen (S), Lu Guan (WR), Musana Nabil (PM), Nicholas Dembicki (E), Mama Traore (G), Caycee Hart (P)

Team 2: River Trail Associates

Left to Right: Brad Kouchoukos (G), Xiang Xiao (T), Zach Hampton (P), Santiago Arrangoiz-Arriola (PM), Siyao Zhu (S), Paul Gibson (WR), Michael Clark (E)

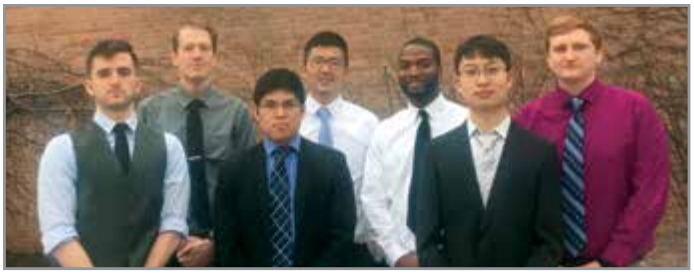
Team 3: Superior Engineering Consulting, Inc.

Left to Right: Shiyu Huang (T), Derek Hibner (S), Cody Norat (P), Jake Magier (WR), John Beisel (E), Brian Durkin (PM), Ouyang Zijing (G)



Team 4: Thinking Green Engineering

Left to Right: Antonio Hamilton (T), Michael Day (P), Haibin Yu (G), Corey Turner (E), Ye Chen (H), James Elsey (PM), Shuonan Li (S)



Team 5: Very Good Engineering & Consulting Co.

Left to Right: Ben Cooper (E), Kurt Facknitz (PM), Eliseo Gutierrez Jr. (G), Qin Long (P), Ricardo Freshley (T), Lei Shi (S), Cole Gibson (H)

Team 6: B.I.L. Associates

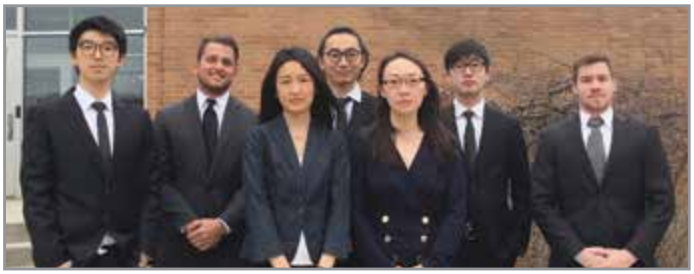
Left to Right: Michael Baker (G), Melanie Kasten (PM), Chris Powell (S), Coulton Pierce (E), Anuj Thaker (P), Veronica Crowley (T), Vivian Ruffolo (WR)

Team 7: Spartan Design Group

Front: Yuqiang Chen (H), Gabryelle Giddens (P), Alexander Sherman (P) **Middle:** Dylan Sheridan (G), Parker Denton (T) **Back:** Jordan Russell (E), Kyle Thompson (S)

Team 8: Eighteen55 Sustainable Solutions

Left to Right: Zemin Yan (WR), Mackenzie Johnson (E), Brian Gammon (G), Victor Ruiz (S), Danell Smith (PM), Kyle Piccard (T), Seirra Patrick (P)



Team 9: R&R Best Value Engineering

Left to Right: Tianyi Chen (P), Michael Kaminski (E), Maioyu Song (WR), Hangming Zhang (S), Xuanying Wu (PM), Zhe Zhang (G), John Mandryk (T)

Key:
E = Environmental
G = Geotechnical
H = Hydrology
P = Pavements
PM = Project Manager
S = Structures
T = Transportation
WR = Water Resources

CE 495 SENIOR DESIGN IN CIVIL & ENVIRONMENTAL ENGINEERING

PROFESSIONAL SEMINAR SPEAKERS

Michael J. Buckler, P.E.
Fishbeck, Thompson, Carr & Huber

Iman Harsini
Michigan State University

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

Ryan D. Musch, P.E.
Fishbeck, Thompson, Carr & Huber

Leanne Panduren, P.E.
Rowe Professional Services

Robert D. Rayl, P.E.
RS Engineering, LLC

Charles Rolfe, P.E.
OHM Advisors

Scott Stowitts, P.E.
Barton Malow

Michael Thelen, P.E.
Consumers Energy

Daniel Thome, P.E.
Nicholson Construction Company

Roy D. Townsend, P.E.
Washtenaw County Road Commission

Kelby Wallace, P.E.
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.

Greg Carnaghi
Unified Investigations & Sciences, Inc.

Rick Chelotti, P.E.
Bergman Associates

Daniel Christian, P.E.
Tetra Tech MPS

Tyler Dawson, P.E.
NTH Consultants

Mike Ellis, P.E.
Barr Engineering Co.

Brad Ewart, P.E.
Soil & Materials Engineers, Inc.

Nathan Fettes
Michigan Department of Transportation

Matt Junak, P.E.
HTNB

Kelly Karll
SEMCOG

Yuanji Li
Michigan State University

Peter Margules, P.E.
NTH Consultants

George McKenzie, P.E.
Consumers Energy

Mario Quagliata
Bergmann Associates

Todd Sneathen, P.E.
Hubbell, Roth & Clark

Michael Thelen, P.E.
Consumers Energy

Anthony Thomas, P.E.
Soil & Materials Engineers, Inc.

Geneva Vanlerberg, P.E.
Lansing Board of Water & Light

Phillip Vogelsang, P.E.
URS Corporation

Emily Warners, P.E.
Consumers Energy

Lauren Warren, P.E.
Parsons Brinckerhoff

Design Day Awards Fall 2015

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.

Rolla C. Carpenter Senior Design Award Winners, Fall 2015

Team Entourage Engineering

Tom Bonney, Chris Rothhaar, Steven McConnell, Alex Wangeman, Alex Zuker, Kaleb Sondgerath, Tony Brehmer

Process Design and Optimization II

Dr. Martin Hawley
Professor and Class Instructor of Chemical Engineering and Materials Science

Thanaphong Phongpreecha
Graduate Student & Teaching Assistant for Chemical Engineering and Materials Science

Course Description

Process Design and Optimization II (ChE 434) is a logical extension of the first semester design course (ChE 433). The abilities developed over a wide range of chemical engineering courses are now applied to a problem extending over a somewhat longer period of time; requiring more initiatives, investigation, accuracy, and a greater measure of individual responsibility. For the 47th successive year, we have worked on the American Institute of Chemical Engineering (AIChE) Student Contest Problem. We use these industry-based challenges for three reasons: 1) they are well-rounded problems, 2) they inform our students and faculties of the set of skills current industries are looking for in chemical engineering graduates, and 3) they serve as a good benchmark for comparison of MSU chemical engineering students' performance nationally.

Eight proposed solution posters from four teams and individuals were selected for presentation on Design Day. Of these final groups, two teams and individuals will be picked for the national AIChE competition this coming Fall. Since 1968, about half of the students whose reports rated first or second at MSU also finished among the top six nationally.

Winner from Year 2015!

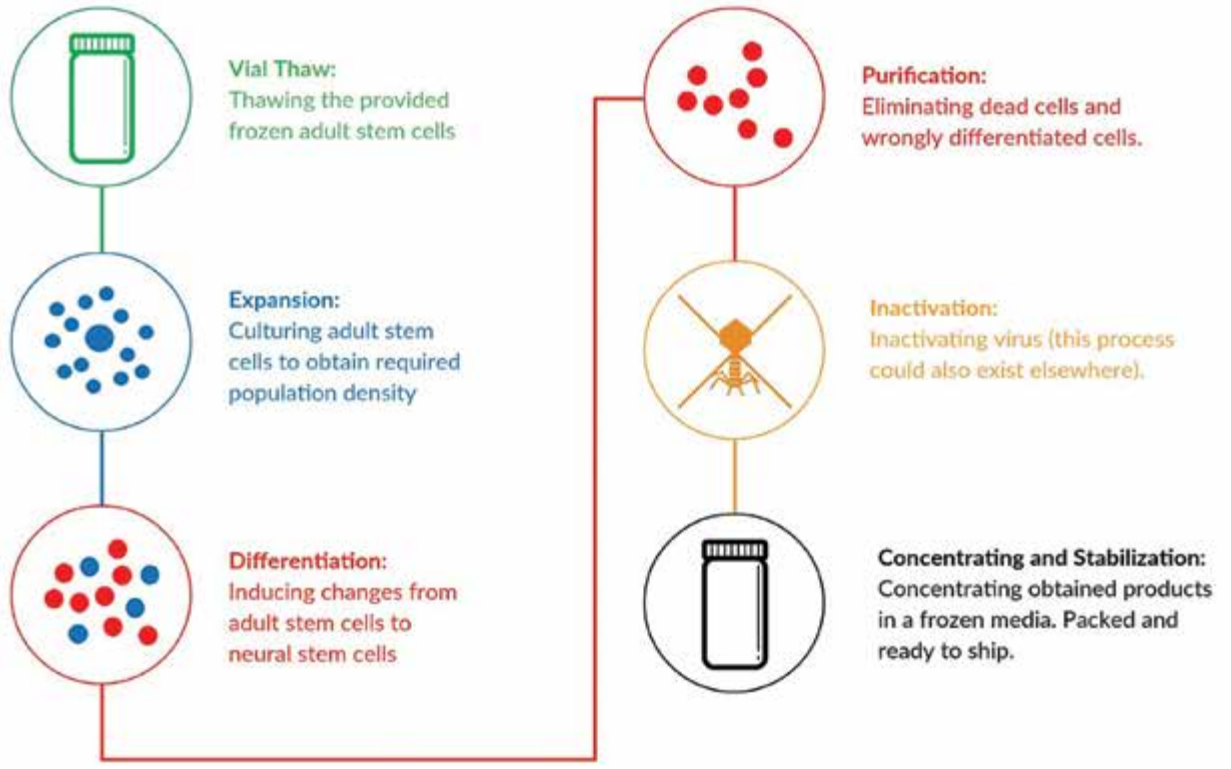
Cale Hyzer, one of the selected individuals from the previous Design Day, presented his proposed solution at the 2015 AIChE Annual Meeting in Salt Lake City, UT. He won the 2015 Omega Chi Epsilon Award (Third place).

AIChE®

Cell Therapy for Spinal Cord Injuries: Commercial Manufacturing Facility

In 2016 AIChE Design Competition, participants are required to design a stem cell manufacturing facility. The company is currently developing a spinal cord injury regeneration therapy that will allow patients to recover from the injury and be able to move again. There is currently an unmet need in the market for the treatment of spinal cord injuries where there are significant functional improvements.

According to the AIChE problem statement, participants will be designing the process, which includes vial thawing, cell expansion, and cell differentiation, to produce a commercial scale production of neural stem cells from a given vial of only 100,000 adult stem cells. Each step represents a multifaceted complexity. For example, the fermenter needs to be designed such that it provides sufficient and uniform gas transfer for the cells, which is conventionally done by stirring, while not compromising the integrity of the delicate cells due to shear force. A flow diagram with a brief description of each step is shown below for better understanding. This project is an ample opportunity for students to showcase their comprehensive set of skills, including literature search, process design, reactor design, adhering to cGMP production guidelines, and many more.



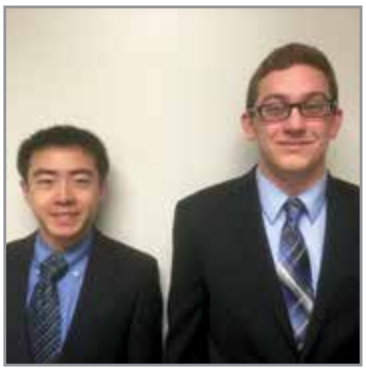
2016 Winning Individuals and Teams


Aaron Schmidt


Jacob Anibal


Rebecca Jacobs


Samantha Boyle


Henry Pan & Andrew Izbicki


Rebecca Carlson & Ariel Rose

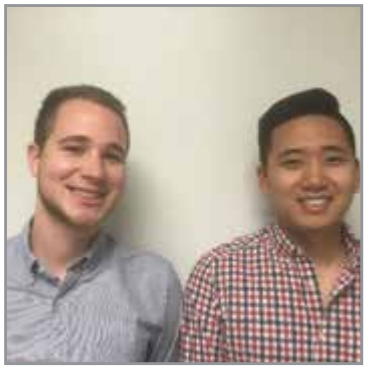

Jeremy Bosco & Matthew Gattinger


Marco Main & Nolan Reichkitzerr

Honorable Mentions


Ammar Babiker & Avik Chakrabarti


Ethan Bowyer & Caleb Smydra


David Desellier & Mahruchi Rhee

The Capstone Projects

Dr. Martin Crimp
Professor of Chemical Engineering and Materials Science

Course Description

MSE466 is a senior level course for Materials Science & Engineering majors providing students with a team-based capstone design experience. A major aspect of this course is to have students apply their course-learned background knowledge and skills in materials science and other disciplines to real-life design problems. A failure analysis investigation (FAI) fits this context. Failures are a major motivating factor for promoting more innovative designs or design changes. A failure analysis investigation provides a unique platform to design and to solve real world engineering problems via systematic engineering approach. By focusing on a specific design failure, the student teams learn how to confront an open-ended problem that requires them to develop a strategic design plan and to execute the methodology for assessing how and why the failure occurred. The analysis is conducted using established investigative procedures and constraints for conducting failure analysis investigation. This semester, there are nine teams working on nine real engineering failures.

Successfully completed team projects culminate in a comprehensive written final report and a strategic redesign plan to improve the design and mitigate future failures. For Design Day the teams present their findings in half-hour presentations. For 2016, the nine teams are conducting the following failure analysis investigations:

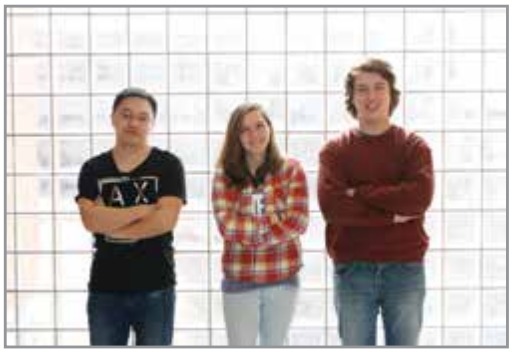
Presentation Schedule – Second Floor Room 2320

Time	Team	Project
8:00 a.m.	The Pinion Minions	Failure Analysis of a Rear 8.8” Differential
8:25 a.m.	Hip Hip Hooray	Failure Analysis of an Acetabular Reamer
8:50 a.m.	Thrill of the Mill	End Mill Investigation
9:15 a.m	The Incredibly Awesome Team	Failure of Bearing Cage in Constant Velocity Joint
9:40 a.m.	Ice Ice Baby	Analysis of a Failed Hockey Skate Blade
10:05 a.m.	3 Doors Down	Failure of Die Cast Zinc Door Latch
10:30 a.m.	The Knights of Ni	Failure Analysis of a Nickel Heat Shield
10:55 a.m.	Ca$h Landed	Strut Housing Lower Connection Failure of a Piper Arrow III Aircraft
11:20 a.m.	Fantastic Fore	Failure Analysis of Top-Flite XL 35” Putter

(left to right) Christina Casali, Kegan McKinnon, Sam Schab

Team Name: The Pinion Minions
Project: Failure Analysis of a Rear 8.8" Differential
Time: 8:00 a.m.

An 8.8" differential failed during use in a Jeep when the driver abruptly shifted from reverse to drive. The differential was disassembled and examined to determine the method of failure. Analysis of the failed part included evaluation of fracture surfaces, macroscopic defects, failure modes, mechanical properties, and microstructures. The investigation was carried out using a variety of testing methods including stereomicroscopy, scanning electron microscopy, chemical testing, metallography, and others. The root cause of failure was determined and recommendations were made to avoid future failure.



(left to right) Wubin Jin, Kaitlyn Broz, Jason Reglin

Team Name: Hip Hip Hooray
Project: Failure Analysis of an Acetabular Reamer
Time: 8:25 a.m.

Two acetabular cup reamers were submitted to DePuy Synthes after failure and were loaned to MSU for failure analysis. Acetabular cup reamers are used to strip the excess bone from the acetabulum to prepare the socket for a total hip replacement. These parts failed within the 'cutting teeth' features of the reamers. Through various investigative techniques, data was collected and analyzed to determine the root cause of the failures.

(left to right) Clarence Jilek, Derrick Defever, Eric Hills.

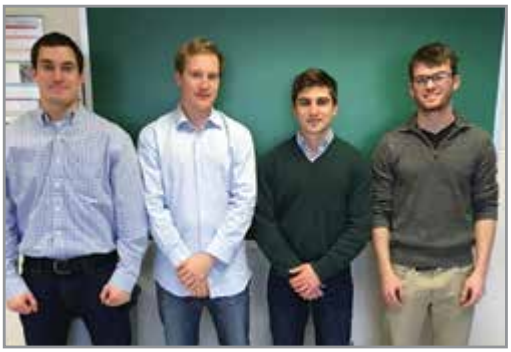
Team: Thrill of the Mill
Project: End Mill Investigation
Time: 8:50 a.m.

In the Michigan State University Physics machine shop, Rob Bennett (MSU Employee) was CNC milling an artifact using a titanium carbide end mill with the trochoidal machining technique. Amidst the milling, the titanium carbide bit fractured in a very unique and peculiar way, which raised the question as to manufacturing flaws in the bit. "Thrill of the Mill" has examined the cause of this failure through Scanning Electron Microscopy (SEM), microstructural analysis, and several other material analysis techniques. This research was done to prevent this failure from happening again. The results will be used to advise future CNC operators and refine the manufacturing process used.

(left to right) Lia Hetherington, Darwin Warga Kane, Mike Zuker

Team: The Incredibly Awesome Team
Project: Failure of Bearing Cage in Constant Velocity Joint
Time: 9:15 a.m.

The bearing cage inside a constant velocity axle failed during use in a 2008 GMC Sierra 1500 pickup truck. The vehicle had been driven for 135,000 miles when failure occurred, a shorter lifetime than typically expected. The cage was shattered into 13 pieces and was possibly driven on for a month before being replaced. Analysis was performed on the bearing cage to conclude the reasons for its failure. This was done through various methods of testing such as non-destructive analysis regarding surface replication, optical microscopy and imaging of the subject and various destructive techniques such as hardness tests, scanning electron microscopy, and other metallographic techniques.



(left to right) Mike Vanderlaan, Max Nolta, Jake Finkbiner, Daniel Branski

Group Name: Ice Ice Baby
Project: Analysis of a Failed Hockey Skate Blade
Time: 9:40 a.m.

The middle of an ice hockey blade fractured after five years of use. The blade was struck by a puck traveling at high velocity, which may have led to the catastrophic failure of the blade. The fracture is unusual as ice skates are often struck by pucks but rarely fracture. This is problematic as a broken blade can be hazardous, leading to injury or damage of equipment. An analysis of the failed specimen was carried out using various testing methods in order to determine the method of fracture and the root cause of failure.

(left to right) Gregg Gugel, Christopher Priem, Lindsay Cocklin

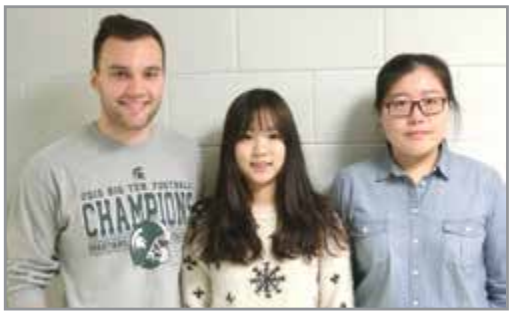
Group Name: 3 Doors Down
Project: Failure of Die Cast Zinc Door Latch
Time: 10:05 a.m.

The main goal of this project was to perform a failure analysis on a chosen part for Michigan State University's MSE 466 course. The chosen component was a screen door latch that fractured during normal usage. The component is approximately 3" x 3" and made out of die cast zinc. The failure occurred during the summer of 2015 in Dewitt, Michigan, while the door was being opened. The part was purchased around 1998, and was manufactured between 1985-2000 by Wartian Lock Company. Our hypothesis for the cause of failure was that based on how the forces were applied to the handle and the poor design of the handle, there were areas that had high stress concentrations, eventually leading to fracture. To prove this, we performed non-destructive and destructive testing procedures on our component.

(left to right) Yuxiang Zhong, Matthew Cummings, Brandon Bocklund

Group Name: The Knights of Ni
Project: Failure Analysis of a Nickel Heat Shield
Time: 10:30 a.m.

A nickel heat shield from a ULVAC ZEM-3 failed when it was handled by an operator under normal use conditions. The walls of the heat shield were punctured and suspected to be embrittled after the part was subjected to thermal cycles at 600°C on the order of hundreds of cycles. Theoretical calculations were performed to predict chemical changes due to diffusion and stresses associated with thermal cycling and fatigue. Physical and chemical analyses were performed to evaluate the cause of the failure.



(left to right) Adam Gros, Mingwan Zhu, Nianjiao Yang

Group Name: Ca$h Landed
Project: Strut Housing Lower Connection Failure of a Piper Arrow III Aircraft
Time: 10:55 a.m.

In 2015, the discovery of a fractured strut housing connection point was found on an annual maintenance check of a Piper Arrow III Aircraft. No casualties were reported in relation to this failure and the part was replaced. The aircraft was manufactured in 1977 and had 2000 hours of recorded flight time. After an initial inspection of the fracture surface, metallurgic abnormalities could be detected macroscopically. We were interested in determining the causes of the fracture and how the abnormalities in the fracture surface developed. Circumstances in the force distribution of the landing gear were also included in the investigation to assist with failure analysis.

(left to right) Rachel Burland, Eric Egedy, Nick Lyttle, Joseph Asciutto

Group Name: Fantastic Fore
Project: Failure Analysis of Top-Flite XL 35" Putter
Time: 11:20 a.m.

A Top Flite putter head and shaft became separated after a strong impact with the ground. After a failed putt attempt, the club was tossed through the air in frustration, and the mallet end struck the ground with appreciable force. A relatively clean fracture surface was apparent after the impact. Use of various mechanical tests, chemical analyses, 3D modelling, and microscopy aided in a fracture analysis. Based on collected data, causes of the fracture were determined.

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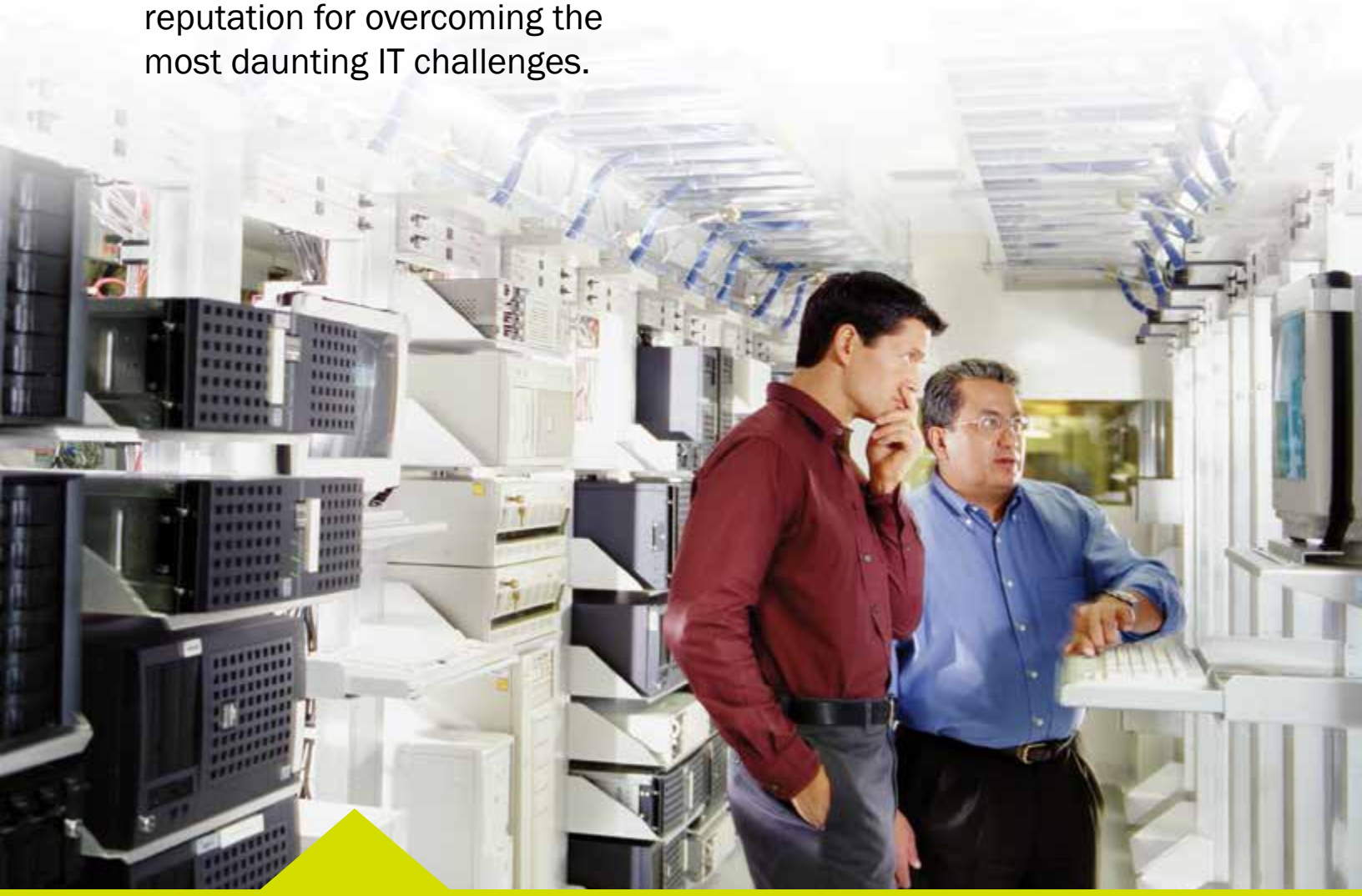

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Computer Science and Engineering

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Yello
Chicago, Illinois

The Capstone Projects

Dr. Wayne Dyksen
Professor of Computer Science and Engineering

Angie Sun
Teaching Assistant

Presentation Schedule – Engineering Building, Room 3405

Time	Team	Project
7:30 a.m.	Amazon	Twitch.tv Comment Ranking and Smart Advertisements
7:50 a.m.	Auto-Owners	Catastrophic Claims Unit Mobilization
8:10 a.m.	GE	Cloud Management Portal
8:30 a.m.	GM	IT Expert Live Help
8:50 a.m.	MSUFCU	Money Smash Chronicle
9:10 a.m.	Quicken Loans	Game of Loans
9:30 a.m.	Break	
9:45 a.m.	Spectrum Health	Mobile Rounding App
10:05 a.m.	TechSmith	Cloud Based Video Face Tracking
10:25 a.m.	Union Pacific	Oculus Rift Inspection and Training Tool
10:45 a.m.	Urban Science	Dealership Inventory Solution
11:05 a.m.	Whirlpool	Mobile Product Catalog
11:25 a.m.	Yello	Syncing Mobile Data Without Internet Connectivity

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, Urban Science, Whirlpool and Yello.

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

Amazon
Twitch.tv Comment Ranking & Smart Adverts

Twitch.tv is a website that provides a platform for entertainers to stream their activities live. Recently acquired by Amazon for nearly one billion dollars, Twitch is ranked above Facebook in peak Internet traffic websites in the United States.

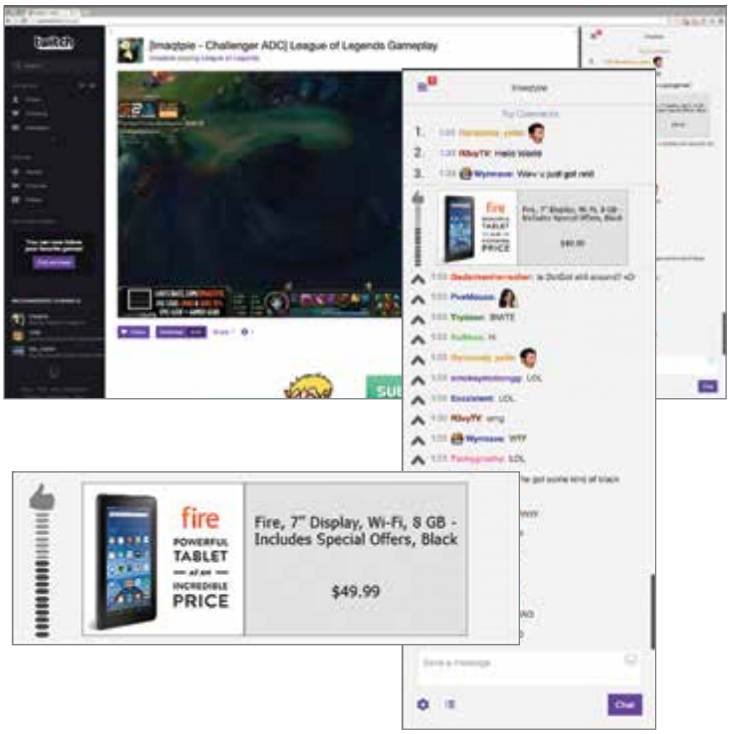
Similar to live television, Twitch grants viewers real-time access to a variety of channels. However, being web-based, Twitch also offers additional unique live features, such as chatrooms where viewers of an individual channel can chat among themselves and with the channel host.

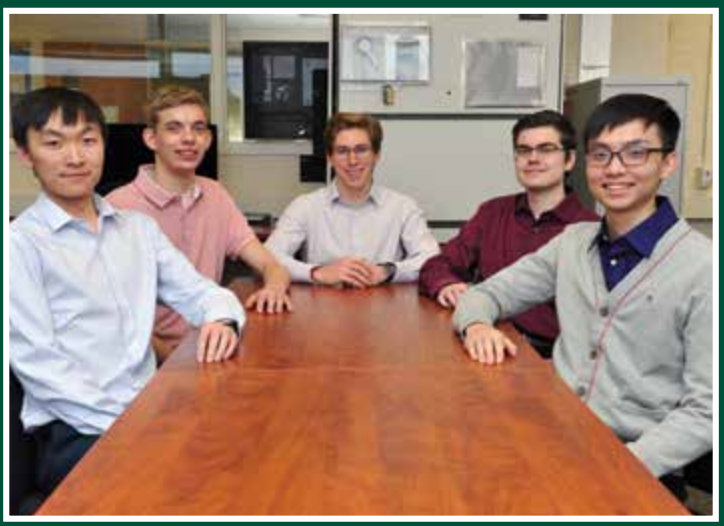
Viewing and interacting with channel chat rooms is an important feature of the overall Twitch viewing experience. Our Comment Ranking system improves viewers' chat experience. Rather than scrolling through long lists of continuously scrolling comments, viewers are presented with a short list of the most popular ones for quick and easy viewing.

Our Smart Advertisements feature listens to both what's being discussed on the channel and what's being discussed in chatrooms to identify products being discussed. After identifying the most talked about products, it displays links to those products on Amazon's website.

Given our two new features, Twitch viewers are able to digest and interact with chat seamlessly while relevant advertisements receive a rise in traffic, which is a win-win for both Twitch viewers and advertisers.

Our *Twitch.tv Comment Ranking and Smart Advertisements* system is written in PHP and C++ and uses a MySQL database and Elastic Compute Cloud (EC2) Amazon Web Services.





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Auto-Owners Insurance
Catastrophic Claims Unit Mobilization

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

Auto-Owners is committed to providing efficient, timely service to its policyholders affected by severe weather events that cause large amounts of damage. Our *Catastrophic Claims Unit Mobilization* system streamlines the entire process of handling large volumes of claims resulting from severe weather events.

Our web app displays where policyholders' properties are located on a map. Auto-Owners claims adjusters utilize overlaid weather radar to locate its customers in high damage areas. Information about these customers is sent to our companion iPad app.

In addition, our web app determines the most centralized location within the high damage area to deploy the mobile claims unit vehicle so the claims adjusters are readily available to assist their policyholders.

Auto-Owners claims adjusters process claims using our companion iPad app. The adjusters file claims on-site, with or without an internet connection. Once connected to the internet, claims that are filed off-line are uploaded to Auto-Owners.

Auto-Owners management can view a statistical analysis of the claims as they are being filed and processed using our web app.

Our web app is written in HTML, CSS, JavaScript and PHP. Our iPad app is written in Swift. Both are supported by a MySQL database with JSON used to communicate between the two.

Auto-Owners Insurance
Life Home Car Business
The No Problem People®

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GE
Cloud Management Portal

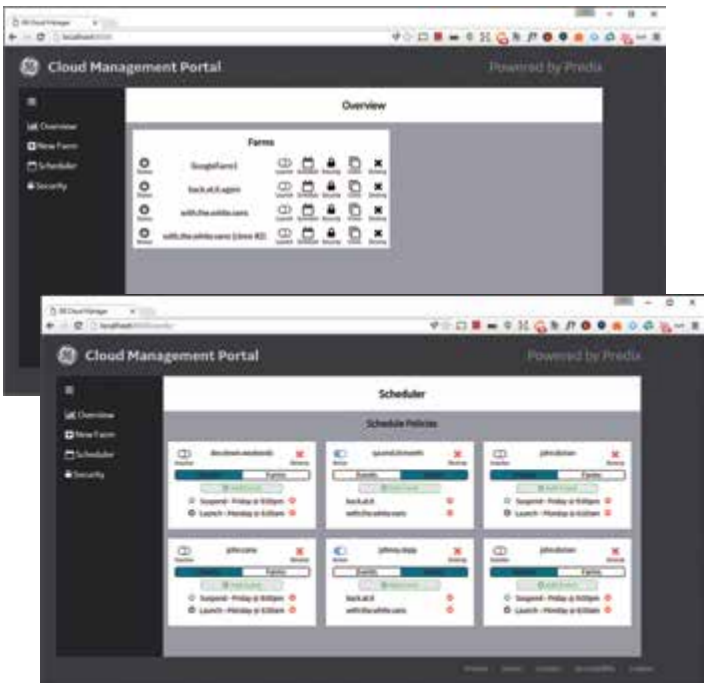
General Electric is the world's digital industrial company with global locations in more than 170 countries and a workforce of 305,000 employees. GE operates in many industries including appliances, power and water, oil and gas, energy management, aviation, healthcare, transportation and capital.

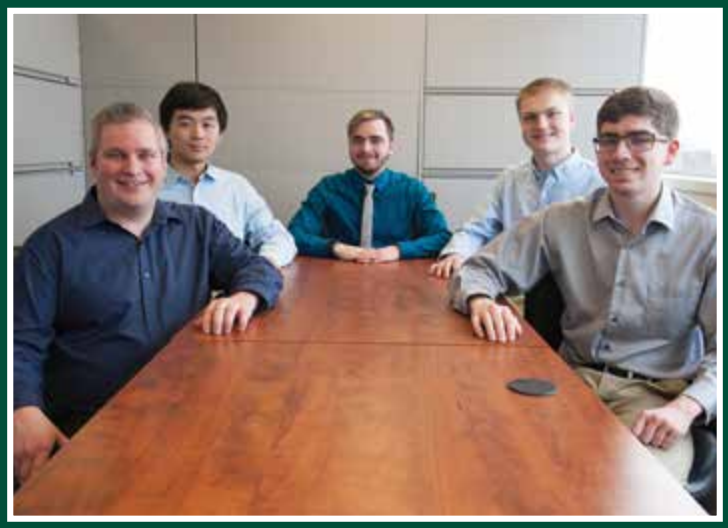
GE businesses rely on compute servers to handle large amounts of data. Servers are used for various applications such as storing files, hosting databases and handling email. Servers are also used to distribute information and run apps via the Internet. Today, computing services are often provided by an outside company at a remote location "in the cloud." GE relies on such cloud servers to manage their apps and deliver services quickly and efficiently.

Managing cloud services is important. Unfortunately, existing cloud management tools are often too complex for many users. Our *Cloud Management Portal* is a tool designed for use by non-technical users to manage and leverage a wide variety of cloud services. Users experience a simplified approach to cloud resource management with the flexibility of handling multiple cloud resource providers.

Our easy-to-use cloud portal makes cloud service management accessible to non-technical people, which increases the use of cloud resources, thereby enabling hospitals, manufacturers and other businesses to function faster and more efficiently.

Our *Cloud Management Portal* is written in CSS, HTML, JavaScript and Python, and utilizes the Scalr API, Amazon Web Services and the Django MVC framework.





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General Motors
IT Expert Live Help

General Motors is a multinational automotive company that sells vehicles in over 120 countries worldwide. Headquartered in Detroit, Michigan, GM produces nearly ten million vehicles per year and employs over 210,000 people.

GM's Global Service Desk (GSD) provides information technology (IT) support to GM employees worldwide. With so many employees, GSD handles a large volume of trouble tickets every day, which sometimes results in long wait times and lost productivity.

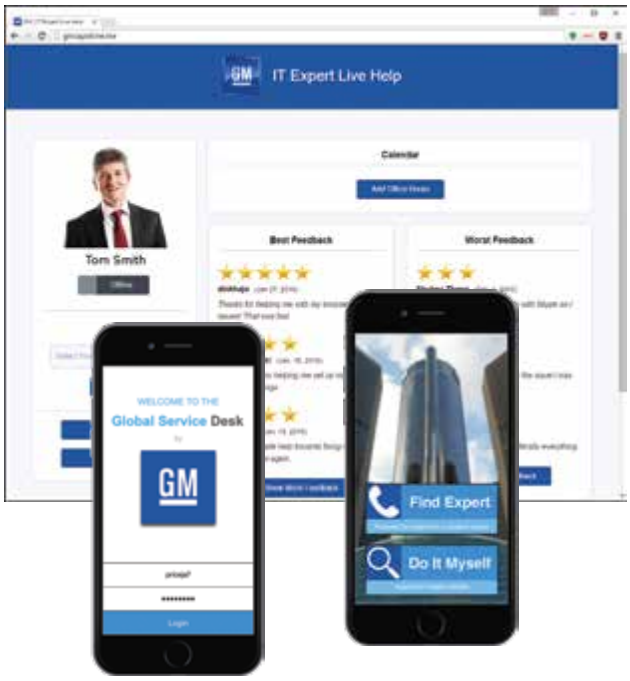
Our *IT Expert Live Help* system provides GM employees with an alternative to the current GSD system. When IT help is needed, a GM employee can use our app to search for a self-help article to fix the problem themselves or they can request immediate help from a volunteer IT expert.

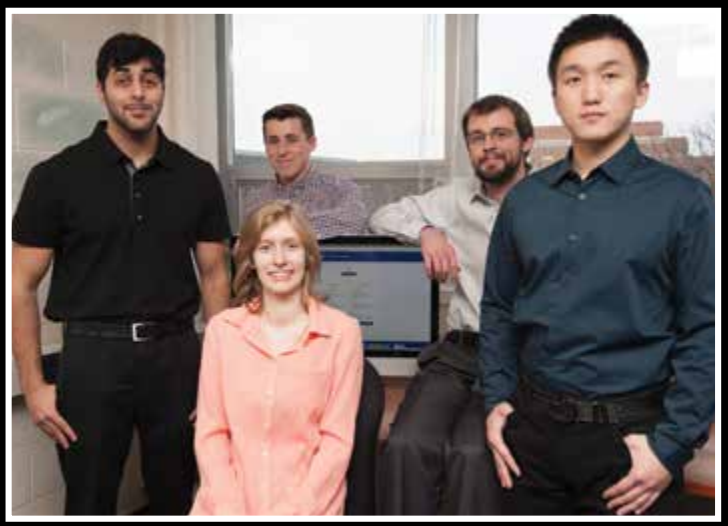
When assistance from a volunteer expert is requested, our app locates an available expert and initiates a Skype call between the person requesting help and the IT expert.

Using Skype, participants can video chat, exchange texts and images such as screen shots. At the conclusion of the help call, users can rate their experience.

Volunteer IT experts manage their availability via our companion web app. They can edit their areas of expertise, their hours of availability and their current availability status.

Our *IT Expert Live Help* mobile and web apps are written in Swift and JavaScript, respectively, interfacing with a SQL database.





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MSU Federal Credit Union
Money Smash Chronicle

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, Oakland University and their surrounding communities.

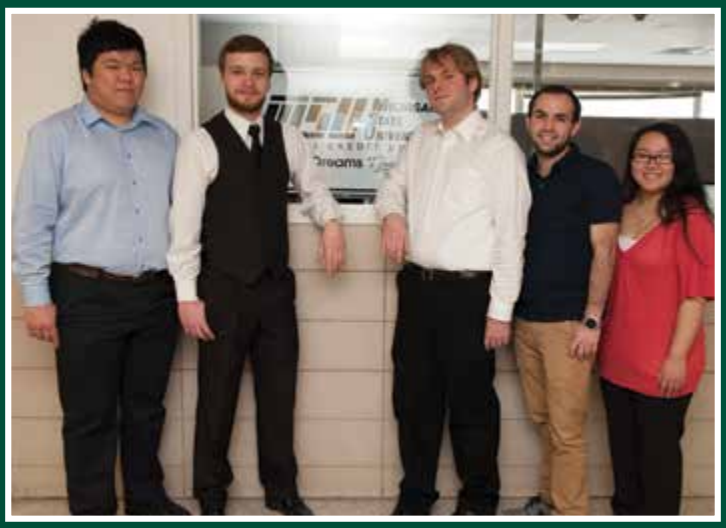
As a university-based credit union, MSUFCU is committed to educating its customers about finances. To improve financial literacy among people of all ages, *Money Smash Chronicle* educates players while providing a simple yet fun and engaging gameplay experience.

Money Smash Chronicle is a tile-matching puzzle game similar to other popular games such as Candy Crush. Like other puzzle games, our app uses the gameplay design philosophy of being easy to learn yet difficult to master. However, in lieu of requiring payments for extra lives and power-ups, players earn these bonuses by taking quizzes covering topics ranging from financial terminology to financial responsibility.

In addition, gameplay obstacles and goals are modeled after real world situations like surprise expenses and bills with upcoming due dates. These obstacles keep gameplay exciting for all skill levels while giving players more "hands-on" financial knowledge.

Money Smash Chronicle can be played in any web browser, as well as iPhone, iPad, Android phones and Android tablets. Our web app is written in JavaScript and WebGL. The mobile versions are native apps written in Swift for iOS and Java for Android.

MICHIGAN STATE UNIVERSITY FEDERAL CREDIT UNION
Building Dreams Together



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Quicken Loans
Game of Loans

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

Our web-based game, *Game of Loans*, educates Quicken Loans team members on the loan process by taking players through a mock mortgage process.

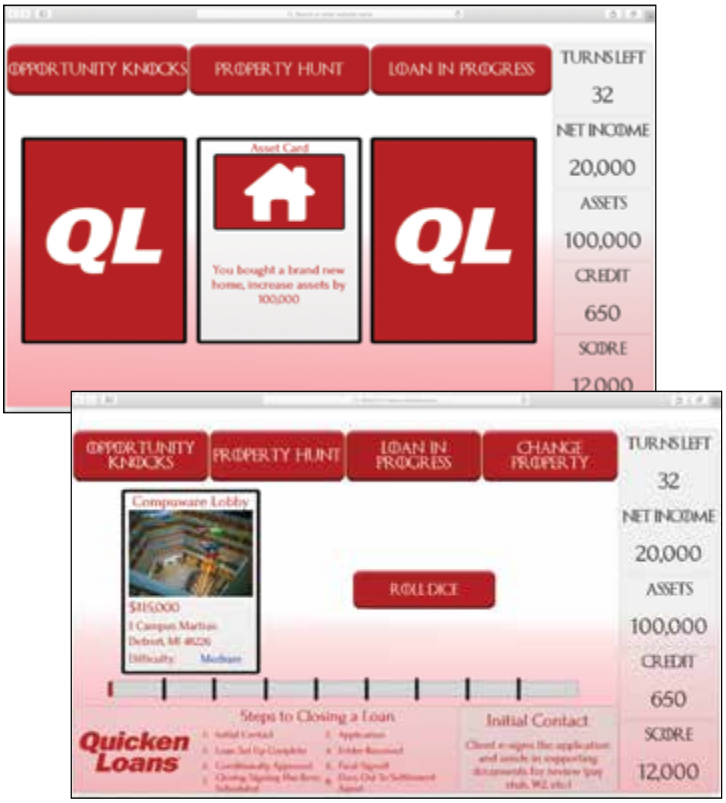
The objective of the game is to close as many loans as possible in a set number of turns. A player's ability to acquire and close a loan is influenced by three in-game statistics: income, assets and credit. A player's statistics are raised or lowered through in-game chance events, such as getting a pay raise or losing a job.

As a player progresses through the loan process, sub-goals appear and indicate passing steps in the actual mortgage process, such as getting conditionally approved.

At the end of a game session, a player is given a score that is based on a combination of the number of loans closed, the difficulty associated with closing each of those loans, and the player's statistics.

A player's score is ranked against other players' scores on a leaderboard, which is managed by a Quicken Loans system administrator.

Game of Loans is written in C# using the Unity game engine, which utilizes WebGL as a platform. A SQL database stores players' scores.



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Engineered to Amaze

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Spectrum Health
Mobile Rounding App

Spectrum Health, located in Grand Rapids, Michigan, provides high quality, high value healthcare through its twelve hospitals, more than 180 ambulatory and service sites, and Priority Health, a health plan with over 700,000 members.

Our *Mobile Rounding App* is designed to improve the patient experience during their hospital stay after surgery. Our system consists of two distinct parts, a mobile app and a web app.

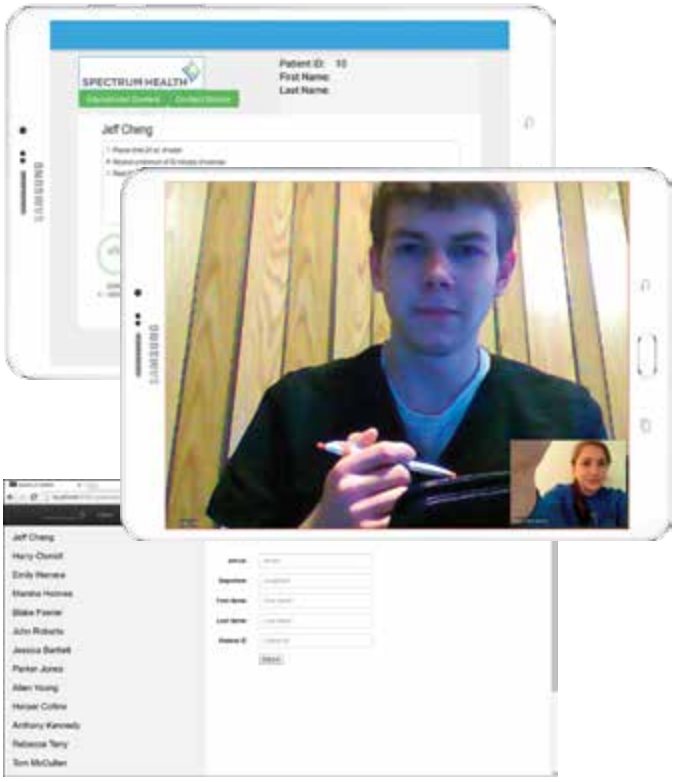
Our mobile app enables patients to contact their surgeon with concerns and questions. Patients can do this through a video call or a text message within our app. Each patient is provided with a personalized tablet to be used during their hospital stay.

In addition to contacting their surgeon, patients can view educational materials that pertain to their surgical procedure. They are also provided with a daily checklist of tasks they are expected to complete each day while they are recovering.

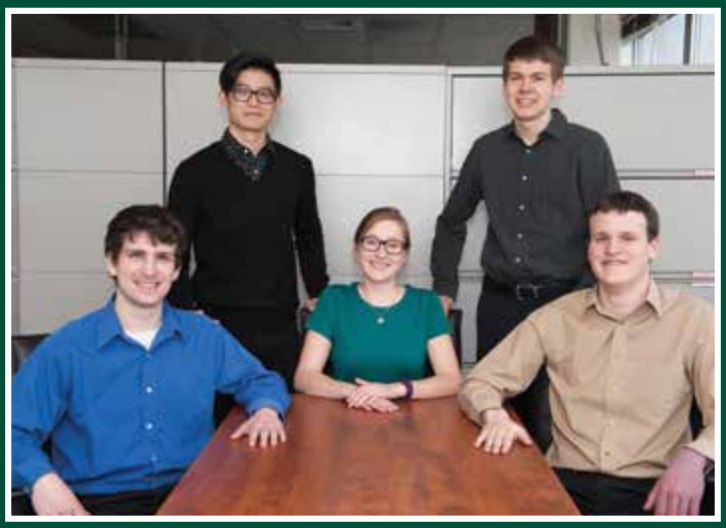
Surgeons like Drs. Jason Slaikeu and Peter Beaulieu, vascular surgeons at Spectrum Health and our project collaborators, use the *Mobile Rounding App* on their tablets to answer video calls from their patients and exchange text messages with them.

Spectrum Health configures tablets and mobile apps for patients using our companion web app. Patient information is entered along with the checklist of tasks to be completed during recovery from surgery.

Our *Mobile Rounding App* is written in Java and C. The web app runs on the ASP.NET Web API and is written using JavaScript with the AngularJS framework, HTML and C#. Our platforms are supported on the backend by a MySQL database.



SPECTRUM HEALTH



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TechSmith
Cloud Based Video Face Tracking

TechSmith provides countries all around the world with screen capture and recording software for individual and professional use. Their products make it easy to create compelling, polished content that's ready to be shared with anyone.

When sharing videos in a public or legal setting, the need to blur faces often arises. A typical process of blurring faces in a video requires frame-by-frame editing, which is extremely tedious and very time consuming.

With our Cloud Based Video Face Tracking software, face blurring is done automatically, quickly and with ease.

For example, suppose a user needs to produce a video containing the faces of protected witnesses for a court hearing. A user begins by logging onto our website and uploading their video into their video library.

Once selected, the video is displayed with all faces automatically tracked. On a face-by-face case, the user then chooses to blur the face, highlight it or leave it as is.

Manual editing is available in case a face is lost or tracked incorrectly.

When finished, the blurs and highlights are rendered into the video. The user can either save it for further editing or export it.

Our Cloud Based Video Face Tracking software is an ASP.Net MVC 5 web app written in C#. The app along with the underlying SQL database is hosted on Microsoft Azure. Face tracking and video encoding, decoding and editing is supported by the OpenCV API via EMGU.

TechSmith®

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Union Pacific

Oculus Rift Inspection and Training Tool

Union Pacific Railroad is the principle operating company of Union Pacific Corporation. Connecting 23 states in the western half of the country with over 32,000 miles of track, it is one of America's leading transportation companies.

Working with large machinery such as locomotives is dangerous, especially for new employees. To minimize the risk of job-related injury, Union Pacific uses sophisticated training simulators to help trainees familiarize themselves with the operation of railroad equipment.

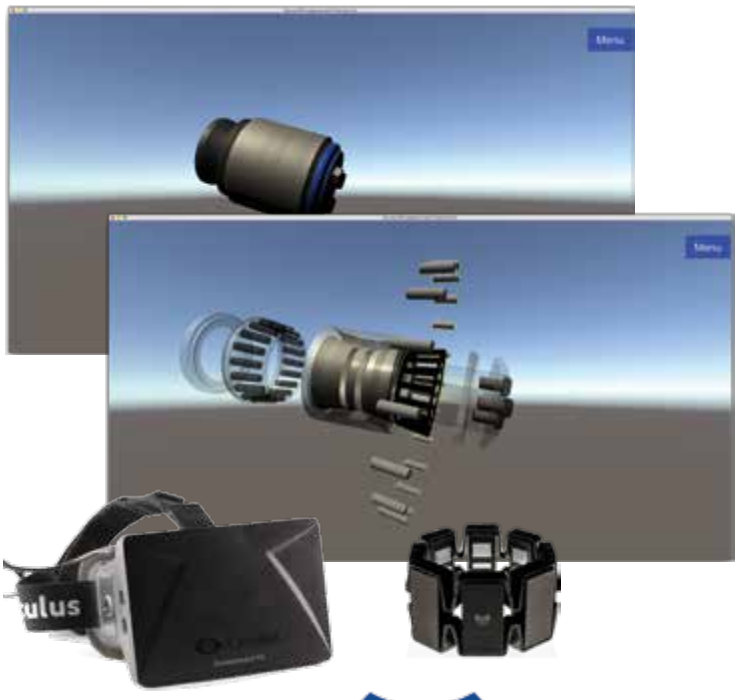
Our *Oculus Rift Inspection and Training Tool* is the latest in virtual reality training software, providing an immersive experience for Union Pacific employees without the risk of working with dangerous equipment.

Our system features two modes: Free View and Guided Lessons.

In Free View, trainees explore the structure of locomotives and other railroad equipment. They interact with these models by rotating them, playing animations of moving parts, and "exploding" the models to view individual components.

Guided Lessons provide trainees with a structured tour of the models complete with audio voice-overs and periodic quizzes to test their knowledge. For example, a trainee might be asked to identify a broken part of a locomotive before continuing.

Our *Oculus Rift Inspection and Training Tool* is an app for both Macs and PCs, powered by the Unity3D gaming engine and written in C#. It uses the Oculus Rift virtual reality headset and Myo Armband gesture controllers to give users a hands-on feel.



UNION PACIFIC

BUILDING AMERICA®

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Urban Science
Dealership Inventory Solution

Urban Science delivers consulting and software solutions that help automotive clients increase market share and boost profitability through high performing retail networks.

Automobile dealerships are responsible for purchasing their own inventory from their manufacturer. The dealer's goal is to purchase the correct quantity and selection of vehicles so as to optimize profitability and provide maximum customer satisfaction.

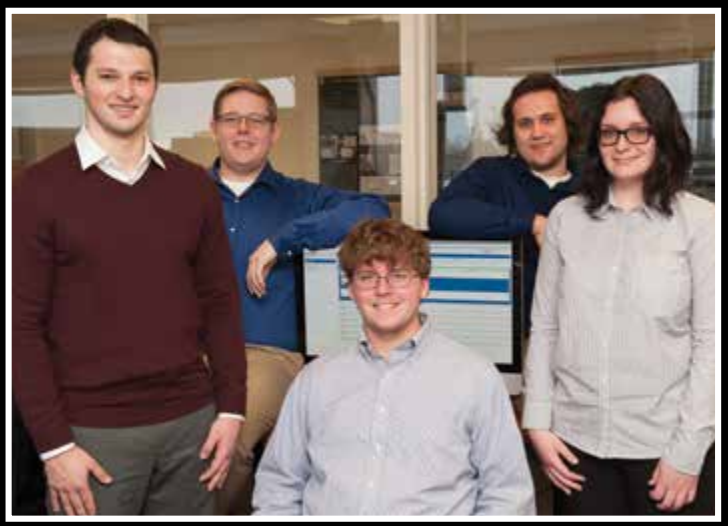
Dealers must consider many factors before making a purchase, such as consumer demand, current inventory and manufacturer allotments.

Our *Dealership Inventory Solution* provides a web application that enables dealers to optimize their purchasing power by making inventory purchasing recommendations. The system considers many factors, while still allowing the dealer to make the final decisions. Our web app also consolidates multiple systems by showing dealers their current and on-order inventory.

In addition to the web application, our system includes Apple and Android phone apps for dealership customers to view a dealer's inventory. Customers can not only determine whether a particular car is in stock, but can also find out where that car is on the dealership lot.

Our web app is built with Bootstrap, AngularJS and jQuery, with a Microsoft SQL Server database. Our mobile apps are built with Ionic, which uses AngularJS, CSS and HTML to deploy versions of our app to both Apple and Android devices.

URBAN SCIENCE



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Whirlpool Corporation
Mobile Product Catalog

Whirlpool Corporation is the number one manufacturer of major appliances in the world, with approximately $20 billion in annual sales in some 170 countries around the world.

Whirlpool markets their products under a number of well-known brands including Whirlpool, KitchenAid, Maytag, Consul, Brastemp, Amana, Bauknecht, Jenn-Air and Indesit.

Whirlpool sells its products through a variety of retail outlets such as Best Buy, Home Depot and Lowes.

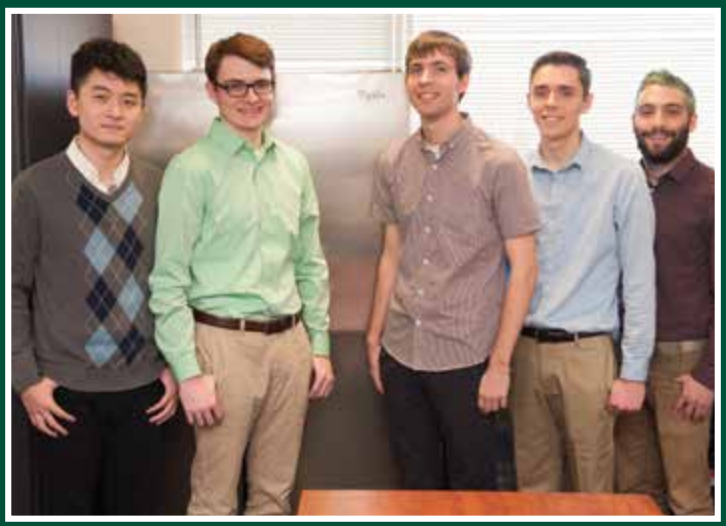
Our *Mobile Product Catalog* provides sales associates with a quick and easy way to obtain information for their customers about any Whirlpool product using their Apple or Android phones or tablets.

Our app shows appliance specifications, key features, images and other information for every Whirlpool product. As a result, sales associates spend less time searching for information and more time guiding their customers through the purchase of a home appliance that is right for their lifestyle.

Specific Whirlpool products are found either by searching by name or by browsing through categories of appliances. Filtering narrows the searches. Appliance features can be compared side by side. Sales associates can share search results with their customers via email and text messages.

Our *Mobile Product Catalog* is implemented in Swift and Java for Apple and Android devices, respectively. We use Google Analytics to provide Whirlpool with big data analytics on consumer interactions with the app.

Whirlpool CORPORATION



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Joe Schoenherr
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Jeffrey Stoller
Benton Harbor, Michigan

Carl Wendtland
Benton Harbor, Michigan

Yello

Syncing Mobile Data Without Internet Connectivity

Based in Chicago, Yello specializes in talent acquisition software designed for companies to collect, organize and search for information about potential job candidates.

Yello's software includes mobile applications used globally at large career fairs. Candidates submit resumes on recruiter tablets during the career fair. Company recruiters then access candidates' resumes and record notes about each.

Companies often have multiple recruiters at job fairs. In this case, the information on all of the candidates is kept synchronized and up-to-date across all of the mobile devices of each company using a wireless Internet connection.

Unfortunately, at some career fair venues there are no wireless Internet connections, while at others the connections are not reliable, causing information synchronization to fail.

Our *Syncing Mobile Data Without Internet Connectivity* system provides wireless network connectivity between mobile devices without a wireless Internet connection. Our software works for both Apple and Android phones and tablets.

At a career fair with limited or no Internet connectivity, one recruiter from a company creates a wireless private network session. Other recruiters from the same company then join that network so that all of the candidate information is synchronized between all of their devices seamlessly.

Our *Syncing Mobile Data Without Internet Connectivity* system uses the NSCoding and WifiDirect networking libraries and is written in Swift and Java for Apple and Android devices, respectively.

yello

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Tanner Stewart
Traverse City, Michigan

Min Weng
Clinton Township, Michigan

Yello
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Chicago, Illinois

Josh Feinberg
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Rob Timpone
Chicago, Illinois

Jason Weingarten
Chicago, Illinois

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 Insurance 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 GM
Global Service Desk Mobile App

Corbin Rangler, Sean Rabaut, Evan Hlavaty, Brian Hart, Michael Palmer
Presented by Scott Lake

MSU Federal Credit Union 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 MSU Federal Credit Union Praxis Award, which is sponsored by MSU Federal Credit Union of East Lansing, Michigan.

Team Symantec
Integrated Silent Authentication via Symantec VIP

Dan Parlin, Scott Binter, Tyler Erskine, James Mariani, Chris Perry
Presented by Samantha Ambergy

Design Day Judges

Samantha Amburgey
MSU Federal Credit Union

Garret Gaw
Amazon

Elizabeth Klee
Urban Science

Justin Walker
GalaxE.Solutions

Mike Drazan
The Toro Company

Adam Haas
Ford Motor Company

Rob McCurdy
Michigan State University

Dave Washburn
MSU Foundation

E. J. Dyksen
Mutually Human

Louise Hemond-Wilson
IBM

Pat McQueen
Salesforce.org

Mark Welscott
Spectrum Health

Rich Enbody
Michigan State University

Fred Killeen
General Motors

Marty Strickler
Rose Packing Company

Karen Wrobel
Fiat Chrysler

TechSmith Screencast Award

TechSmith®

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 TechSmith
Intelligent Real World Text Recognition

Deb Deb, Max Miller, Cody Pearson, Whitney Mitchell, Jordyn Castor
Presented by Dewey Hou

Urban Science Sigma Award

URBAN SCIENCE

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 Spectrum Health
Patient Service Delivery Planning

Chaz Bean, Josh Curl, Justin Oh, Jim Torres, Luke Stanton
Presented by Elizabeth Klee and Mike DeRiso

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DO BOTH AT GM.

There's an unmistakable momentum happening at GM. Now, more than ever, we're poised to shape the future of tomorrow, today. From robust IT initiatives to shortened software development cycles, GM is defying convention to elevate the automotive industry as we know it. Bring your ideas and lend your experience to an international company that's as excited about your success as we are our own. Take the next step in your career at GM and discover what our employees already know — that together, there's no stopping us.

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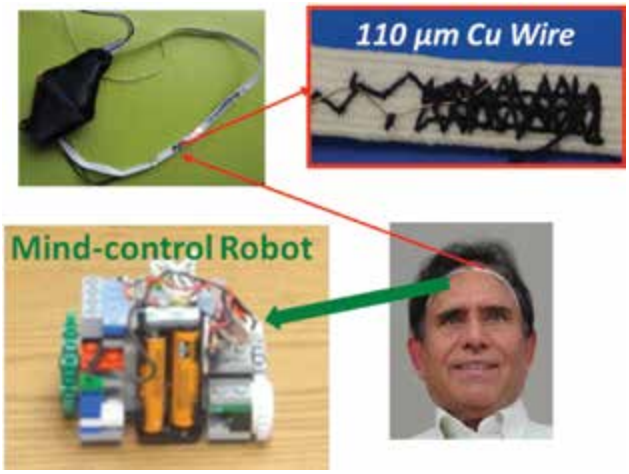
ECE 101
Introduction to Electrical and Computer Engineering

Dr. Dean M. Aslam
Professor of Electrical and Computer Engineering

Lab Instructors:
Aseel Alinaizi
Sean Evans

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

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) mind-control robots, (c) program LEGO robot using C-code (MSP430 microcontrollers) and NXT controllers, (d) pH measurement using NXT sensors, (e) maple-seed robotic fliers (MRF) with onboard electronics, (f) location of bio-molecules using RFID, (g) renewable energy resources using windmill and solar cells, and (h) nanotechnology study using a LEGO gear-train.



Team Members	Project Title
Team #1 Tim Drangins, Franklin Pedro, Ramzy Smara	NXT Robot Sensors
Team #2 Kael Fineout, Umut Kaplan, Curtis Williams	Renewable Energy Resources
Team #3 Cody Campeau, Nicholas Frechette, John Nesbitt	NXT Robot Sensors
Team #4 Anthony Elenbaas, Brett Roginski	Maple-Seed Robotic Fliers (MRF)

ECE 410
VLSI Design

Dr. Fathi M. Salem
Professor of Electrical and Computer Engineering

A Programmable Filtering Module in CMOS ICs

Integration of sensors (microphones or camera) with quick decision on-the-fly leads to many appealing applications in new generation smartphones. Example applications are in speech recognition, natural language processing, language translation, image recognition, identifications, image tagging, navigations, etc. Simply, powerful and adaptive processing would assist the smartphone user with information, voice, image, and data. There are new forms (architectures and designs) of adaptive and/or programmable Finite-Impulse-Response (FIR) filters that if designed as modules into integrated circuits (ICs) could bring new capabilities onto the smartphone (and off of the cloud). There is also an added security benefit. This project is a recurrent theme from the last year Design Challenge where teams of students are to improve upon the architectural designs.

Each team of 4 to 5 Students in ECE 410 is challenged to design (from schematic to physical layout and verification) a programmable FIR filter (with 16 to 64 taps). The FIR filter architecture will be designed into an IC chip-die guided by the performance metrics. Each team will address the full sensory signal processing path and make decisions regarding processing the sensed physical analog signal in (i) purely analog mode, or (ii) mixed signal (digital/analog) mode, in order to best meet an optimized design. A complete CMOS module will be designed, simulated with layout, and verified using the industry standard Cadence VLSI design tools. The teams' project outcomes will be judged on their ability to satisfy several competing performance metrics: (i) execution speed, (ii) power consumption, and (iii) total die (module) area.

Team 1	Team 2	Team 3	Team 4
Theodore Chupp	Bowen Tan	Ian Grosh	Bradley Bukoski
Chans Head	Haojun Wang	Alexandria Marone	Paul Dionise
Christopher Huber	Tian Xie	Joseph Schmitz	William Miller
Austin Nolen	Yaoting Xu	Jeffrey Walthers	Lanea Williamson

Team 5	Team 6	Team 7	Team 8
Jiale Hu	Bo Li	Joseph Fabbo	Amanda Charris
Conor Eckler	Yan Liu	Dani Fernandez	Christopher Cummings
Samuel Scime	Alexander Marlow	Yun Lou	David Powers
Qiaoyi Yang	Dylan Marzolino	Rohan Panda	Michael Vitale
Ziwen Zhang		Zixiao Yu	

The Capstone Projects

Dr. Timothy Grotjohn
Professor of
Electrical and Computer Engineering

Dr. Lalita Udpa
Professor of
Electrical and Computer Engineering

Presentation Schedule – Rooms 2205 and 2250 Engineering Building, Second Floor

Room 2205	Team Sponsor	Project Title
8:10 a.m.	Dr. Wolfgang Bauer, MSU	In-shoe Weight Sensor
8:35 a.m.	Great Lakes Controls & Engineering	Aeroponic Control System for Efficient Growth
9:00 a.m.	Great Lakes Controls & Engineering and Conceptual Inovations	Regenerative Electric Driven Power Cart
9:25 a.m.	Student Developed Project	IV Assistant Robot
9:50 a.m.	Break	
10:05 a.m.	General Motors	Vehicle Interior Noise Measurement System
10:30 a.m.	ArcelorMittal	Conveyor Transfer System for Coils
10:55 a.m.	MSU RCPD, Asian Aid and Texas Instruments	Wheelchair Motor Control Circuit Design
11:20 a.m.	MSU RCPD and MSU Demmer Center	Other-than-sight Marksman Guidance System

Room 2250	Team Sponsor	Project Title
8:10 a.m.	MSU ECE Department	Agricultural Robotics Vehicle
8:35 a.m.	DTE Energy	Evaluation of Conductors in Primary Distribution
9:00 a.m.	Instrumented Sensor Technology	Vibration Energy Harvester
9:25 a.m.	MSU Voice Biomechanics Lab	Classroom Noise Monitor
9:50 a.m.	Break	
10:05 a.m.	Eaton Corporation	Accurate Position Measurement System
10:30 a.m.	Eaton Corporation	Localization System
10:55 a.m.	MotionControlShop.com	IntelliMotor
11:20 a.m.	Student Developed Project	Non-contact Temperature Sensor for the iPhone

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 AgBOT Competition, ArcelorMittal, Dr. Bauer, Conceptual Innovations, DTE Energy, Eaton Corp., General Motors, Great Lakes Controls and Engineering, Instrumented Sensor Technology, MotionControlShop.com, MSU Demmer Center, MSU Resource Center for Persons with Disabilities, MSU Voice Biomechanics Lab, and Texas Instruments. Thank you to each of these team sponsors.

ECE 480 Room 2205 | 2nd Floor **8:10 a.m.**

Michigan State University
In-shoe Weight Sensor

In an effort to become healthier, many people have begun to look to technology as a means of bettering themselves. The reason for the success of many of these devices is that they allow each user to individually track their progress towards becoming a healthier, more active person, becoming, in effect, a "personal trainer." To this end, Dr. Wolfgang Bauer, Department of Physics and Astronomy, Michigan State University, began to develop a scientific interest in the features of these many health-oriented devices. There are currently many devices available in this market, yet none that allow a user to track their weight without requiring them to step onto a scale. After consideration of possible solutions, the concept of an in-shoe force sensor was ultimately chosen as the best option.

By installing the device in a pair of shoes, the user would be able to view their weight throughout the day so long as they have their shoes on. In order to make the device more user friendly and commercially accepted, the shoe would also have to connect to a smartphone via a wireless connection. This would allow users to navigate a simple application in order to view the readout of their in-shoe weight sensor. By creating this novel device, a large gap that currently exists in health tracking devices would be filled and great strides could be made in the market.

MICHIGAN STATE UNIVERSITY

Michigan State University
Team Members (left to right)

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Mohamadou Diatta
Thiès, Senegal

Steven Criner
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Alexandra Mackenzie
New Haven, Michigan

Michigan State University
Project Sponsor

Dr. Wolfgang Bauer
East Lansing, Michigan

Project Facilitator
Dr. Virginia Ayres
East Lansing, Michigan

ECE 480 Room 2205 | 2nd Floor **9:00 a.m.**

Great Lakes Controls & Engineering and Conceptual Innovations

Regenerative Electric Driven Power Cart

The main goal of our project was to create a control system for a regenerative electric driven power cart. Our team wanted to impact companies in a revolutionary way where people do not have to put in as much effort into pushing heavy materials.

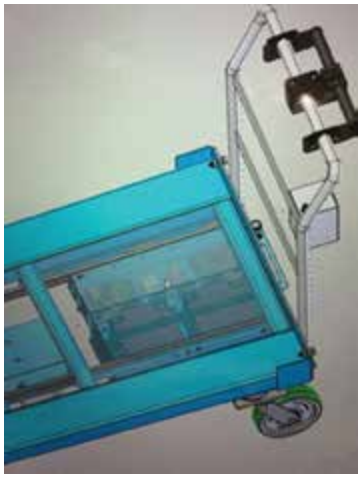
The purpose of having regenerative electric driven power carts is to help prevent the average worker from exerting lots of physical energy. The electric driven cart will allow the worker to easily move parts to their respective areas. It also provides its own regenerative power to last a full workday without plugging in to charge.

The electric driven power cart will be useful for many companies that have a lot of parts and supplies that have to be moved. This cart can withstand up to 8,000 pounds of material without slowing down in speed.

The electric driven cart is customer-friendly and has a controlled speed. This allows the user to only use two buttons: forward and reverse. Safety features such as an E-Stop button are also added to prevent injury.

The image pictured on the right shows where the control system will be placed on the cart. The control system will be on the bottom side of the cart with the control panel below the handlebar.

This project uses a fully programmable microcontroller, charge controller, and a motor controller. These three parts are all combined into one component.



Great Lakes Controls & Engineering

Conceptual Innovations
Engineering from Concept to Innovation

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Great Lakes Controls & Engineering and Conceptual innovations
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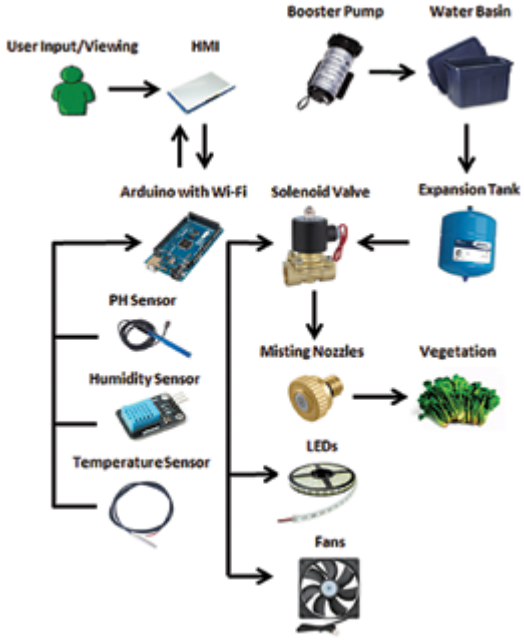
Great Lakes Controls & Engineering

Aeroponic Control System for Efficient Growth

Great Lakes Controls & Engineering is interested in developing an automatically controlled aeroponic system for growing leafy greens. They have tasked the ECE 480 Design Team 8 with developing a prototype. The intention is to eventually mass produce this system and make it available to all, so the team and sponsor hope that this prototype will lay the foundation for future work on further developing such a system for commercial use.

The main objective of this project was to create an automatically controlled closed-loop system for growing leafy greens in a small space. The plants will be grown aeroponically, which is to say that there will be no growth medium. Rather, the plants' roots will be suspended in air and sprayed with nozzles at regular intervals. The system water is stored in a tank below the growing area. The tank has a pump to boost the water to high enough pressure to push the water through the nozzles. Lighting for the system is provided by rows of LED lights suspended above the plants that produce the proper spectrum of light to ensure efficient growth.

The system is housed within an aluminum frame with a plexiglass enclosure for the roots and nozzles. It is controlled by the user through a Human Machine Interface (HMI) that interacts with various sensors, a solenoid valve, lights, and fans to control and monitor all aspects of the system through a microcontroller. The system runs off of 120VAC and is Wi-Fi accessible.



Great Lakes Controls & Engineering

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Great Lakes Controls & Engineering
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Student Developed Project
IV Assistant Robot

An area of potential improvement in the day-to-day operations of hospitals is the method by which intravenous (IV) therapy is currently administered. The typical IV pole, on which an IV pouch is attached to the patient via a line, is an area rife with potential improvement. These IV poles are unstable and difficult to move, especially for weakened, disabled, or otherwise incapacitated patients. This causes an unfavorable situation where patients must either struggle to move while on IV therapy, potentially tripping and falling, or must move with the help of a healthcare professional, which is inhibitive to both the patient's independence as well as the health care personnel's time and efforts.

We will address this issue by replacing the traditional IV pole with an autonomous robot capable of following the patient wherever they need to go whilst avoiding collision hazards. This robotic device must be able to accurately track the patient as well as the environment and to constantly adjust its position as is appropriate. Naturally, it will have to fulfill all of the load-carrying work of the traditional IV pole as well as to be able to do so at a speed that will accommodate a patient moving at walking pace.

This robot will be of a similar look and feel to a traditional IV pole, but with a robotic base to house all of the necessary motors, sensors, and other electronics. Other peripherals will include a wearable wristband that will serve as the tag that the robot will follow, and a charging base that the robot will sit upon while not in active use.

Michigan State University **Student Developed Project**

Team Members (left to right)

Vincent Zickefoose
Detroit, Michigan

Brandon Hart
East Lansing, Michigan

Lam Nguyen
Dewitt, Michigan

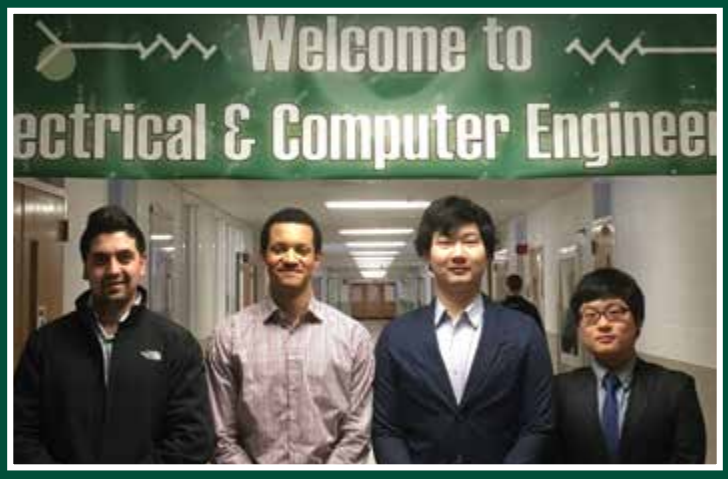
Bhim Khanal
Haslett, Michigan

ECE 480 Room 2205 | 2nd Floor **10:05 a.m.**

General Motors
Vehicle Interior Noise Measurement System

General Motors (GM) has been creating quality automobiles for over one hundred years. Since it was founded, the company has consistently been one of the largest manufacturers of automobiles. This is because consumers know that they will experience a comfortable and quiet ride whenever they choose a GM vehicle. Our project is centered around the company's quality assurance and improving the methods that automakers use to measure the interior acoustics of their vehicles while in operation.

Our team has created a system for measuring the interior noise levels of operating vehicles. This system ensures repeatable and reproducible results across multiple vehicles and driving terrains. Using this system, the team was able to take vehicle measurements to verify the correct operation of the system. The team was also able to provide insight into the engineering process used to develop this system, which can be used by GM to assist in the development of new SAE and ISO standards, as well as for government regulation.



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General Motors
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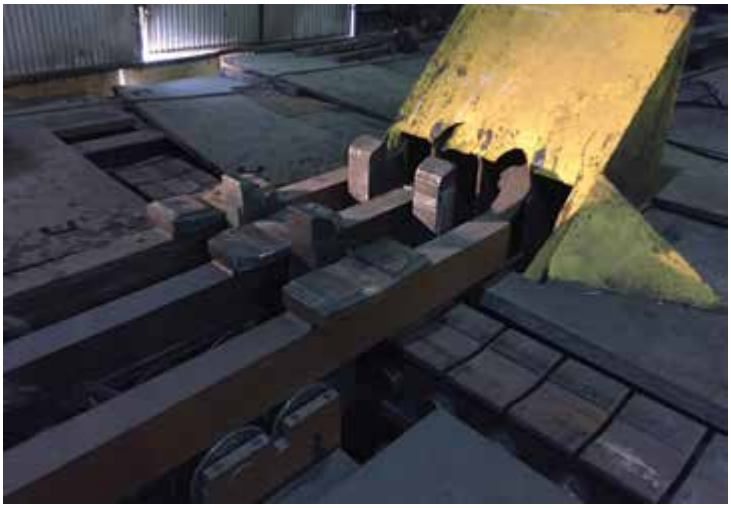
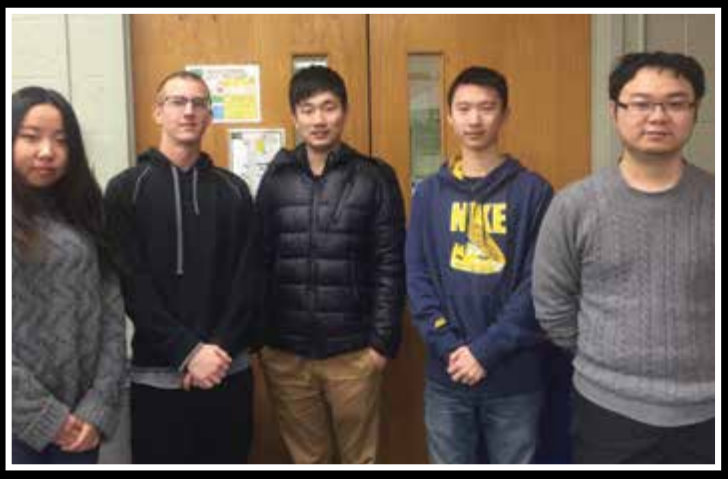
ArcelorMittal
Conveyor Transfer System For Coils

ArcelorMittal is the world's largest steel producer, producing almost twice the amount of steel of the next highest producer, at over 98 million tons in 2014. Its second largest plant in the US, located in Burns Harbor, Indiana, uses a series of conveyor belts to move the very heavy coils (up to 35 tons) from the hot mill to the finishing mill.

Today, an operator presses a button to stop the hot mill conveyor when the coils are positioned at the center of the lift. They are then lifted from their position on the conveyor by a lift system underneath the hot mill conveyor so the forklift system can get underneath the coils. Once propped up by the lift, the forklift attached to the finishing mill conveyor can move underneath the coils before the lift is lowered to set the coils on the forklift. The forklift can now move backwards towards the finishing mill conveyor, place the coil on the belt, and move back to its original position to repeat the process. Our team's goal is to eliminate the need for an operator by having a sensor acquire the position of the coil and automate the process by sending feedback to a microcontroller, which can process the signal and response to control the conveyor. An alarm is also initiated at the start of the transfer and runs for its duration to warn nearby employees that heavy machinery is being used to move the coils.



ArcelorMittal



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Arcelor Mittal
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Lauren Hart
Burns Harbor, Indiana

ECE Faculty Advisor
Dr. Hassan Khalil
East Lansing, Michigan

ECE 480 Room 2205 | 2nd Floor **10:55 a.m.**

MSU RCPD, Asian Aid and Texas Instruments
Wheelchair Motor Control Circuit Design

Electric wheelchairs are extremely vital to the well-being of many handicapped people around the world. These wheelchairs are typically powered using DC motors but these can be too costly for many of the impoverished people around the world and specifically the people of Bobbili, India.

ECE 480 Team 4 is proposing to develop an electric wheelchair that would use an automotive alternator in place of the DC motor, helping to make the wheelchair more affordable for the people of Bobbili.

The proposed design would convert an automotive alternator into a PMAC DC motor which would significantly reduce the cost while potentially producing more torque with better efficiency.

Team 4 will be improving on last semester's ECE 480 Team 9 project by implementing a drive microcontroller capable of detecting rotor position without the use of external sensors. This design improvement will decrease the cost of production. Also, additional functionality will be added such as reverse drive direction and regenerative braking.

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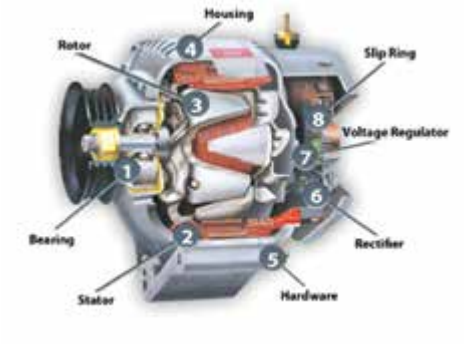

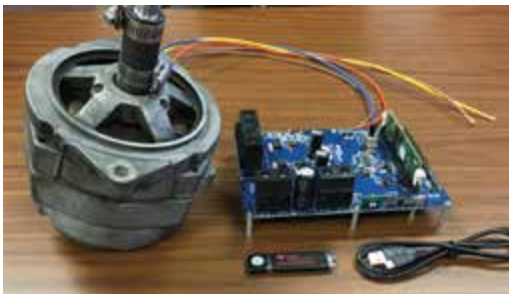

TEXAS INSTRUMENTS

AsianAID Give Hope TODAY

MICHIGAN STATE UNIVERISTY | Resource Center for **Persons with Disabilities**

Michigan State University
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MSU RCPD
Texas Instruments
Project Sponsors

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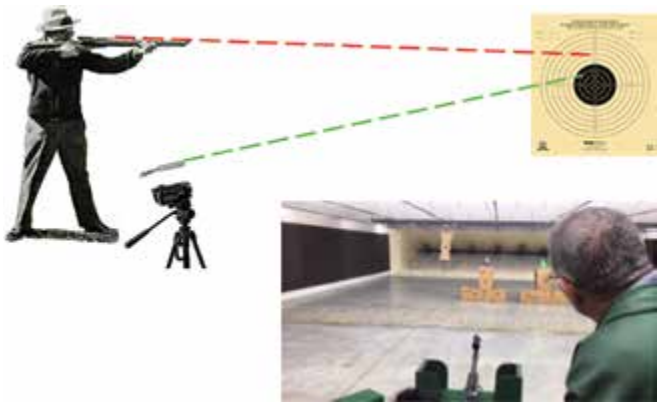
Dallas, Texas

MSU RCPD and MSU Demmer Center
Other-than-sight Marksman Guidance System

The overarching goal of the Other-than-sight (OTS) Marksman Guidance System (MGS) is to provide visually impaired persons with the ability to operate a firearm in a manner as identical as possible to a sighted shooter. Vision related disabilities commonly impede the use of devices developed around sight, barring participation in many activities such as marksmanship. By enabling visually impaired persons to engage in shooting activities, such persons will have the opportunity to enjoy an experience previously denied to them by their disabilities.

Beginning in January of 2015, the Demmer Center and the Resource Center for Persons with Disabilities (RCPD) began a collaboration to develop a method for visually impaired persons to operate a rifle. This resulted in a system utilizing a spotting scope, headphones, and a modified target. The magnification of the scope reduced the field of vision at 50ft to a much smaller area than the target. This allowed differentiation of the target from the background using a photo-resistor. Generation of audio feedback was used to indicate proper aim.

Functionality was far from refined, however. The OTS MGS vastly improves the effectiveness of its predecessor by utilizing computer vision and haptic (physical) feedback. A firearm-mounted laser is used to project the point-of-aim, while a second laser is used to "paint" the target. A digital camera and Raspberry Pi 2 microcontroller track the monochromatic light of the lasers on the target. Increased distance between the lasers is then communicated to the user via increased strength of vibration from an Eccentric Rotating Mass (ERM) motor.



DEMMER CENTER
Shooting Sports • Education • Training

MICHIGAN STATE UNIVERISTY | Resource Center for **Persons with Disabilities**

Michigan State University
Team Members (left to right)

Xuan He
Shanghai, China

Alexander Marlow
Holt, Michigan

Jiaming Ye
Shanghai, China

Dan O'Donovan
Troy, Michigan

MSU RCPD
MSU Demmer Center
Project Sponsor

Stephen Blosser
East Lansing, Michigan

ECE 480 Room 2250 | 2nd Floor **8:10 a.m.**

MSU ECE Department
agBOT Agricultural Robotics Vehicle

Agricultural robotics is an aspect of farming and agriculture that is growing rapidly as technology gets more in-depth. The idea of an agBOT (Agricultural Robot) is simply to take over the "mindless" work of planting seed over great distances; a job that farmers face day in and day out.

As part of Design Group 10, our goal is to manufacture, from the ground up, a scalable prototype of an agBOT. This scalable finished product will be size of an RC car, and the technologies we incorporate will be easily transitioned to a full size agBOT (a truck, bobcat, etc.) When our prototype is complete, a future team will be able to clearly see our design of the agBOT, a detailed layout and schematic of its subsystems, and our overall intent for the future of how the agBOT should function.

In the end, we plan to improve observation, intervention, and analytic data storage within agricultural work methods. This robot should be able to provide real-time video feed while it works, and be able to drive itself to user-inputted GPS coordinates.

A RC car, pictured on the right, was used because of its motor, its size, and the power associated with it. The best microcontroller is a Raspberry Pi. This device is a mini computer that can be programmed to do essentially anything, and is highly compatible with cameras, GPS, and motors. Everything is done within a $500 budget provided by our sponsor the MSU ECE Department.

DEPARTMENT OF ECE
ELECTRICAL AND COMPUTER ENGINEERING

Michigan State University
Team Members (left to right)

Jeff Walthers
Holt, Michigan

Joe Schmitz
Plymouth, Michigan

Nick Mirallegro
Ocean City, New Jersey

Wen Ni
Xiangtan, China

Eric Testa
Ocean Township, New Jersey

Sean Ellison
Grosse Ile, Michigan

MSU ECE Department
Project Sponsor

Prof. Timothy Grotjohn
Okemos, Michigan

DTE Energy

Evaluation of Conductors in Primary Distribution

DTE Energy Electric generates, transmits and distributes electricity to 2.1 million customers in southeastern Michigan. With an 11,084 megawatt system capacity, the company uses coal, nuclear fuel, natural gas, hydroelectric pumped storage and renewable sources to generate its electrical output. Founded in 1903, DTE Energy Electric is the largest electric utility in Michigan and one of the largest in the nation.

With regard to the distributed aspects of operation, DTE is working with Michigan State University to conduct a research project for a cost analysis of the operation of various overhead conductors used in primary power distribution systems.

The cost analysis will take into account not only the initial cost of purchasing and installing the conductors but also the cost incurred from the resistive power losses in conductor. The operating conditions of these conductors are a transmission voltage of 13.2 kV and loading between 8 MVA (typical) and 12 MVA (emergency).

A report will be generated for DTE outlining which conductor will be most economical for their purposes and the reasoning behind the recommendation. Along with the report, a tool will be produced in order to allow DTE to quickly and easily perform this cost-versus-loading analysis for other conductors and distribution systems.

DTE Energy
Know Your Own Power™

Michigan State University
Team Members (left to right)

James Wedell
Mason, Michigan

Aaron Noga
Jackson, Michigan

DTE Energy
Project Sponsor

Nelu Andrei
Detroit, Michigan

Project Facilitator
Dr. Joydeep Mitra
East Lansing, Michigan

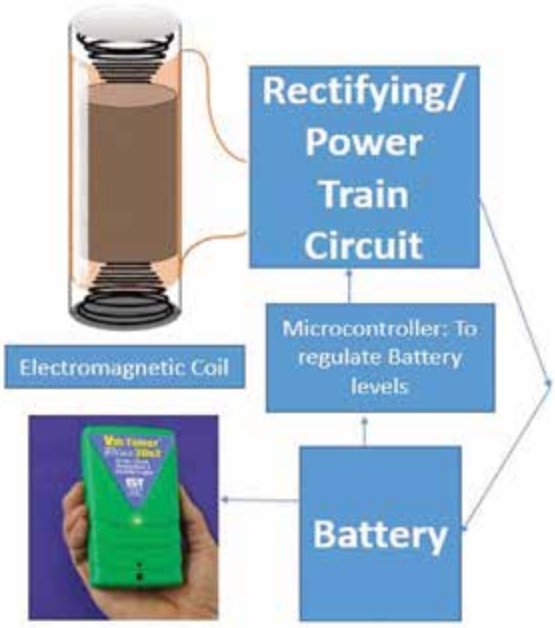
ECE 480 Room 2250 | 2nd Floor **9:00 a.m.**

Instrumented Sensor Technology
Vibration Energy Harvester

Instrumented Sensor Technology develops portable sensor devices that can monitor the vibrational environment of shipping vehicles. This information is used to ensure a certain standard when shipping products across the country. However, these devices have a limited operation life because they run on batteries. Batteries are an effective solution to supplying power to portable devices, but as power demands increase, batteries begin to fall short. Batteries are heavy, expensive, and require constant maintenance as they need to be changed every time they die.

Our project is to develop a device that can harvest vibrational energy present in the shipping vehicles where IST's portable sensor devices are implemented and convert this mechanical energy into electrical power to supply these devices. The ultimate goal is to prolong the battery life of these devices beyond their current lifetime or remove the need for batteries all together.

To do this we plan on harvesting the vibrational energy using an electromagnetic coil. Vibrations in the body of the shipping vehicle can be transferred to a magnet that passes through a coil. This will induce a current in the coil and provide a voltage swing which can be collected into a rechargeable cell.



IST Instrumented Sensor Technology

Michigan State University
Team Members (left to right)

Stephen Pliska
Novi, Michigan

Jovanni Ivanaj
Lake Orion, Michigan

Andrew Schroeder
Frankenmuth, Michigan

Tom Dochoda
Ann Arbor, Michigan

Daniel Fresneda-Rojas
Lansing, Michigan

Instrumented Sensor Technology
Project Sponsor

Greg Hoshal
Okemos, Michigan

MSU Voice Biomechanics Lab

Classroom Noise Monitor

The growing interest in the research of classroom acoustics is due to the effect that excessive noise levels can have on the cognitive development of young children. Both excessive noise and room reverberation negatively affect speech intelligibility in a classroom as well as the teacher's voice capabilities.

The goal of classroom noise monitor is to help students learn how to control their voices in the classroom. The monitor will measure the noise of the both teacher and students in the classroom by taking a reading from two microphones. One will be on the teacher's body, while the other will remain mounted on a wall or on the ceiling. The students will then get a reminder by the classroom noise monitor based on their noise level. This reminder will come to the students as colors on a traffic light: green for good, yellow for getting too high, and red for way too loud. This will hopefully help teachers keep their voices vibrant by not talking over the children all day.

The device proposed would achieve all of this by measuring the noise of the children and the voice of the teacher by means of sound pressure levels. Using voice segmentation, the microcontroller on the circuit will compute moments when the teacher is pausing between words, and use that pause to take a sample from the classroom microphone. The samples will be used to determine the noise level of the classroom during the teacher's pause and output the according action.

MICHIGAN STATE UNIVERSITY

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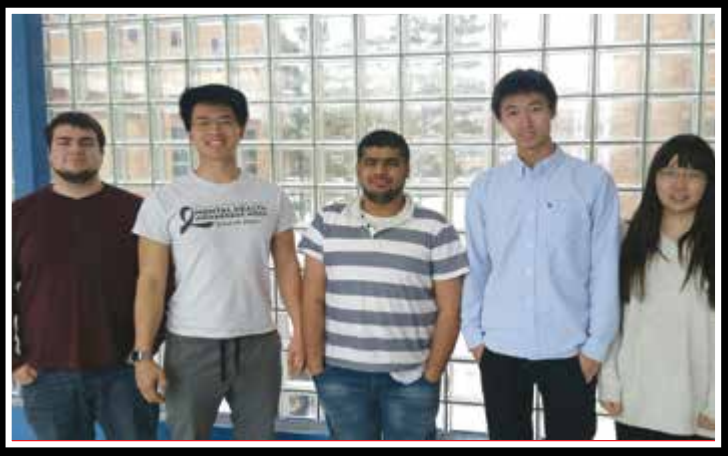


Michigan State University
Team Members (left to right)

Michael Vitale
Oakland, Michigan

Daniel Lau
West Bloomfield, Michigan

Abdullah Alsaadan
Saudi Arabia, Riyadh

Haiyang Hong
Shanghai, China

Yijun Yao
Shijiazhuang, China

MSU Voice Biomechanics Lab
Project Sponsors

Pasquale Bottalico
East Lansing, Michigan

Simone Graetzer
East Lansing, Michigan

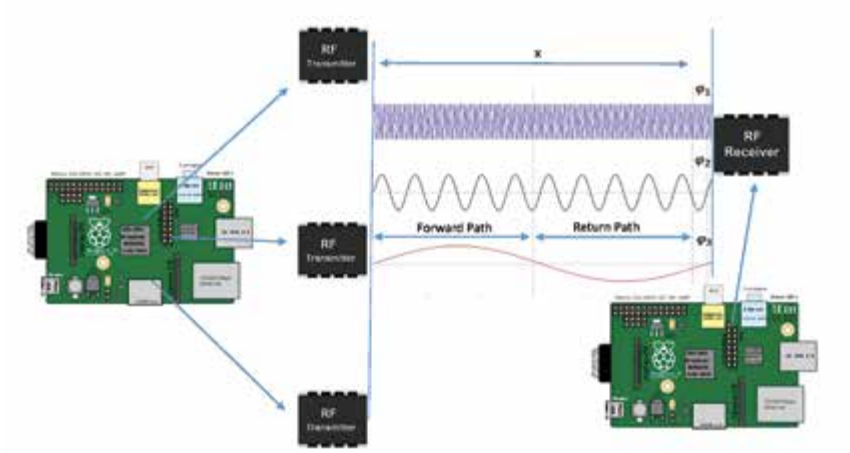
ECE 480 Room 2250 | 2nd Floor **10:05 a.m.**

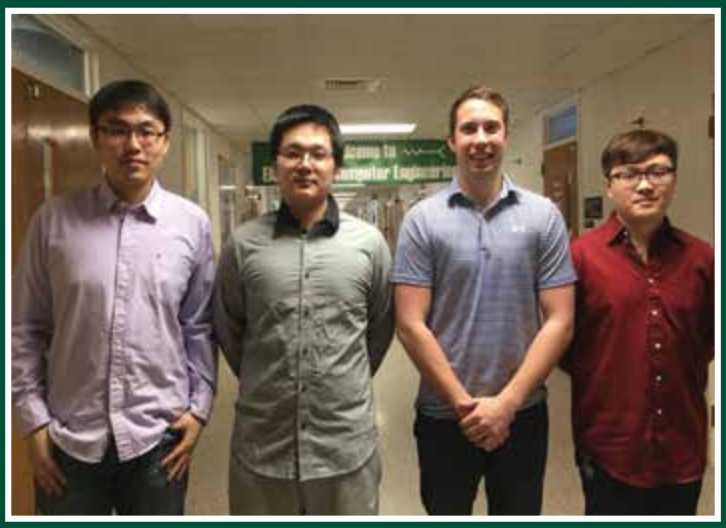
Eaton Corporation
Accurate Position Measurement System

Eaton Corporation is a multinational power management company that provides solutions to customers in managing electrical, hydraulic and mechanical power efficiently, safely and sustainably. Eaton Corporation needs a reliable way of determining the position of a truck from a pre-determined location within a truck loading bay.

Current position measurement products that operate with the degree of accuracy required by Eaton Corporation are very expensive and are often limited to military usage. Our team is developing a product that can detect the relative position between two objects using electromagnetic waves. The product will first determine the distance between the two objects by sending and receiving electromagnetic waves. The product will use three distance measurements in a form of triangulation to determine the position of the objects from one another.

The product will then be placed within a predetermined location within a truck loading bay and within a truck. As the truck enters the truck loading bay, the product will calculate and display the relative positon between this predetermined location and the truck to a human supervisor overseeing operations within the truck loading bay.





Michigan State University
Team Members (left to right)

Kun Qian
Zhejiang, China

Zixiao Yu
Guangdong, China

Erik Juziuk
Troy, Michigan

Miao Yu
Zhejiang, China

Eaton Corporation
Project Sponsor

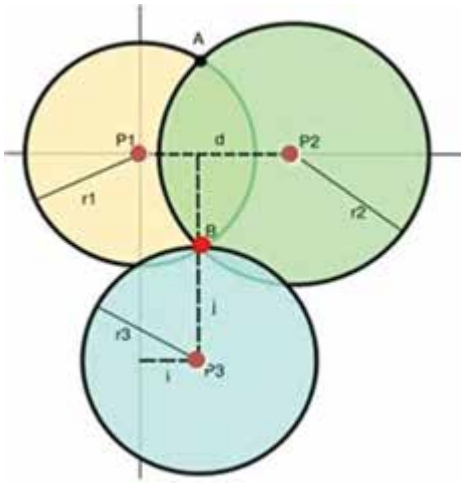
Rajeev Verma
Southfield, Michigan

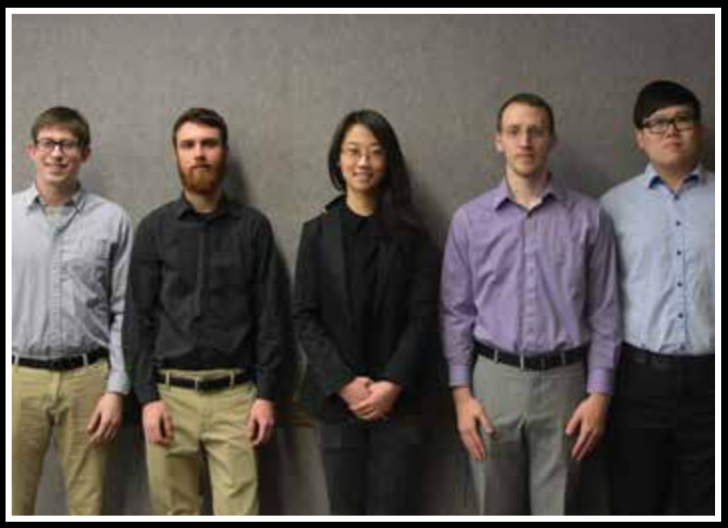
Eaton Corporation
Localization System

Eaton is a power management company with 2015 sales of $20.9 billion. Eaton has approximately 97,000 employees and sells products to customers in more than 175 countries. Eaton has an automotive division focused on commercial vehicle development, and the automotive segment produces products such as superchargers, engine valves, valve train components, cylinder heads, locking and limited-slip differentials, fuel, emissions, safety controls, transmission and engine controls, spoilers, exterior moldings, plastic components, and fluid connectors. For our project, Eaton wishes to deploy a low-cost localization system that can be easily integrated into commercial vehicle docking areas. Trucks will know precisely where their trailer tail is in relation to a known docking platform.

Ultra Wideband (UWB) technologies have become increasingly popular for developing a relatively accurate localization system with an error rate of 10 centimeters. Design Team 13 is working to create an application specific localization system using UWB that at production will cost less than $50.00. The accuracy is desired to be under 10 centimeters and able to localize a 100-meter area. UWB uses nanosecond pulses and a wideband frequency coverage which maintains accuracy without line-of-sight.

Five UWB enabled transceivers and a multi-lateration technique allow us to develop an accurate and reliable location system. Once the localization functionality is established, the team will carry out testing to measure accuracy of the system and validate functionality outside and inside buildings with vehicles and building walls blocking line-of-sight.





Michigan State University
Team Members (left to right)

Chris Huber
Marysville, Michigan

Caelan Fields
Atlanta, Georgia

Hanqing Wang
Qingdao, China

David Gilbert
Kalamazoo, Michigan

Zihao Wang
Tai'an, Shandong, China

Eaton Corporation
Project Sponsors

Kevin Snow
Galesburg, Michigan

Rajeev Verma
Southfield, Michigan

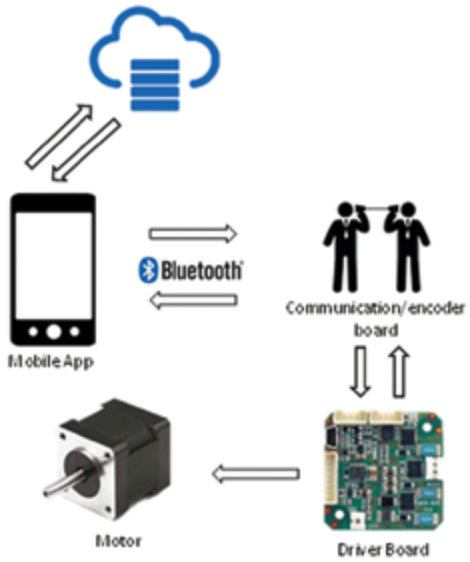
ECE 480 Room 2250 | 2nd Floor **10:55 a.m.**

MotionControlShop.com
IntelliMotor

Until 2015 there was a patent held by Animatics (Moog) that prevented manufacturers from integrating a closed loop controller/driver with a brushless motor. Since the patent expired, there have been multiple other manufacturers that have entered the market, but their solutions are often overly expensive and occupy too much space. The enclosures for the driver, controller, and encoder are much larger than the diameter of the motor, and their use of fragile optical encoders increases the amount of packaging needed on an already irregularly shaped device.

In industrial applications, it is common for dozens of motors to be located in hard to reach places, which makes updating firmware and altering code tedious and time consuming. On top of this, USB connections have been known to cause ground loop and level shift hazards, which can damage the motor systems.

To improve current designs, Team 15 created the IntelliMotor; a motor that is compact in size, and utilizes a Virtual Human Machine Interface in the form of an Android application. By using Bluetooth to eliminate wired communication, we improved safety and ease-of-use. The PCB receives datagrams from the vHMI and forwards signals to the driver board. In tandem with the PCB, Team 15 created an Android app that sends datagrams via Bluetooth and saves scripts to the cloud.



MOTION CONTROL SHOP

Michigan State University
Team Members (left to right)

Joe Stephan
Plymouth, Michigan

Chans Head
Pinckney, Michigan

Angelica Minissale
Novi, Michigan

Theo Chupp
Ann Arbor, Michigan

Barend Ungrodt
Saint Joseph, Michigan

Motion Control Shop
Project Sponsor

Mike Head
Pinckney, Michigan

Project Facilitator
Dr. Tongtong Li
East Lansing, Michigan

Student Developed Project

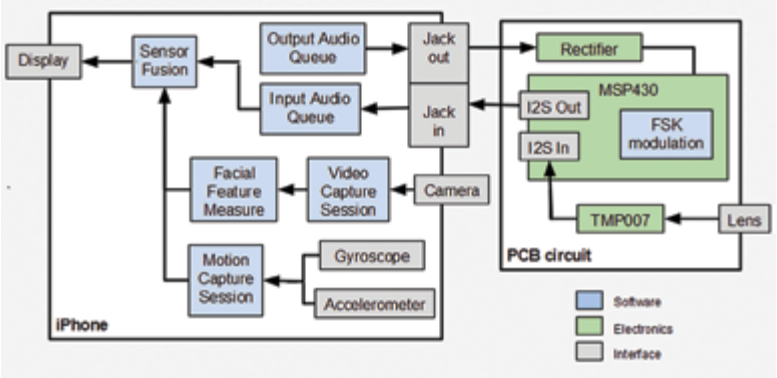
Non-contact Temperature Sensor for the iPhone

Not many advances in temperature measuring technology have been made in the medical field since the invention of the mercury thermometer. There is an infrared temperature measurement gun found in industrial settings, but these devices are not accurate enough to be used for body temperature. The instant in-ear thermometer is the most common medical temperature device; however, this is contact-based and does not utilize a means to store temperature results.

Therefore, the goal of this project is to design a device to reduce contact with the potentially sick and create a storage space for test results. The device will trade some of the features common among commercial and industrial grade non-contact temperature sensors for a less costly device in terms of materials and power consumption.

The project applications focus on Personal Health and Wellness, and improving medical tools for clinics. Keeping a personal record aids with providing a complete and accurate summary of an individual's medical history. Data from these electronic devices can be collected from a smartphone and shared with medical institutions and hospitals worldwide. This grants patients access to a wide range of health information sources, the best medical practices, and health knowledge.

The system consists of a temperature sensing circuit that includes a microcontroller and temperature sensor. The circuit interfaces with an iPhone and a mobile application for processing the data and communicating with the network.



Michigan State University
Team Members (left to right)

Anna Little
Saint Louis, Michigan

Ian Bacus
Portland, Oregon

Craig Stoddard
Hartland, Michigan

Yousef Gtat
Benghazi, Libya

Anishpal Gill
Sterling Heights, Michigan

Yujie Hao
Shandong, China

Student Developed Project

Project Facilitator
Dr. Ramakrishna Mukkamala
East Lansing, Michigan

Design Day Awards Fall 2015

Electrical & Computer Engineering Prism VentureWorks Prize & Winners, Fall 2015

Prizes 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.

Prism VentureWorks First Place: Team Great Lakes Controls & Engineering Incoming Power Grid Monitoring

left to right:
Zhihoug Qian, James McCormick, Victor Tobenna Ezenwoko, Alex Lange, Jacob Jebb

Prism VentureWorks Second Place: Team MSU RCPD E-bike Motor and Controller

left to right:
Joshua Lamb, Alex Sklar, Myles Moore, Tyler Borysiak, Stephen Dunn

Prism VentureWorks Third Place: Team Dr. Satish Udpa RFID Luggage Tagging and Tracking

left to right:
Henry Nguyen, Emmanuel Wadieh, Brian Prange, Ziye Xing, Marwan Baraya

ME 371 Mechanical Design I

Dr. Brian Thompson
Professor
Department of Mechanical Engineering

Dr. William Resh
Professor
Department 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

Team 1
Abdullah Alluhaidan
Mohsen Al-Qamber
Hashim Hanis

Team 2
Zhongyu Shi
Yi Wei
Tianhang Xu
He Yan

Team 3
Pranay Chaturvedi
Evan Cummings
Ryan Kruzel
Shane Neal

Team 4
Brenna Bolton
Andrew Brockman
Elizabeth Davidson
Michael Popielec

Team 5
Michael McAtee
Michael Reynolds
Andrew Roach

Team 6
Stephen Camilletti
Emily Donohue
Sarah Sonego
Jonathan Zofchak

Team 7
Martyna Cieslak
Joseph Rombach
Anna Sommerfeld
Brian Wingate

Team 8
Pronob Biswas
Bijan Masrouri
Zachery Osisek
Jalaj Prakash

Team 9
Joshua Borton
Jacob Khodl
Kristian Rego
Richard Simon

Team 10
Karl Fischer
Andrew Hieber
Eric Martin
Gray Ritchey

Team 11
Marissa Grobbel
Rachael Kain
Vincent Pahl
Tess Reed

Team 12
Yuchen Ni
Yu Sang
Yuanyaun Wang

Team 13
Brian Clark
Thomas Kobak
Hai Nguyen
Michael Okuniewicz

Team 14
Tyler Bauder
Thomas Griffith
Jacob Overla
Jacelyn Pozniak

Team 15
Kaiwei Chen
Xinyu Mao
Lei Xu

Team 16
Edward Clark
Jonathon Howard
Cody Kelly
John LeFevre

Teams and members: Section 2

Team 1
Alexander Athens
Austin Krauss
Tyler Nicolay
Andrew Tran

Team 2
Benjamin Childs
Steven Collareno
Mitchell Heinz
Austin Payne

Team 3
Oscar Castro
Angela Dobrzelewski
Aaron Gordon
Matt Marsh

Team 4
Faisal Alhuwemel
Shiyao Liu
Hoi Ho Hawke Suen
Mingyu Wang

Team 5
Thomas Baldwin
Brennen Burns
Zachary Decker
Xiaonan Liu

Team 6
Kevin Glime
Matt Strzalkowski
Jake Wojnicki
Courtney Zimmer

Team 7
Alex Holtshouser
Jonathan Katt
Douglas Kubiak
Jiayi Li

Team 8
Conner Archey
Anthony Ethridge
Matthew Norman
Matthew Rist

Team 9
Allison Bakka
Ping Ni
Matthew Pottebaum
Pengfei Zhao

Team 10
Daniel Burchart
Joseph Hartford
Carly Head
Sarah Whitney

Team 11
Leah Iseler
Devon Leasher
Ashley Wilkey
Adam Ziemba

Team 12
Jacob Flight
Ihn Hur
Joseph Snay
Mark Vanpoppelen

Team 13
Jennifer Carmichael
Jacob Huver
Brooke Otterbein
Jacob Schoenborn

Team 14
Shayne Maguire
Zhaoqiang Mi
James Oconnor
Zhiwei Wu

Team 15
Leah Mondro
Amanda Pfutzenreuter
Daniel Setili
Amy Sutton

ME 412
Heat Transfer Laboratory

Chris Paul, Academic Specialist - Teaching
Mechanical Engineering

Enhanced Cooling of Microprocessors

Microprocessors play an integral part in our daily lives, through the functions they perform in devices such as microwave ovens, automobiles, computers, cell phones and televisions. A critical factor in their continued development and utilization is the maintenance of their operating temperatures at acceptable levels, as they produce heat that must be dissipated. In this ME 412 design project, we explore efficient ways of enhancing the heat transfer from an electrically heated plate, as a surrogate for a microprocessor.

Each team is to design, analyze, build and test a heat transfer device to minimize the operating temperature in the center of the upward-facing side of an electrically heated plate. The electrically heated plate comprises a flexible heater sandwiched between two thin horizontal metal plates. A box fan is available to provide an airflow within a specified velocity range, which may be used to augment the heat transfer. The objective of the project is to minimize the operating temperature of the plate when 20 Watts of power is supplied, subject to cost, weight and size constraints.

Competition Schedule

Time	Station A	Station B	Station C	Station D
8:00 a.m.	Haochen Li Michelle Lou Zhi Hong Phuah	Stephanie Dejong Rachel Geary Rachel Horstman	Matthew Knudtson Logan Springgate Eric Waldron	David Bernier Nathan Fedewa Connor Montgomery
8:20 a.m.	Shaoyu Han Richard Harrington Akiem Harshman	Andrew Crechiolo Leo McLaughlin Andrew Stanny	Eric Bargiel Jacqueline Frey Matthew Igo	Patrick Frahm Michael Kron Michael Wicker
8:40 a.m.	Julia Briggs Sarah Parsons Aaron Smith	Daniel Cornelius Lucia DelVillano Jiewen Huang	Eric Buday Lindsay Clark Kathleen Landwehr	Zachary Abbott Alexandria Allman Michael Schwartz
9:00 a.m.	Sapan Patel Dominic Waldorf Robert Zuerlein	Elizabet Gojcaj Daniel Lumley Mitchell Obrien	Evan Bushman Brice Furr Lance Roth	Naomi Carlisle Chase Gunderud Paul Miller
9:20 a.m.	Tyler Karp Joseph Savage Ian Waugaman	Jacob Pusheck Andrew Slatin Aleksandr Vartanian	James Cuthbert Axel Ivers Davis Trapp	Bingchen Chi Tunan Guo Jessica O'Brien
9:40 a.m.	Nickolas Aguayo Taylor Forbush Andrew Gregg	Cody Thon Shenzhou Xin Tingyuan Zhang	Jonathan Bianchi Reace Head William Kang	Anthony Kobak Abhimanyu Singh Bradley Trublowski
10:00 a.m.	Nicole Bruggema Tim Smith Matthew Sutter	Ryan Blancke Benjamin Rowley Philip Skinkle	John Danielson David Dudley Benjamin Yancho	Gregory Peterson Lee Teasley Steven Ward
10:20 a.m.	Stephen Saksa Jason Vismara Robert Warfield	Brian Cobus Matthew Maier Haoyu Wang	Bashaier Alsinan Vikram Mandelia Gerald Rivkin	Daniel Summers Zhengyuan Xie Nicholas Youngerman
10:40 a.m.	Shannon Grace Steven Lund Charles Pynnonen	Peter Howes Steven Price	Daniel Blair Quinn Putt	Katherine Arends Maxwell Bennett Nicholas Scibilia
11:00 a.m.	NickChocko Matthew Klooster Joseph Latorre	Zackary Hickman Hiroya Miyoshi Alexander Taylor	Blake Hatherley Tim Mijnsbergen Eric West	Michael Doa Max Dunigan Andrew Kalina

8:30 a.m. - 11:50 a.m. Room 1345 | First Floor Mechanical Engineering

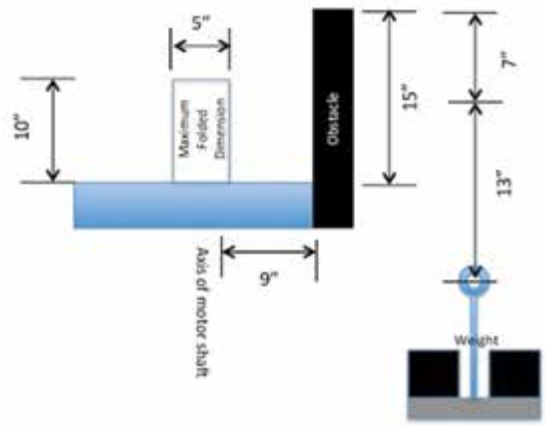
ME 471 Mechanical Design II

Dr. Patrick Kwon
Professor of Mechanical Engineering

Dr. Dahsin Liu
Professor of Mechanical Engineering

Motorized Extending Crane

The goal of this project is to design, build and test a scale version of a crane that extends to raise a weight as shown in the accompanying figure. The system should be designed and manufactured to lift the maximum weight possible with the minimum system mass and cost, while maintaining a smooth and controlled motion. The power input is a single motor attached to the system, though additional inputs are allowed with penalties. The folded dimensions of the crane must not exceed 10" H x 10" W x 5" D. All structural components and fasteners (mechanical only – no welding) must be of steel or aluminum. The deployed crane must extend beyond the 15"-high obstacle and reach down 7" to hook the weight in no more than 60 seconds, and raise the weight within a further 60 seconds.



Time	Team	Station	Team members
8:30	1	A	Daniel Blair, Samuel Boyea, Alexander Caine, Olivia Weprich
	1	B	Adam Anderson, Shane Frakes, Alexander Kowal, Takahiro Yuasa
8:40	2	A	Nicole Bruggema, Christopher Churay, Wesley Dorin, Qilin Zhu
	2	B	Alyssa Bartlett, Michael Gaduski, Jacob Krummrey, Daniel Riggs
8:50	3	A	Jared Abood, Connor Daly, Zachary Dutcher, Shuowei Geng
	3	B	Andrew Benson, Matthew Gagnon, Wesley Lanigan, Guangchao Song
9:00	4	A	Daniel Busch, Brendan Fitzpatrick, Joseph Genoa, Mark Hartfelder
	4	B	Andrew Boyer, Evan Gallagher, Sahem Marji, Alexander Starbird
9:10	5	A	Sagar Dangal, Karan Ghuman, Shane Hessling, Matthew Hitch
	5	B	Cody Bradford, Brittany Galliers, Jack Mcdougall, Tyler Stricker
9:20	6	A	Jacqueline Frey, Qiren Gao, Kendra Martin, Ian Mular
	6	B	Joseph Brooks, Daniel Garberding, Yewei Jiang, Erik Mcguire
9:30	7	A	Nicholas Goguen, Yuzhou Gu, Kyle Hawkins, Stephen Moye
	7	B	Luyi Chen, Trevor Gilmartin, John Mclaughlin, Gueorgui Tzourov
9:40	8	A	Martin Dwornick, Paul Heeder, Abigail Henning, Leah Nonis
	8	B	Stephen Covitz, Matthew Hart, David Meleca, Shangyou Zeng
9:50	9	A	Kyle Foco, Daniel Lumley, Andrew Morgott, Christopher Slamp
	9	B	Herbert Darrow, Kyle Moeller, Jeremy Reisig, Yuheng Wang
10:00	10	A	Alexandra Morford, Nathaniel Noel, Jesse Ouellette, Aaron Urbonya
	10	B	Tyler Draggoo, Yu He, Trevor Herrinton, Jacob Neubecker, Steven Ward
10:10	11	A	Rachael Acker, Lindsay Nault, Kyle Ringwelski, Richard Tran, Morgan Weber
	11	B	John Ellbogen, Alexander Ho, Joshua Neubecker, Evan Weider
10:20	12	A	Mark Becker, David Jagow, William Kelly, Matthew Schomisch, Haonan Zhou
	12	B	Kevin Ellis, Maryrose Jakeway, Eric Olsen, Andrew Wandor, Penghao Wu
10:30	13	A	Saad Bahbishi, Jonathan Bianchi, Abigail Livingston, Daniel Summers
	13	B	Brandon Fortman, Jennie Parrish, Jordan Timm, Trevor Young

Weigh Team Projects (8:00 a.m. - 8:30 a.m.)
Break (10:40 a.m. - 11:10 a.m.)
Semi Final Competition (11:10 a.m. - 11:40 a.m.) - #3 vs #4
Final Competition (11:40 a.m. - 11:50 a.m.) - #1 vs #2

ME 478
Product Development

Dr. Patrick Kwon
Professor of Mechanical Engineering

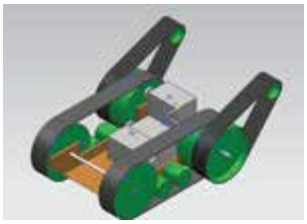
Stair Climbing Vehicle

The objective is to design and build a vehicle that climbs up and down stairs, as part of a project which integrates engineering knowledge gained during the students' education at MSU. Starting as an individual project and evolving into a team project, each team produces a vehicle by accomplishing a series of design and manufacturing tasks. Students contribute both individually and collaboratively to accomplish these tasks using CAD/CAM packages, CNC machining, 3D printing, etc. When the vehicle has been built, a control system is designed and implemented using the MyRio platform for remote operation via the engineering wireless network.

Teams and Members

Enterprise:

Reace Head
Kyle Moeller
Lee Teasley
Yuxiang Zhong

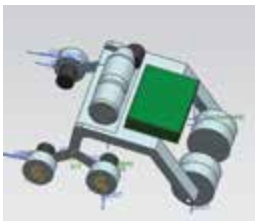


Taishan:

Shane Frakes
Christopher Priem
Mingwan Zhu

Koenigsegg:

Rachel Burland
Bingchen Chi
Nicolas Fraikin
Evan Meier

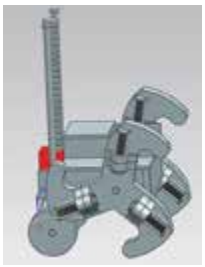


The Stairmaster:

Lucia Delvillano
Alejandro Porras
Robert Warfield

Rasteador Noche:

Mark Becker
Derrick Defever
Dominique Dubay



Trackasaurus:

Elizabeth Davidson
Joshua Dewys
Eric Hills

SCARLETT:

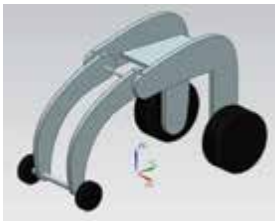
Yu Chen
Wesley Dorin
Anthony Kobak

Treveler:

Even Aavestrud
Daniel Blair
Richard Harrington

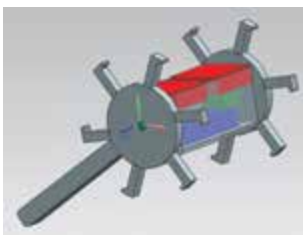
Stair-tan:

Zhi Hong Phuah
Gerald Rivkin
Shangyou, Zeng



Wall-EB:

Jack Mcdougall
Leah Nonis
Jordan Timm



8:00 a.m. - 11:00 a.m. Room 1240 | First Floor Mechanical Engineering

ME 497
Biomechanical Design
Dr. Tamara Reid Bush
Associate Professor of
Mechanical Engineering

MKT 420
New Product Development
Dr. Hang Nguyen
Assistant Professor of Marketing
Business College

Biomechanical Design and New Product Development

The Biomechanical Design and New Product Development course (ME 497/MKT 420) provides students with a unique opportunity to develop and market a real, new product that incorporates some biomechanical function. This class is novel insofar as students work in inter-disciplinary teams of engineers and marketers. Students experience the entire process of new product development, from need identification, concept generation and testing, to product development, design analysis and launch. This course further strengthens students' knowledge and real world exposure by working with Spartan Innovations and entering local innovation competitions.

Teams and Members

#	Team members	Team Slogan
01	Mark Cogo, Christine Hampton, Jessica Kaczmarek, Matthew Knudtson, Mollie McCarthy	Heal-To-Toe: A compact ankle therapy device with multiple ranges of motion and variable resistance.
02	Jason Avedesian, Daniel Cornelius, Andrew Kalina, Jennifer Kruger, Alison Osborn	The Stair Walker: A hybrid walker design capable of maneuvering up- and downstairs. The design utilizes adjustable legs that are deployed using a lightweight hand-triggered release.
03	Shayna Allen, Martin Dwornick, Paul Heeder, Deon Howard, Shuzheng Li	Gear Shield: A device for the bike that protects your pants from tearing.
04	Andrew Benson, Blake Jackson, Derek Remer, Benjamin Rowley, Michael Schwartz	The Super Bike: A tabletop exercise bike for disabled children. The main features are ease-of-use, convenience, kid-friendliness, and kid-excitability.
05	Michael Brzenzinski, Spencer Dunn, Kevin Glime, Tyler Reinke, Andrew Wandor	Flex Right: A safer, modified leg extension machine designed to allow the knee to move more naturally for a more beneficial workout.
06	Rachael Acker, Max Dunigan, Amanda Kadykowski, Theresa Shermetaro, Steven Ward	Benelift: Stand up from any chair with Benelift. Its rising cushion and retractable balance-assist arms provide a compact and portable solution.
07	Alex Dunckel, Yunxiao Jia, Tim Smith, Matthew Sutter	High-Roller: A mechanically operated wheelchair seat lift to allow the user to access previously inaccessible areas such as countertops, cupboards, and shelves.
08	Shelley Bedford, Martyna Cieslak, Carly Head, Kelsey Polansky	Snack-In-A-Box: Provides children a contraption in which they can work on their fine motor skills with a reward system in place.
09	Daniel Busch, Bradley Glasser, Alexander Hogan, Kathleen Noblet	Open Token: Assists wheelchair-bound people to open non-automatic doors on their own.
10	Nicole Bruggema, Stephanie Holmes, Kathleen Landwehr, Andrea Vedrody, Alexis Wiersma	Wheelie Transfer: A storable wheelchair attachment that enables users to independently transfer to and from the ground.
11	Curtis Coscarelly, Abigail Henning, Andrew Mclaughlan, Emma Sriro, Eric Waldron	Wrist-a-Grab: A wrist activated grabbing device that allows use by individuals with limited hand function.
12	Danielle Heger, Zackary Hickman, Tyler Mcmullin, Hiroya Miyoshi, Tristan Worthington	Pumpercise: A wheelchair attachment that propels the user through a calf pumping movement to promote blood flow and strengthening of leg muscles.
13	Alexander Friedman, Lucas Johnson, Ashlee Krystek, Jessie Smith, Kelsey Terwilliger	EZ-UP: A lifting device for hospitals and retirement homes that will allow patients to be quickly lifted in order to easily place a sling under them.
14	Rachel Erdman, Peter Howes, Leah Iseler, Scott Matthews, Chloe Wood	Sud-Support: A system that allows amputees of all income levels the luxury of standing in the shower.
15	Brandon Fortman, Carson Mcguire, Gerald Rivkin, David Slubowski, Amanda Turner	The Pushin-Cushion: A ratchet-powered seat assist that helps the user get out of a chair.
16	Taylor Fabbri, Brendan Fitzpatrick, Kyle Hawkins, Mauro Rosselli, Olivia Weprich	The Handi-Can: A trashcan for people with limited function in their hands, such as people with arthritis or those with spinal injuries.
17	Li Jen Chew, Stephanie Dejong, Natalie Salehi, Darby Spiegel, Morgan Weber	The Cycle Feet: A wheelchair that offers a versatile approach to moving around. The customer can utilize their feet to pedal like a bike or use their arms to move like a traditional wheelchair.
18	Andrew Crechiolo, Jake Deyonker, Mark Hartfelder, Thomas Kobak, Yiqi Ye	Transcooter: A knee walker that transforms into a hands-free crutch to allow increased mobility for people with lower leg injuries.

While no award compares to helping you achieve better health, we're proud of the recognition we receive for our efforts.

For the second straight year, Spectrum Health Butterworth and Blodgett Hospitals have been named one of America's Best 50 Hospitals by Healthgrades®. The award signifies the top one percent of more than 4,500 hospitals for year-over-year superior clinical performance.

AMERICA'S 50 BEST HOSPITALS™ 2016 healthgrades

TRUVEN HEALTH ANALYTICS 100 TOP HOSPITALS 2016

Spectrum Health Butterworth and Blodgett Hospitals (nine times recognized) and Spectrum Health Zeeland Community Hospital (twice recognized) are among the nation's 100 Top Hospitals® according to Truven Health Analytics™ for sustaining the highest national standards in hospital care and management.

The Capstone Projects

Dr. Giles Brereton
Associate Professor of
Mechanical Engineering

Presentation Schedule – Room 1202

Time	Team Sponsor	Project Title
8:30 a.m.	CMS Energy	Liquid Level Gauging System
9:00 a.m.	ArcelorMittal	Reduction of Cobbling in Pickle Line Choppers
9:30 a.m.	EMD Technologies	Enclosure Design for the Power Flame Torch
10:00 a.m.	EMD Technologies	Design of a Crib Air Manifold to Reduce SIDS
10:30 a.m.	Continental AG	Optimized Back Cover Design for Radar Sensors
11:00 a.m.	Fiat Chrysler Automobiles	Vehicle Design Using Real World Drive Cycle Data
11:30 a.m.	Environmental Protection Agency	Road Speed Fan for Vehicle Dynamometer Tests
12:00 p.m.	Gerdau Steel	Camera Mount for a Vacuum Degasser

ME 481 Mechanical Engineering Design Projects

ME 481 is a required course for mechanical engineering majors at MSU. The course provides students with a team-based capstone design experience in which they:

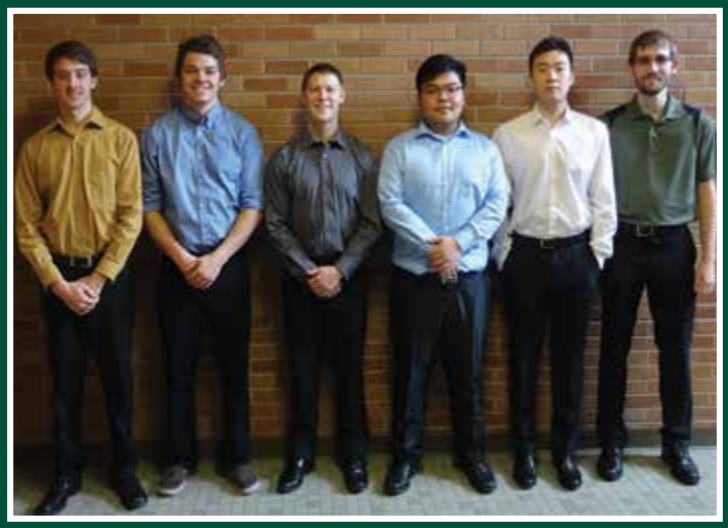
- Use the technical expertise, communication skills, and teaming methodologies they have learned throughout their mechanical engineering curriculum, together with their creativity, to solve real world problems
- Collaborate with practicing engineers to address problems sponsored by industry
- Develop new products or redesign existing products to reduce costs or enhance reliability and functionality
- Interact with large, medium, and small companies in the automotive, defense, aerospace, consumer products, and agricultural industries, and with US government agencies.

We gratefully acknowledge the support of this semester's project sponsors: ArcelorMittal, Robert Bosch LLC, CBS Solar, CMS Energy, Continental AG, EMD Technologies, Environmental Protection Agency, Fiat Chrysler Automobiles, Ford Motor Company, Gerdau Steel, Hitachi Automotive Systems, Ingersoll Rand, Meritor Inc., Michigan AgrAbility, Steelcase, Tenneco Inc., and Whirlpool Corporation; and educational partners at Heartwood School and MSU's Department of Entomology.

CMS Energy
Liquid Level Gauging System

CMS Energy is a public utility that provides natural gas and electricity to more than 6.6 million of Michigan's 10 million residents. CMS Energy plans to increase safety and reduce costs by implementing a system that can better regulate the output of odorant into natural gas pipelines. Odorant is mixed with natural gas so that, in the case of a gas leak, the leak can be detected by smell. Utilizing too little odorant would be a safety concern, whereas too much odorant would be wasteful and costly. The output of odorant for mixing with gas depends on the odorant level in the tank, which is currently monitored by an employee who reads the liquid level gauge on-site. This procedure is both inefficient and sporadic, as tanks are sometimes not checked for days or even weeks.

The goal of this project is to design a solution that can accurately and remotely measure the liquid levels of over 60 odorant tanks across the state. The solution must fit a variety of tanks while meeting cost and safety requirements. The design must be non-intrusive such that the liquid level can be measured from outside the tank. The selected design will be assembled and tested thoroughly for accuracy and reliability before being presented to CMS for review.



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Lee Teasley
Rochester, Michigan

Greg Peterson
Rochester, Michigan

Tingyuan Zhang
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Haoyu Wang
Fuxin, Liaoning

Brian Cobus
Lansing, Michigan

CMS Energy
Project Sponsor

Kurt Adams
Jackson, Michigan

ME Faculty Advisor
Norbert Mueller
East Lansing, Michigan

ArcelorMittal

Reduction of Cobbling in Pickle Line Choppers

ArcelorMittal is the world's largest steel producer with a portfolio spanning the automotive, construction, home appliance, and energy industries. Its Burns Harbor, Indiana location is its second largest steel making facility in America, with an annual capacity of five million tons of raw steel. The final step in steel production is the finishing process, which takes place after the steel has been cast and hot-rolled. The finishing process starts at the pickle line; this line runs sheet steel through hydrochloric acid to remove surface scale and trims the edges to the desired width. The strips of steel that are trimmed from each side of the sheets travel through a chute and are then chopped into short pieces to be recycled. The strips of steel often "cobble," or tangle, in this chute between the circular trimmer knives and the cutting chopper. These cobbles require the line to shut down for an operator to remove the entanglement manually. Cobbling on this line causes approximately 2.5 hours of downtime per month and represents 2.2 million dollars of lost revenue per year.

The goal of this project is to design a new, robust chute system for scrap steel. This chute system will be designed to minimize the occurrence of cobbles, thereby reducing the line downtime, while satisfying constraints of ease of maintenance and operability, and high durability.

ArcelorMittal

Michigan State University
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John Danielson
LaGrange Highlands, Illinois

Logan Springgate
New Lenox, Illinois

Benjamin Yancho
Traverse City, Michigan

Zachary Tuller
Stevensville, Michigan

ArcelorMittal
Project Sponsor

Lauren Hart
Burns Harbor, Indiana

ME Faculty Advisor
Tom Pence
East Lansing, Michigan

ME 481 Room 1202 | First Floor **9:30 a.m.**

EMD Technologies
Enclosure Design for the Power Flame Torch

EMD Technologies is a company based in Addison, Illinois, with a history of innovation and successful product development in a range of applications, from safety and medical devices to consumer products. One of its consumer products is the Power Flame, a device that is an alternative to outdoor tiki torches or fire pots. Two shortcomings of these exterior torches are their inability to expel sufficiently large amounts of insect repellent into the air, and their use of a highly flammable and potentially dangerous fuel, which has also been known to cause serious injuries and death to children and adults. EMD's solution to these problems is the Power Flame system, which uses a non-toxic and non-flammable fuel and is able to expel sufficient insect repellent into the surrounding air.

The goal of this project is to design an enclosure for the Power Flame system that will either prevent water entry into or permit water to be easily expelled from the enclosure. If water is to be expelled, it must be done without removing melted wax---the fuel source of the flame---in the process. The enclosure must meet the quality and functionality requirements of EMD Technologies, be functional and aesthetically pleasing to the consumer, and be manufacturable at a low cost and in a short timeframe. The team will construct and test a prototype of their optimal design and present it to EMD Technologies for further evaluation.

EMD Technologies, Innovation & Development

Michigan State University
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Quinn Putt
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Eric Waldron
Farmington Hills, Michigan

Zackary Hickman
Clinton Township, Michigan

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EMD Technologies
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Dan Masterson
Addison, Illinois

ME Faculty Advisor
Indrek Wichman
East Lansing, Michigan

EMD Technologies

Design of a Crib Air Manifold to Reduce SIDS

EMD Technologies is an engineering consulting company located northwest of Chicago in Addison, Illinois. It serves a variety of customers, from individual entrepreneurs to well-established market leaders, and specializes in reinventing retail, consumer, medical, and commercial products to provide a competitive advantage. It is especially interested in creating products that help eliminate stress and danger in households and wishes to introduce a smart crib to its product line.

The goal of this project is to incorporate an advanced air manifold into the design of a crib. Recent research suggests that providing air movement around a sleeping child can reduce the occurrence of Sudden Infant Death Syndrome (SIDS) by 72%. SIDS results in 2,500 - 4,000 deaths per year in children ages 1 month to 1 year. The MSU team will analyze a range of designs to provide the desired airflow rate and circulation patterns in the most efficient and reliable manner. The most effective design will be incorporated in a prototype which will then be tested and provided to EMD for further development.

EMD
TECHNOLOGIES, INNOVATION & DEVELOPMENT

Michigan State University
Team Members (left to right)

Patrick Frahm
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Lucia DelVillano
Fraser, Michigan

Michael Wicker
Grand Rapids, Michigan

Rachel Horstman
Frankenmuth, Michigan

Nathan Fedewa
Williamston, Michigan

EMD Technologies
Project Sponsor

Daniel Masterson
Addison, Illinois

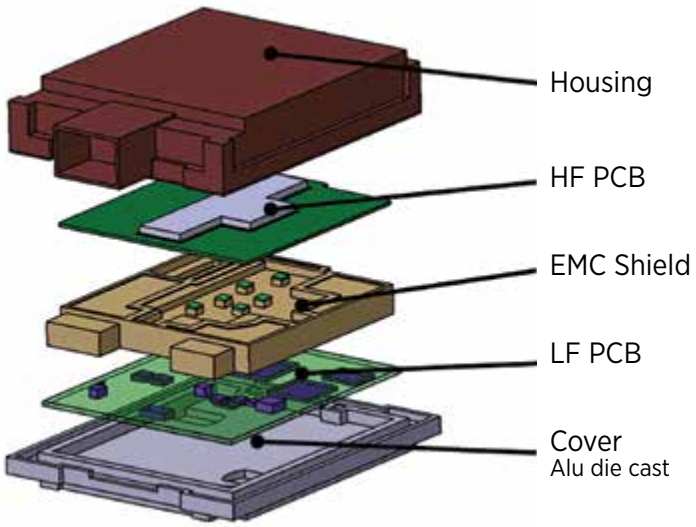
ME Faculty Advisor
Abraham Engeda
East Lansing, Michigan

Continental AG

Optimized Back Cover Design for Radar Sensors

Headquartered in Hanover, Germany, Continental is a leading manufacturer of automotive parts, ranging from tires and brake systems to powertrain and safety components. In an effort to improve driver safety, Continental is developing its Advanced Driver Assistance Systems (ADAS) unit, which employs sensors to operate adaptive cruise-control and blind-spot monitoring functions. Currently, the back cover of each ADAS unit is manufactured from die-cast aluminum. To meet the growing demand for ADAS units, Continental is interested in replacing the die-cast cover with an injection-molded one in an effort to significantly increase manufacturing tool life while simultaneously reducing production costs.

To maintain the thermal and mechanical performance of the current aluminum part, the team will research suitable resins for the back cover of the radar sensor. In addition, the geometry of the part will be redesigned due to the change from aluminum to a resin. An optimal cover design that best satisfies Continental's heat transfer and injection molding requirements will be then be selected and tested for functional integrity.



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Jiewen Huang
Zhongshan, China

Niko Vukov
Troy, Michigan

Axel Ivers
Grosse Pointe, Michigan

Sean Raymor
Lake Orion, Michigan

Kevin Wilberding
Troy, Michigan

Continental AG
Project Sponsor

Brandon Fisk
Auburn Hills, Michigan

ME Faculty Advisor
Sharon Xiao
East Lansing, Michigan

Fiat Chrysler Automobiles

Vehicle Design using Real World Drive Cycle Data

Fiat Chrysler Automobiles (FCA) has its headquarters in Auburn Hills, Michigan, and is one of the ten largest automakers in the world. It strives to make safer, more reliable and more efficient vehicles. One way in which it does so is to incorporate drive cycle data, from recorded driving patterns of customers, into the design of its vehicles' components. Data on driving patterns can be used to compute load conditions on individual components of each vehicle. This load information is useful for indicating where failure or misuse occur in the life cycle of vehicle components. FCA uses this information in the design process by developing in-house drive cycles, based on driving-cycle data, for components and so anticipates and corrects potential problems before the vehicle is released to market. However, as real world driving conditions change, it is important to refine in-house drive cycles used for testing to ensure they still represent real world usage.

The objective of this project is to develop software to use the real world driving database for individual vehicles (of various makes, models, in different regions, cities and climates), compiled by the National Renewable Energy Laboratory (NREL) to undertake analyses of vehicle driving patterns and component loads. The results of these analyses will then be compared with results from FCA's in-house model to refine this model and consequently the design criteria for FCA's components.

FCA
FIAT CHRYSLER AUTOMOBILES

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Team Members (left to right)

James Leung
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Matthew Sutter
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Yu Chen
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Tim Smith
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Fiat Chrysler Automobiles
Project Sponsors

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Bengaluru, India

Venkat Ramakrishnan
Chennai, India

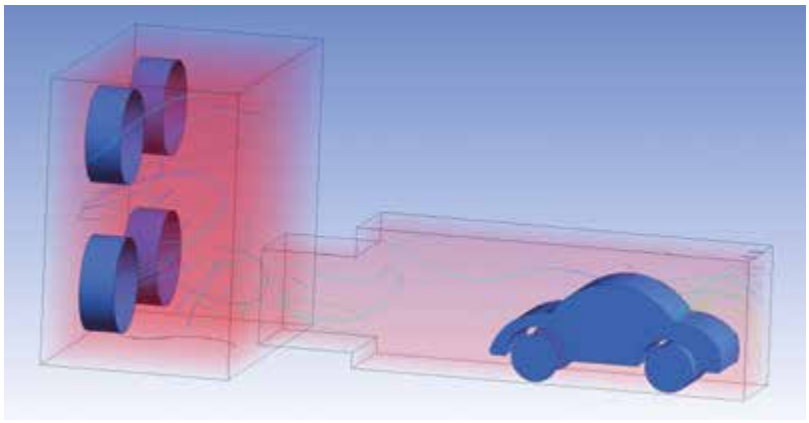
ME Faculty Advisor
Sharon Xiao
East Lansing, Michigan

ME 481 Room 1202 | First Floor **11:30 a.m.**

Environmental Protection Agency
Road Speed Fan for Vehicle Dynamometer Tests

The United States Environmental Protection Agency (EPA) conducts research and enforces regulations in many areas relating to human health and the natural environment. Topics of study and regulation include: air, climate change, ecosystems, health, land, waste and cleanup, pesticides, substances and toxins, sustainable particles, and water. The EPA also conducts vehicle fuel economy and exhaust gaseous and particulate emissions tests on all vehicles sold in the United States. Some of these tests are carried out with vehicles mounted on dynamometers, with the effect of air motion replicated using a system of road speed fans. The EPA is interested in designs for such road speed fans that reduce operational costs and satisfy sustainability testing targets.

The objective of this project is to develop a road speed fan system with optimal energy efficiency and airflow uniformity that can be implemented in dynamometer test cells at the EPA's National Vehicle and Fuel Emissions Laboratory. Airflow inefficiencies and path obstructions of the current fan system must be identified in order to reduce power requirements during vehicle testing. A computational fluid dynamics (CFD) model will be constructed to demonstrate how the optimal fan system results in improvements in airflow uniformity and associated electrical savings over existing systems, in a complete test cycle that spans a range of road speeds.



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Environmental Protection Agency
Project Sponsor

Dr. Matt Brusstar
Ann Arbor, Michigan

ME Faculty Advisor
Junlin Yuan
East Lansing, Michigan

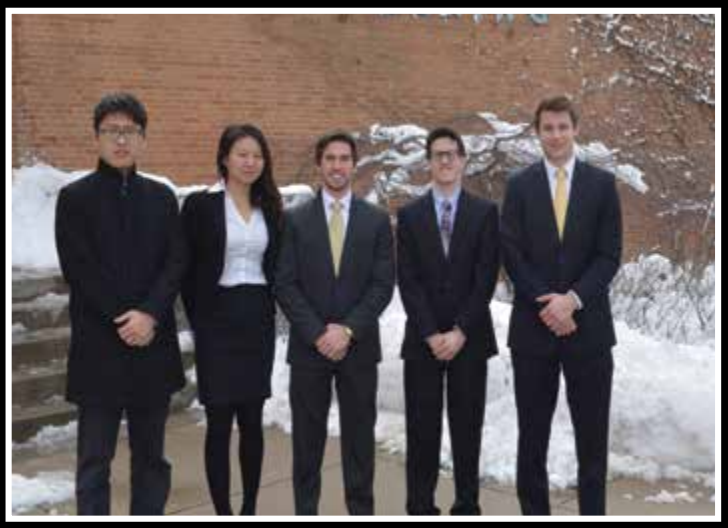
Gerdau Steel

Camera Mount for a Vacuum Degasser

Gerdau Steel is the world's 14th largest steel manufacturer, currently producing around 26 million metric tons of steel per year. An important part of the steelmaking process is vacuum degassing---the removal of nitrogen and hydrogen from molten steel by placing it in a vacuum chamber. This refinement process helps to produce steel without mechanical embrittlement, blowholes, or nitrides caused by nitrogen. It also produces steel without a reduced tensile ductility due to excessive hydrogen in the steel after solidification. The amount of argon gas released into the vacuum chamber during degassing is critical to producing flawless steel. In order to monitor the argon concentration, an operator at the Gerdau plant must look through a window into the chamber to determine when sufficient argon has been added.

The challenge for the MSU engineering team is to design a mount to hold a camera that will image the vacuum degassing chamber so that the process operator can monitor when enough argon has been added to the degassing chamber without having to leave the control room. A custom camera mount, which can withstand the extreme conditions within a steel plant, will be designed and manufactured to accommodate a camera specified by Gerdau Steel. The prototype will be built and undergo preliminary testing at MSU and then on-site testing at Gerdau Steel's Jackson facility.

GERDAU



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Jinyang Qiu
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Anthony Kobak
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Reace Head
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Casey Palanca
White Lake, Michigan

Gerdau Steel
Project Sponsor

Rui Badaraco
Jackson, Michigan

ME Faculty Advisor
Seungik Baek
East Lansing, Michigan

Rotational Development Programs

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About the programs:

Bosch offers two rotational development programs:

- Professional Development Training (PDT) Program for Bachelor's level graduates
- Junior Managers Program (JMP) for Master's level graduates

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- Gain **international** work experience
- High **visibility** and senior leadership exposure
- **Drive your own career**

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- Minimum one completed internship/ co-op experience, or at least six months full-time, relevant work experience related to your field of study
- Excellent verbal and written communication skills
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The Capstone Projects

Dr. Giles Brereton
Associate Professor of
Mechanical Engineering

Presentation Schedule – Room 1208

Time	Team Sponsor	Project Title
8:30 a.m.	Michigan AgrAbility	Design of an Outdoor Wood Furnace Loader
9:00 a.m.	Michigan AgrAbility	Design of a Folding Step for a Tractor
9:30 a.m.	Heartwood School	Adaptable Gait Enhancement Device
10:00 a.m.	Ford Motor Company	Measurement of Driveshaft Joint Friction
10:30 a.m.	Robert Bosch LLC	Design of a Waste Heat Recovery System
11:00 a.m.	CBS Solar	Optimized Solar Panel Mount Design
11:30 a.m.	Meritor, Inc.	Simulator for Hybrid Electric Powertrains
12:00 p.m.	Hitachi Automotive Systems	Gasoline Direct Injection Test Controller

Mechanical Engineering Design Program

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 ME faculty who supervised ME 481 design teams this semester are: Ron Averill, Seungik Baek, Giles Brereton, Abraham Engeda, Brian Feeny, Farhad Jaberi, Dahsin Liu, Al Loos, Norbert Mueller, Ahmed Naguib, Tom Pence, Tamara Reid Bush, Dan Segalman, Rod Tabaczynski, Brian Thompson, Indrek Wichman, Sharon Xiao, Junlin Yuan, and George Zhu.

ME 481 Room 1208 | First Floor **8:30 a.m.**

Michigan AgrAbility
Design of an Outdoor Wood Furnace Loader

Michigan AgrAbility is a company that provides services to help farmers who are suffering from illness, disability or aging. It does this by researching, designing and developing farming tools, equipment and methods that will assist their clients in their daily work. Partnering with Michigan State University Extension and Easter Seals Michigan, and with funding assistance from the U.S. Department of Agriculture, Michigan AgrAbility assists approximately 1,900 Michigan farmers each year. Currently a client, Dennis Johnston, uses a wood burning furnace to heat his home but has difficulty lifting and loading large logs into it. Michigan AgrAbility is interested in having a wood furnace loader designed that would allow the furnace to be loaded with little or no strain on the back, legs and arms.

The MSU team will investigate the problem on-site and develop multiple design concepts for simplifying or automating the loading process. An optimal design will then be selected and a prototype fabricated and tested at MSU. When all design requirements are met, this device will be transported and installed at the client's home.

Michigan State University
Team Members (left to right)

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Hayden May
Cary, Illinois

Nadia Amira
Tunis, Tunisia

Philip Skinkle
Jackson, Michigan

Steven Lund
Saline, Michigan

Michigan AgrAbility
Project Sponsor

Ned Stoller
Lowell, Michigan

ME Faculty Advisor
Tamara Reid Bush
East Lansing, Michigan

Michigan AgrAbility

Design of a Folding Step for a Tractor

Michigan AgrAbility provides services and assistance to individuals in the agricultural industry that have an injury, disability, or illness. Michigan AgrAbility researches and develops unique farming tools, equipment, and methods to help these people to be more productive.

To avoid collisions with objects on the ground, tractor steps are built to maintain high ground clearance. Typically, this gap is about 22 inches between the ground and the bottom step. While these steps can be challenging enough for a healthy person to climb onto, it is often nearly impossible for a farmer with physical restrictions or other disabilities to get into their tractor. Aftermarket steps have been created to address this concern, but these steps still leave a gap of a few feet between the ground and the first step. Static low hanging steps are not feasible as they collide with the uneven terrain of a farm. The goal of this project is to create a retractable extension to these aftermarket steps that provides stability and will allow a worker with very restricted movement to easily climb onto a tractor. After using the steps, the step extension will smoothly return to a stowed position where it will not interfere with rough terrain or any essential functions of the tractor.

If an ingenious design is conceived, it will be proposed as an aftermarket option to be produced by K & M manufacturing.

Michigan State University
Team Members (left to right)

Nick Chocko
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Charlie Pynnonen
Grand Rapids, Michigan

Gerald Rivkin
Farmington Hills, Michigan

Paul Latorre
Temperance, Michigan

David Bernier
Rochester Hills, Michigan

Michigan AgrAbility
Project Sponsor

Ned Stoller
Lowell, Michigan

ME Faculty Advisor
Ron Averill
East Lansing, Michigan

ME 481 Room 1208 | First Floor **9:30 a.m.**

Heartwood School
Adaptable Gait Enhancement Device

Heartwood School, in the Ingham Intermediate School District, provides specialized rehabilitation facilities and staff for students with various disabilities, aged from 3 to 26 years. These students have moderate to severe cognitive impairments that hinder coordination while walking. Consequently, they currently require continual one-on-one assistance from Heartwood staff members, because they lack the self-confidence to walk unaided.

To bridge the gap between highly-supported (physically connected to a staff member) and independent walking, the MSU team will create an Adaptable Gait Enhancement Device. This device is a self-powered mechanism that the student grips with both hands while walking. The mechanism constrains the arm motions of the student to simulate those of natural swinging of the arms to promote balance and a normal gait. The mechanism will be designed to support the required loads using finite-element analysis. A prototype will be built and tested at MSU before being presented to Heartwood for further evaluation.

Ingham Intermediate School District
Heartwood School

Michigan State University
Team Members (left to right)

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Grand Ledge, Michigan

Michael Schwartz
Clarkston, Michigan

Julia Briggs
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Zachary Abbott
Wexford, Pennsylvania

Alexandria Allman
Stevensville, Michigan

Junhun Gong
Chongqing, China

Heartwood School
Project Sponsor

Joanne Janicki
Mason, Michigan

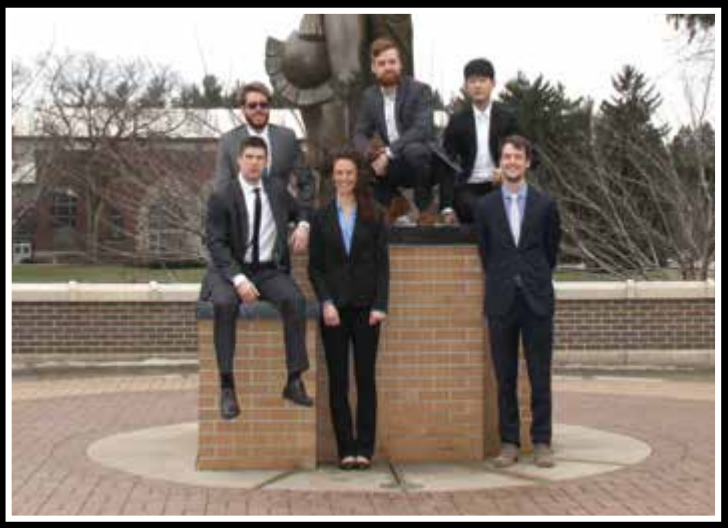
ME Faculty Advisor
Brian Thompson
East Lansing, Michigan

Ford Motor Company

Measurement of Driveshaft Joint Friction

Ford Motor Company is one of the largest automakers in the world with its headquarters located in Dearborn, Michigan. It designs vehicles which vary in size from 4-cylinder compact cars to heavy-duty commercial trucks. During Ford's vehicle development process, engineers rely heavily on Computer-Aided Engineering (CAE) simulations. CAE simulations assist engineers' understanding of the design and allow them to identify design flaws early in the process. Ford is currently not satisfied with its driveline CAE models. In particular, the behavior of joints under driveshaft torque appears to be poorly simulated and consequently, experiments are needed to develop better joint-friction models.

Ford has requested that the MSU team redesign an existing test rig for driveshaft joint friction. Specific improvements include applying torque during testing, resolving vibration problems, and improving signal processing and recording. Data from this rig will be used to measure frictional forces in universal joints and the resulting torque on the driveshaft under simulated driving conditions in order to refine joint-friction models. It will help Ford improve the fidelity of its CAE modeling and increase the safety, durability, and quality of its vehicles.



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Ford Motor Company
Project Sponsor

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Dearborn, Michigan

ME Faculty Advisor
Daniel Segalman
East Lansing, Michigan

ME 481 Room 1208 | First Floor **10:30 a.m.**

Robert Bosch LLC

Design of a Waste Heat Recovery System

Robert Bosch is a German multinational engineering and electronics company headquartered in Gerlingen, Germany. It is a privately owned company with business interests in mobility solutions, industrial technology, consumer goods and energy/building technology. Bosch's main products are automotive components for gasoline- and diesel-fueled engines, and for chassis systems. As the demand for more efficient vehicles grows, strategies such as waste heat recovery become of greater commercial interest. The Diesel Systems group at Bosch is exploring how effectively a Waste Heat Recovery (WHR) system, in which hot exhaust gas is used as the heat input to a Rankine cycle, might increase the efficiency of commercial vehicles.

The particular challenge for this team is to design a tank system for a Rankine cycle with ethanol as the working fluid. The tank system is placed upstream of the pump in the cycle and must be designed to use a system of valves to remove/purge air from the ethanol before it enters the pump. Purging will be achieved by using valves to control the volume of ethanol in the tank and release air to the environment. The team will design and build a prototype to test this concept.

BOSCH

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Elizabet Gojcaj
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Yash Kankaria
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Robert Bosch
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East Lansing, Michigan

CBS Solar
Optimized Solar Panel Mount Design

Contractor Building Supply, Inc (CBS) is a Michigan- based company that has been providing renewable energy solutions for nearly 40 years, and provides solar panels to residential and commercial customers. Its main office is located in Copemish, Michigan, and it serves Michigan and its neighboring states. CBS currently transports unassembled solar models to sites for installation. As an essential cost-saving measure, is it necessary to replace the current system with one in which pre-assembled models are transported to sites to reduce labor and installation costs.

The MSU Team will design a solar panel structure that can be pre-assembled at CBS Solar and transported safely to project sites. The final design will be a prototype that will hold four 300W solar panels of approximately 13ft x 6ft in area. The design must be able to withstand onsite environmental and fatigue conditions for 25 years. The prototype must also be cost-efficient and easy to fabricate so that it can be replicated easily. The prototype and transport method will be presented to CBS Solar for further evaluations and implementation.

CBS Solar
A Division of Contractors Building Supply Inc.
Michigan Made for the World

Michigan State University
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CBS Solar
Project Sponsor

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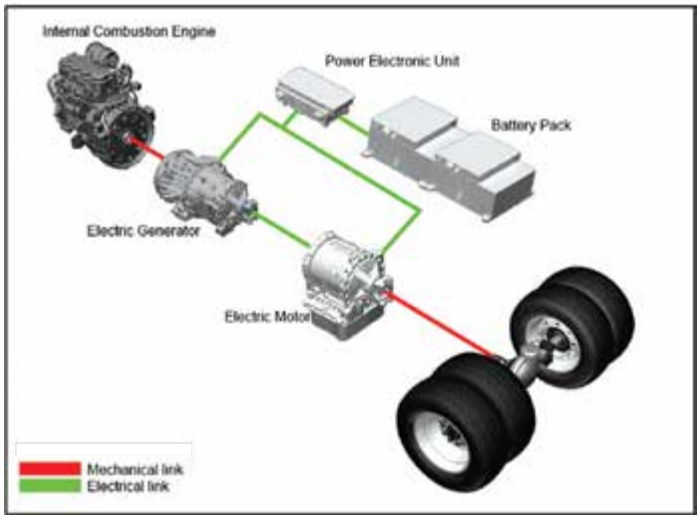
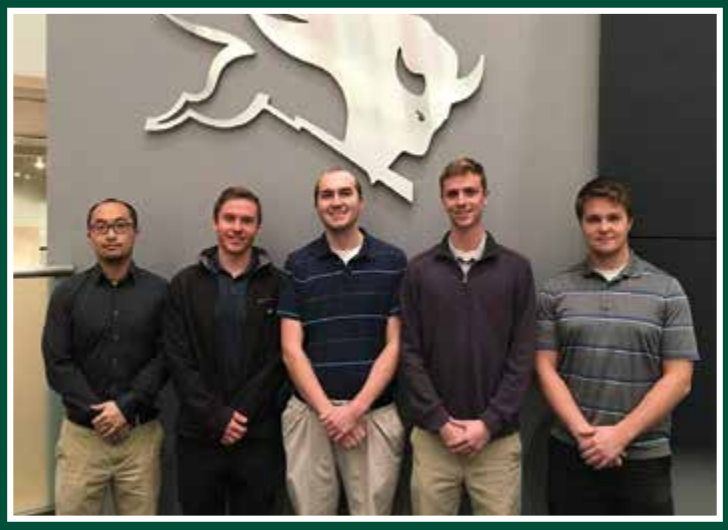
Meritor, Inc.
Simulator for Hybrid Electric Powertrains

Meritor, Inc. is an automotive supplier headquartered in Troy, Michigan. It specializes in axles, brakes/safety systems, drivelines, suspensions, and aftermarket parts for commercial vehicles, trucks, and military applications. Much of its revenue is from sales of axles for large transport vehicles. As hybrid electric vehicles become more prevalent across the global market, design simulation tools capable of providing insights into the performance of different hybrid electric powertrain configurations are needed to guide powertrain design. Meritor's Hybrid Powertrain Performance Calculator for Commercial Vehicles is one such computational design tool intended to accurately predict the performance, component costs, and market potential of a tractor trailer equipped with a modern series hybrid electric powertrain.

The MSU design group is to create a robust and versatile simulation program to predict the efficiencies and costs of custom-designed hybrid powertrain systems. The program would use inputs such as time required to accelerate, speed on grade, traction limits and maximum speeds to predict the optimal hybrid electric powertrain configuration for the chosen vehicle. The program will be presented to Meritor for further refinement and use as a design tool.





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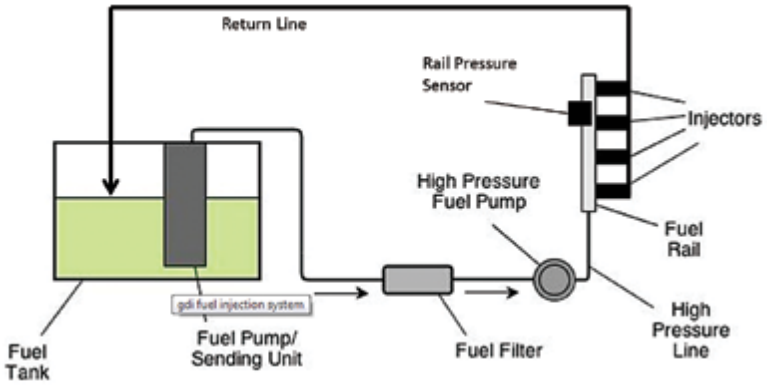
Hitachi Automotive Systems
Gasoline Direct Injection Test Controller

Hitachi Automotive is a subsidiary of the global Hitachi Corporation---one of the largest technological conglomerates in the world and involved in a variety of industries including automotive components and systems. The greatest challenge facing today's automotive industry is to maximize fuel efficiency while minimizing vehicle exhaust-gas emissions, and this challenge is directly related to the introduction of gasoline into engine cylinders using fuel injection. In order to improve gasoline direct injectors (GDI) to meet future emissions and fuel-economy requirements, Hitachi wishes to create a GDI test bench.

The MSU team will design, build and test one part of a GDI test bench: the hardware interface between the direct injection system and its controller. It will also program a graphic user interface (GUI) for the controller, thereby providing Hitachi with a primary component of the GDI test bench.



HITACHI
Inspire the Next

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Hitachi Automotive Systems
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Steve Miller
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George Zhu
East Lansing, Michigan

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The Capstone Projects

Dr. Giles Brereton
Associate Professor of Mechanical Engineering

Presentation Schedule – Room 1300

Time	Team Sponsor	Project Title
8:30 a.m.	MSU Department of Entomology and Application Insight	Mist Cooling to Delay Budding in Apple Trees
9:00 a.m.	Ingersoll Rand	Design of an Improved Air Handling Inlet Hood
9:30 a.m.	Ingersoll Rand	Panel Mounting of HMI Fans in HVAC Units
10:00 a.m.	Steelcase	Part Hanging System for Automated Paint Lines
10:30 a.m.	Tenneco Inc.	Design of a Thermoacoustic Demonstrator
11:00 a.m.	Tenneco Inc.	Design of a Compact Mat Cutting Tool
11:30 a.m.	Whirlpool Corporation	Lid Initiated Detergent Dispenser for Washing Machines
12:00 p.m.	Whirlpool Corporation	Design of a Dryer Door Closure Fixture

Mechanical Engineering Design Program Awards

The Mechanical Engineering Design Program awards prizes in three technical categories and one presentational category on Design Day. The most significant award is the Thomas Alva Edison Design Award–a medal–given to each member of the ME 481 capstone design team that produces the most outstanding technical design project. Each team's technical report is read from cover to cover to evaluate the detailed engineering analyses of each project and assess how much technical Mechanical Engineering value has been added to the project solution by each team. It is not unusual for Mechanical Engineers to include analyses that are more traditionally found in electric, civil, chemical or biomedical engineering, if the optimal project solution requires it. The quality of a team's prototype of its design solution is also an important factor, as is the clarity of its presentation of the design solution. The Edison Award is given to the team which best meets these criteria.

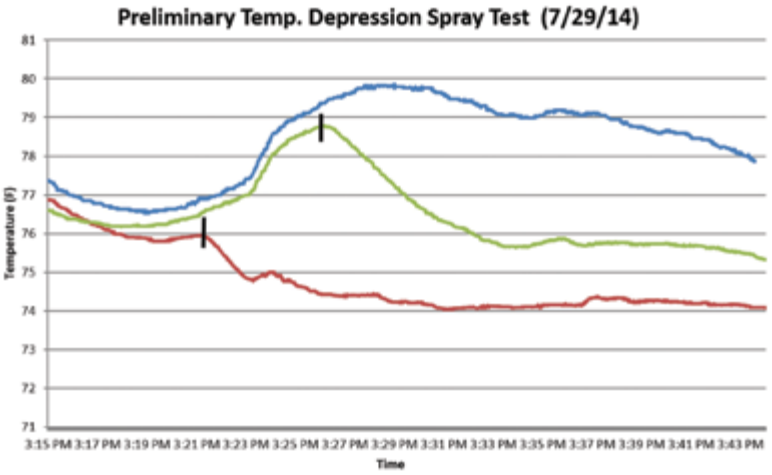
A second ME 481 award is given to the team that gives the best technical project presentation. The importance of communication of scientific and engineering ideas cannot be understated, and it is for this reason that we make the ME 481 Project Presentation Award. Award winners will typically have built an impressive prototype which forms the basis for a very clear and effective presentation of the project background and its solution, often incorporating live or video demonstrations of its functionality. The Design Program also makes awards to the winners of its ME 471 Machine Design competition, the rules and constraints of which vary from semester to semester.

MSU Dept. of Entomology & Application Insight

Mist Cooling to Delay Budding in Apple Trees

Michigan's agricultural industry contributes more than $100 billion annually to the state's economy. In 2012, the Michigan apple farming industry suffered an 87% loss in its annual crop harvest due to weather: temperatures in early spring were higher than normal, which caused apple trees throughout Michigan to bud earlier than expected. A subsequent frost destroyed many young apple buds, and much of the crop was lost, prompting interest in ways of delaying budding. The MSU Department of Entomology, in conjunction with Application Insight, previously developed an advanced spraying system for pesticide distribution in high density orchards, and is interested in modifying it for use in an automated mist-cooling system, which could lower the temperature of prematurely warming buds by cooling the surrounding air through evaporative cooling, thereby delaying budding.

The goal of this project is to create an optimized misting control system to delay budding in apple trees. The system will have the capability of monitoring ambient temperature and humidity conditions in the orchard in order to determine when and for how long misting is required. The system will then automatically spray the plants according to the programming of a control system.



The graph above shows the effects of mist cooling on apple trees. The blue line represents a baseline temperature reading of the

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Bashaier Alsinan
Al Qatif, Saudi Arabia

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MSU Department of Entomology

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Application Insight
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ME Faculty Advisor
Giles Brereton
East Lansing, Michigan

Trane – Ingersoll Rand

Design of an Improved Air Handling Inlet Hood

Trane® is a subsidiary of Ingersoll Rand and specializes in heating, ventilation, and air conditioning (HVAC) products, both in residential and commercial subsets. This project focuses on the commercial division's air handling systems, which are installed on the roof of a building and used for climate control, humidity control, and overall air quality control. These air handling systems have an inlet hood which covers the inlet airflow duct. This hood, together with a high performance moisture eliminator, is used to keep water out of the air handling units during precipitation (and particularly during wind-driven rains). These inlet hoods are too big to be shipped pre-installed, whereas more compact hood designs are difficult to manufacture.

The design challenge for the MSU team is to reduce the inlet hood size without compromising either the feasibility of manufacturing or the performance of the inlet hood in preventing water entrainment into the unit. The team will use computational fluid dynamics to explore different designs and optimize the one that best matches these criteria.

Michigan State University
Team Members (left to right)

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Shannon Grace
Three Rivers, Michigan

Tim Mijnsbergen
Plymouth, Michigan

Blake Hatherley
Brighton, Michigan

Ben Rowley
Romeo, Michigan

Ingersoll Rand
Project Sponsor

Mike Lewis
Lexington, Kentucky

ME Faculty Advisor
Farhad Jaberi
East Lansing, Michigan

Ingersoll Rand

Panel Mounting of HMI Fans in HVAC Units

Trane is a subsidiary of Ingersoll Rand that offers climate control solutions for homes, as well as commercial, industrial, and institutional buildings. It is a world leader in air conditioning (HVAC), heating, dehumidifying, and air cleaning systems. Horizontal Motorized Impellers (HMIs) are used in a number of its air handling units, because they are very compact and efficient air-moving devices. Multiple fans are required to produce sufficient airflow in mid- to large-size air handling units and these are currently floor-mounted. Although HMI fans are designed to be panel-mounted, the current wall assembly designs cannot support their weight.

The objective of the project is to develop a design that allows arrays of HMI fans to be mounted on the walls of the air handling units. An optimal design should be cost-effective and easy to manufacture, assemble, and install. Furthermore, the units are shipped when fully assembled and so must withstand shock loads and vibrations encountered during transportation to the installation site. The team is to evaluate various design approaches using FEA and cost analysis to determine their performance and feasibility. In doing so, it will create a general design tool that can be applied to all HMI and HVAC unit sizes.

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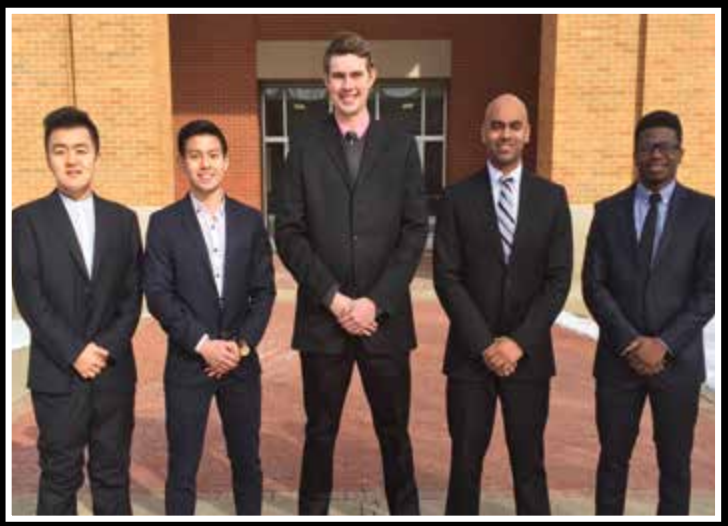
Steelcase

Part Hanging System for Automated Paint Lines

Founded 1912 in Grand Rapids MI, Steelcase is a furniture company that specializes in products for the office, education, healthcare, and retail industries. In order to improve the efficiency and quality of painting in its manufacturing processes, Steelcase wishes to change from human line operators to an automated robotic system, thereby decreasing the amount of paint wasted as overspray and the number of operators required. Thus fewer resources are required to manufacture each part, and the environmental effects of wasted paint are reduced.

A primary concern with a robotic system is that the swaying motion of suspended parts that move through turns and elevation changes in a track makes automated spray-painting difficult. To address this concern, the MSU team was asked to redesign the interface between the parts and track on which they hang, with particular emphasis on minimizing the sway of parts as they traverse the track. To accomplish this design task, the team will conduct a series of trials, utilizing mathematical and engineering concepts and theories to determine several possible conceptual solutions. These solutions will be evaluated and the optimal one will be tested and presented to Steelcase.

steelcase



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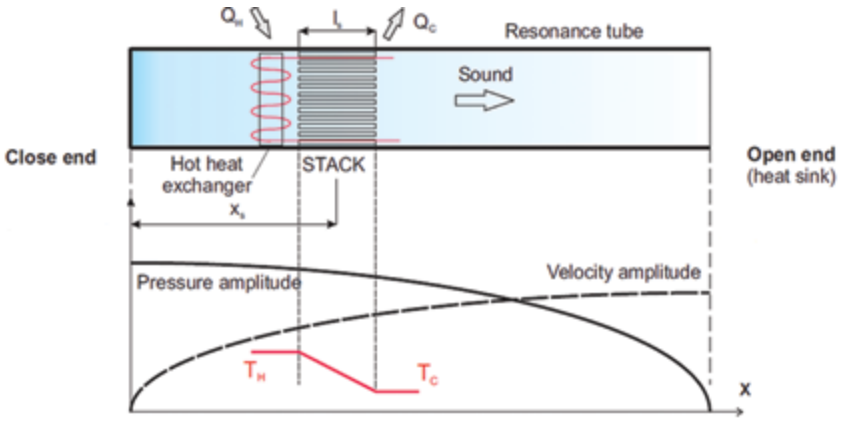
Tenneco Inc.
Design of a Thermoacoustic Demonstrator

Tenneco Inc. is a leading supplier of replacement parts for the automotive industry. Located in Grass Lake, Michigan, the company is pioneering developments in environment-friendly products and systems that enhance vehicle performance. In particular, Tenneco is exploring the development of technologies for energy recovery of waste heat from exhaust gases, which can reduce net carbon dioxide emissions and improve vehicle efficiency. One of these technologies is the thermoacoustic conversion of heat into acoustic energy, which is then converted into electricity by a diaphragm generator. Although the physical components of such a system are relatively simple, the intricacies of how the technology works can be difficult to explain. To address this issue, the team will design and develop a tabletop-size prototype to demonstrate the thermoacoustic phenomenon behind this energy-recovery technology.

After developing a prototype, a parametric study will be conducted to characterize the performance of the system according to the choice of stack and tube diameter, stack position within the tube and stack length. The results obtained from this investigation will form the foundation for further research and development of this technology for future marketable products.



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Naomi Carlisle
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Grass Lake, Michigan

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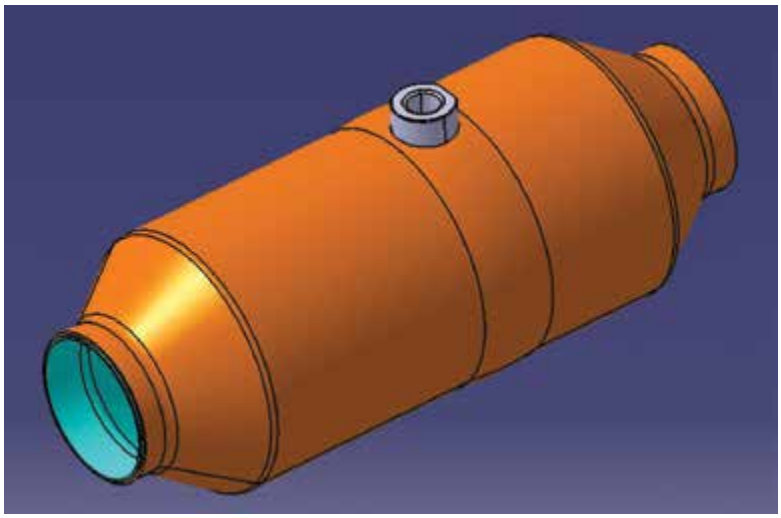
Tenneco Inc.
Design of a Compact Mat Cutting Tool

Tenneco Inc. is a leading manufacturer of vehicle exhaust systems, catalytic converters, and street-vehicle suspensions. Its catalytic converters have been used in vehicles for emissions control since 1975. The catalytic converter uses a ceramic substrate that is wash-coated in precious metals, which undergo catalytic reaction with carbon monoxide, unburned hydrocarbons, and oxides of nitrogen in the exhaust gas to reduce the regulated emissions of the vehicle. The ceramic substrate is wrapped in a metal shell for protection, and a mat is used to form the barrier between the outer shell and the substrate. This mat, made of ceramic fibers, wraps around the circumference of the catalytic converter and rejoins with itself using a tongue design. This tongue design is currently manufactured using a tool and die method but often leaves fiber residue behind. Tenneco wishes to optimize the method of cutting its mats, as well as to add a 30° angled cut as another option for their customers.

This MSU team will create and evaluate a set of conceptual designs for a mat cutter based on Tenneco's design constraints. An optimal design will be selected using a Pugh chart and a prototype will be built to perform at a high level of functionality, while being able to withstand several hundred uses per day. The final design will give a very precise cut each and every time, while being aesthetically pleasing.



TENNECO

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John Neidhart
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Tenneco Inc.
Project Sponsor

Stephen Myers
Grass Lake, Michigan

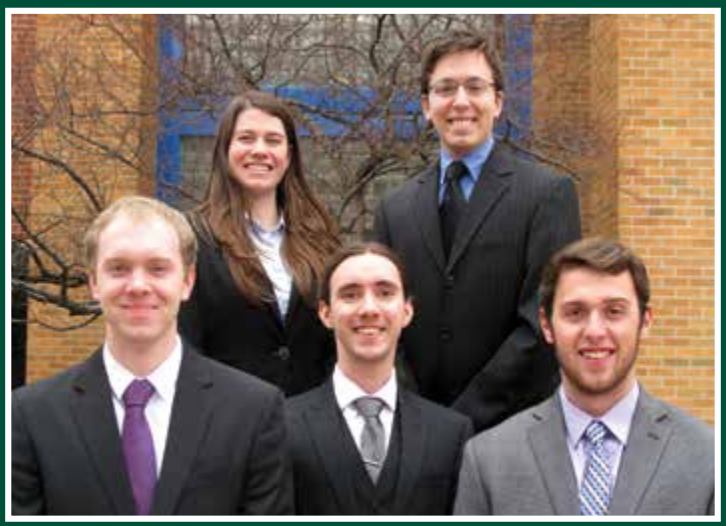
ME Faculty Advisor
Alfred Loos
East Lansing, Michigan

ME 481 Room 1300 | First Floor **11:30 a.m.**

Whirlpool Corporation
Lid Initiated Detergent Dispenser for Washing Machines

Whirlpool Corporation, located in Benton Harbor Michigan, is an international enterprise and one of the world's largest manufacturers of household appliances, such as washing machines, dryers, refrigerators, ovens and microwaves. As part of its efforts to improve existing products and develop new ones, to increase customer satisfaction and market share, Whirlpool is interested in enhancing the user accessibility and simplicity of a top-loading, high-efficiency washing machine.

The MSU team will develop a system which eliminates the need for consumers to lift heavy bottles of liquid laundry detergent, by delivering the detergent directly from a reservoir to the washer basin. This system will be lid-actuated and mechanical in operation. A prototype will be delivered to Whirlpool for testing and possible implementation in future washing machines.



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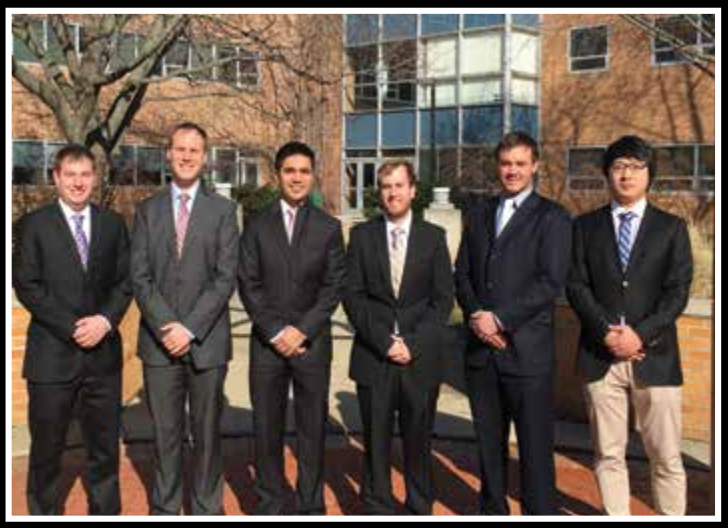
Whirlpool Corporation
Design of a Dryer Door Closure Fixture

Whirlpool Corporation, based in Benton Harbor Michigan, is a major appliance manufacturer. They make a wide variety of home appliances including washers, dryers, refrigerators, ranges, etc. This project is targeted at clothes dryers and the noise the dryer door makes when it is closed. This subtle detail of an appliance's function is important to Whirlpool's operations because it wants to improve all aspects of its current dryers to create a higher quality product in a competitive consumer marketplace.

The MSU engineering team will design a fixture that applies a force to close the door of any Whirlpool dryer. The fixture needs to be able to control and measure the rate of closure of the door and be able to provide that same rate of closure for all shapes, weights and sizes of doors. The rate of closure must be easily adjustable by the operator, either manually or via a software interface. It must also remain quiet for 0.25 seconds prior to and during door closure to allow for accurate noise measurement. The fixture also needs to be mobile and easy to assemble or disassemble to allow for use on different machines. A prototype of the optimal design will be built and tested at MSU and then presented to Whirlpool for further application.



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Whirlpool Corporation
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Dahsin Liu
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Design Day Awards

ME 481 Thomas Alva Edison Undergraduate Design Award

Left to right: Jeffrey Hilk, Mark Taylor, Tyler Finses, Dylan Etheridge, William Burek

The Edison Undergraduate Design Award is given to the ME 481 Design Team that is judged to have produced the best technical design project.

Last semester's scholars designed, built, tested and demonstrated a sprayer system for fruit crops that achieves a remarkable reduction in wasted pesticides. The team was supervised by Dr. Farhad Jaberi.

Fall 2015

ME 481 Project Presentation Award:

The ME 481 Project Presentation Award for the best presentation of a design project was awarded for design of an assembly system to achieve a precise backlash in an engine timing camshaft, in a project sponsored by Hitachi and supervised by Dr. Steve Shaw.

Left to right: Andrew Shih, Shane Toreki, Dan Bowers, Robert Wygant, Ryan Glynn

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. The Leonardo da Vinci award for Fall 2015 was presented to the team with the best design of a power-actuated folding ramp for a wheelchair.

Left to right: Matthew Marchetti, Michael Schwartz, Patrick Frahm, and Lance Roth

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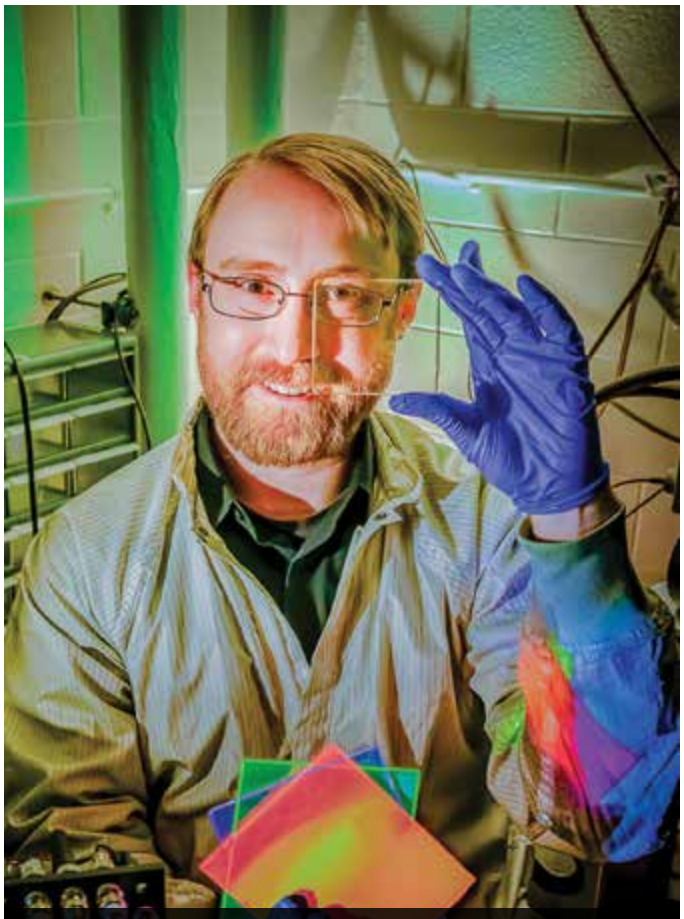

Dr. Richard Lunt was awarded the MSU Innovation Center 2015 Innovation of the Year award for his transparent solar technology. An assistant professor in the Department of Chemical Engineering and Material Science, his technology can be placed on existing infrastructure to discretely harvest solar energy.

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