MICHIGAN STATE UNIVERSITY

MICHIGAN STATE UNIVERSITY

Design Day

COLLEGE OF ENGINEERING

Spring 2017

Microsoft

Executive Partner Sponsor

Microsoft

Welcome from Microsoft

On behalf of Microsoft and the College of Engineering at Michigan State University, we welcome you to Design Day.

At Microsoft, we celebrate a long history of outstanding creativity and design. We are proud to be the Executive Partner Sponsor of Design Day.

We value our longstanding strategic partnership with Michigan State University. We sponsored our first computer science capstone project over a decade ago. Many MSU graduates have joined Microsoft over the years.

Engineering design is a key to the economic engine of our country and our world. The creativity and innovation that is displayed at Design Day gives us confidence for a bright and strong future, knowing that MSU's students of today will become the engineering leaders of tomorrow.

Best wishes to all of the students, their proud parents, faculty and project sponsors.

Special congratulations to all of the graduating seniors.

Go Green!

Scott Wadsworth
Partner Engineering Manager

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Mark Your Calendars!! It's time to save the date for Fall 2017 Design Day!

Join us December 8 2017, 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.

We are pleased to acknowledge Microsoft as our Design Day Executive Partner. Our Design Day Supporting Partner Sponsors include Amazon, Auto-Owners, Blackstone, Bosch, General Motors, IBM, MSU Federal Credit Union and TWO MEN AND A TRUCK®. We thank all of our sponsors for their generosity and their ongoing commitment to Design Day.

As many of you know, Mike Sadler was an outstanding punter for our football team who was tragically killed in an auto accident last summer. As you may not know, Mike earned a Bachelor of Science degree in our Applied Engineering Sciences program in just three years, and then completed a Master's degree in Public Policy before graduating in 2015. After being accepted at several top law schools, Mike chose Stanford Law School where he would have been a member of the class of 2019.

You will see that the back cover of this Design Day book is dedicated to Mike. Starting with this Design Day, we will be honoring Mike's outstanding academic achievements by awarding the first Mike Sadler Medal to the Applied Engineering and Sciences capstone team that goes "above and beyond."

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, which involves some 160 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 28, 2017

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 Students Organizations		1st Floor West Wing Lobby 8:00 a.m. – Noon					
ECE 101 Demonstrations			2nd Floor 2200 Hallway 9:00 a.m. – Noon				
ECE 410 Demonstrations			2nd Floor 2200 Hallway 9:00 a.m. – Noon				
EGR 100/102 Demonstrations			2nd Floor 2300 Hallway 8:30 a.m.-Noon				
ME 371 Demonstrations			1st Floor Rooms 1225, 1230 & 1234 8:30 a.m.-Noon				
ME 471 Competition		1st Floor Room 1345 8:00 a.m. - 11:40 a.m.					
ME 478 Competition			2nd Floor Room 2320 9:00 a.m.-11:00 a.m				
ME 497/MKT 420 Demonstrations			1st Floor Dow Wing 9:00 a.m.-10:30 a.m.				

CAPSTONE COURSES							
All Capstone Posters for most projects, including BE485/487 and ChE 434		1st Floor 1200/1300 Hallway 8:00 a.m. - Noon for most ChE on 2nd Floor 2400 Hallway					
AESC 410/SCM 491 Project Presentations		1st Floor Rooms 1255, 1257 & 1260 Anthony Hall: 8:00 a.m. – 11:05 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 8:30 a.m.-11:25 a.m.				
ME 481 Project Presentations			1st Floor Rooms 1202, 1220 & 1300 8:30 a.m. - 12:30 p.m.				
MSE 466 Project Presentations			1st Floor Room 1145 8:20 a.m. – 11:40 a.m.				

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

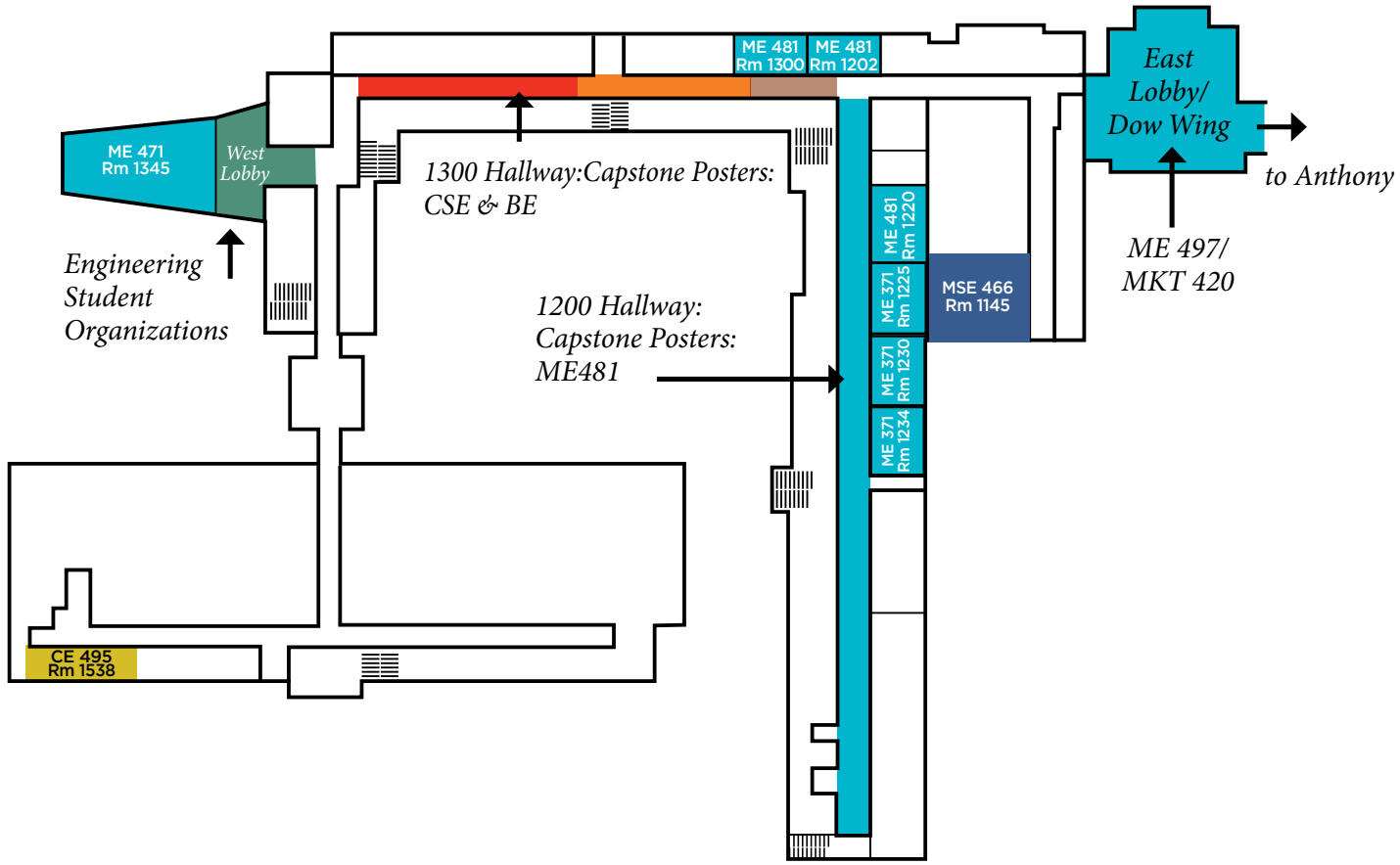
"Like" the College: https://www.facebook.com/SpartanEngineering "Follow" the College: https://twitter.com/msu_egr_news

To stay up to date w/Careers in Engineering:

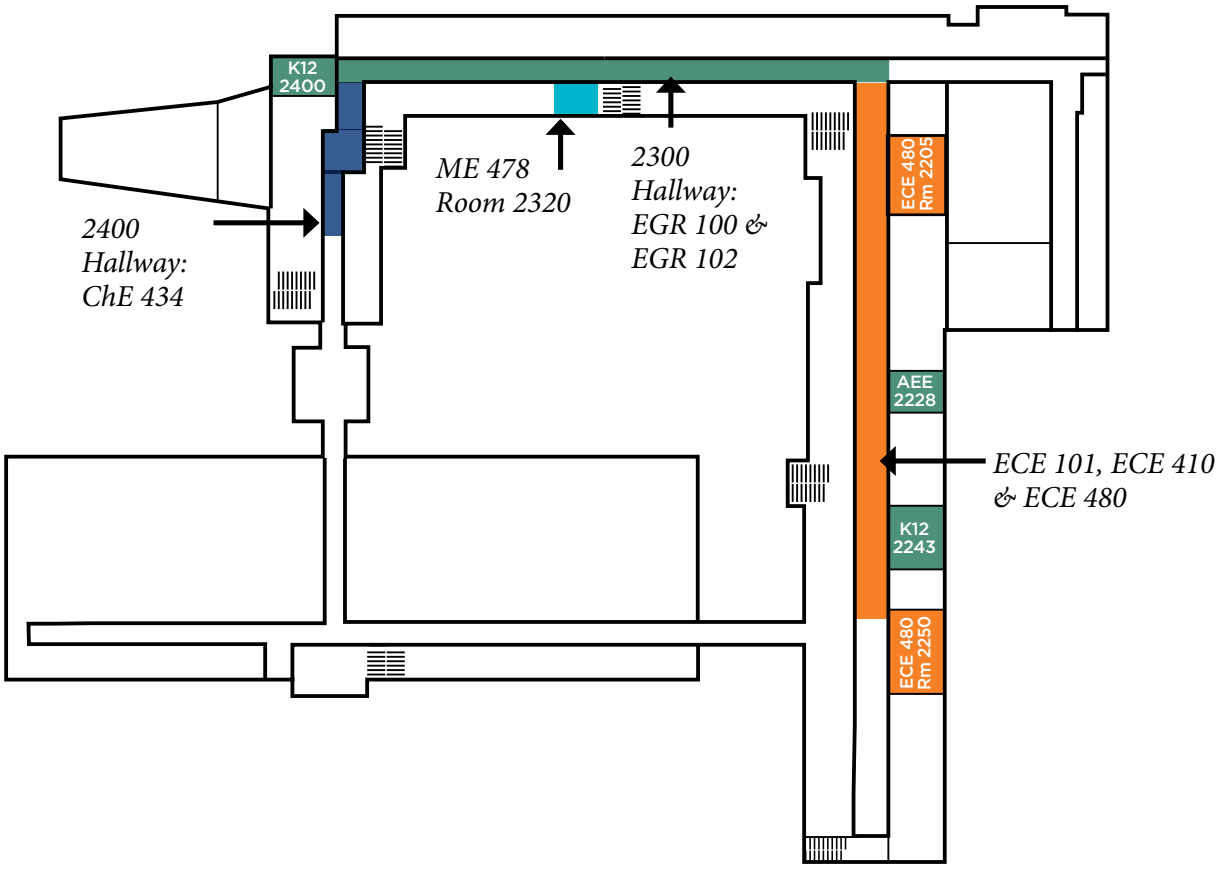
"Like" Us http://www.facebook.com/pages/The-Center-for-Spartan-Engineering/226159694117936

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

1st Floor Engineering

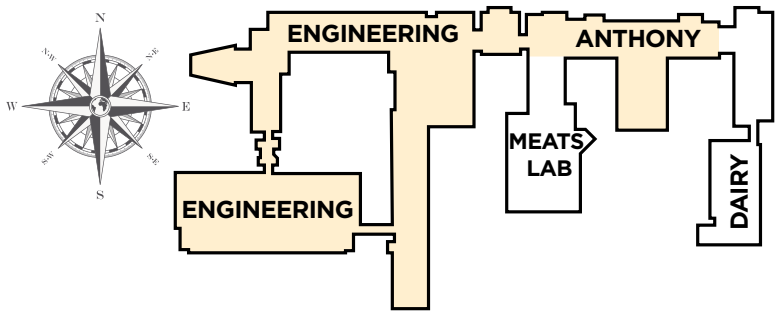


2nd Floor Engineering

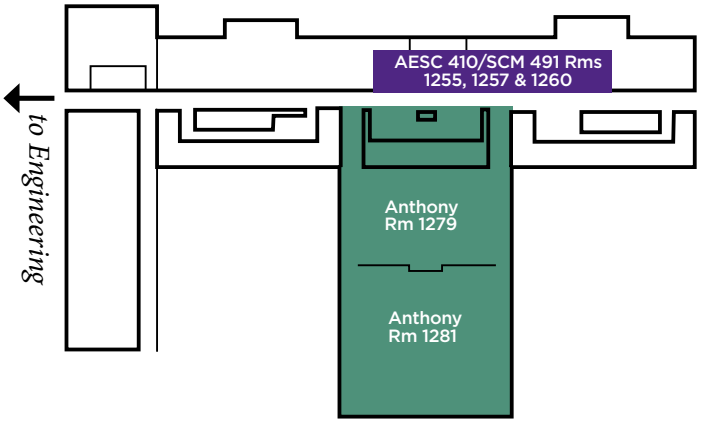


Design Day Floor Plans of the MSU Engineering Building

Overview



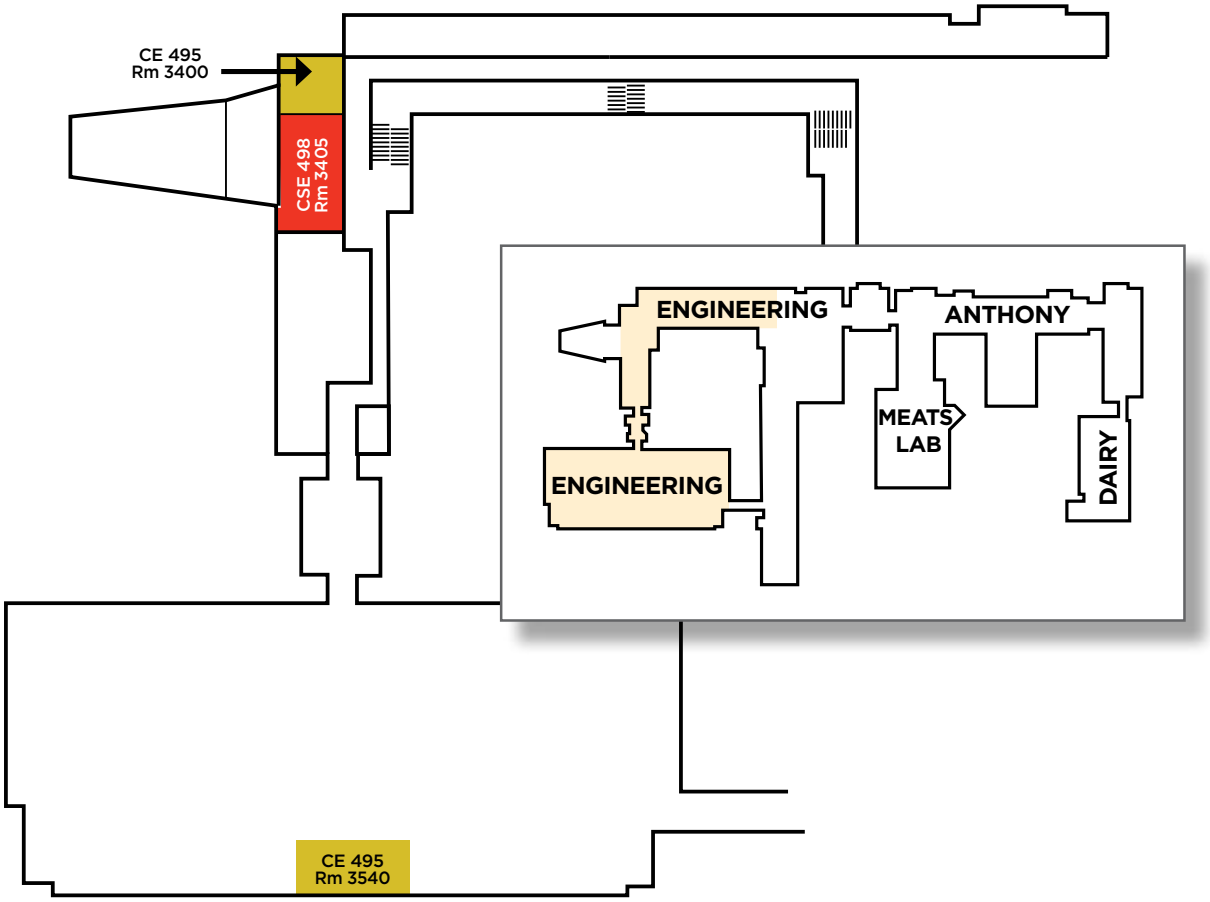
1st Floor Anthony



Color Legend:

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

3rd Floor Engineering



MSU Federal Credit Union is a proud supporter of the 2017 MSU College of Engineering Design Day!

It's our mission at **MSUFCU** to help you achieve your financial goals. We serve MSU students, staff, and faculty by offering low cost loans and higher rate savings.

Join today and learn great tips from our Financial 4.0 team. Gain access to budgeting tools financial calulators, blogs, contests, and more through the Financial 4.0 app!

Visit us online at msufcu.org/financial40 or download the Financial 4.0 app.

BRANCH LOCATIONS:

East Lansing	3777 West Road
	4825 E. Mt. Hope Road
	523 E. Grand River Avenue
	MSU Union, 49 Abbot Road Room 108
Lansing	104 S. Washington Square
	200 E. Jolly Road
	653 Migaldi Lane
	Sparrow Professional Building Suite 300
Haslett	16861 Marsh Road
Okemos	1775 Central Park Drive
	2300 Jolly Road
Mason	1133 S. Cedar Street
Charlotte	180 High Street
Auburn Hills	3265 Five Points Drive
Rochester	102 Oakland Center
Clarkston	8055 Ortonville Road
Ortonville	4 South Street

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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

DART FOUNDATION

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.

The following schools will be participating in this Spring's Design Day events: Brandon High School, Detroit Edison Public High School Academy, East Lansing High School and Women in Engineering

	Room 1279 Anthony Hall Check in for all schools	K'NEX Bridge Team Build Room 2243	VEX Robotics Room 2400	1st & 2nd Floor Voting/project viewing	Trebuchet Launch Competition Anthony Hall 1279
8:00–8:15	Check in for all schools				
8:15–8:30	Welcome & voting procedures				
8:40–9:30		Women in Engineering	Brandon High School	Detroit Edison Public High School Academy	East Lansing High School
9:35–10:20		East Lansing High School	Women in Engineering	Brandon High School	Detroit Edison Public High School Academy
10:25-11:10		Detroit Edison Public High School Academy	East Lansing High School	Women in Engineering	Brandon High School
11:15-12:00		Brandon High School	Detroit Edison Public High School Academy	East Lansing High School	Women in Engineering
12:15–12:30	Awards Ceremony, 1279 Anthony Hall, lunch immediately after (EVERYONE)				

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

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 2017

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

Dean Buggia
Instructor and Technology Teacher, Okemos High School

Rigoberto Burgueno
Civil Engineering Faculty

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

Rachel Esch
K-12 Outreach Secretary

John Plough
AP Physics Teacher East Lansing High School

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

Imen Zaabar
UTC Faculty and Outreach Team

K12 Awards Fall 2016

EGR 100 Kids' Choice Award (Tie)
LEGO MINDSTORMS ROBOTICS TOURNAMENT

EGR 100 Kids' Choice Award (Tie)
Lego Battlebots: the Journey of Four Diligent Engineering Students

ME 371 Kids' Choice Award

ECE 480 Kids' Choice Award
Winning Team Advisor: Dr. L. Udpa

Mr. R. Watson, VEX Robotics Instructor, poses with the VEX Robotics Champions:
The Grand Rapids Home Schooled Team

The Grand Rapids Home Schooled Team Wins the K'Nex Bridge Challenge
Led by Mr. D. Buggia

The Women in Engineering Team Dominates the New Trebuchet Launch
Led by Mr. J. Plough

EGR 100 Introduction to Engineering Design

Dr. Jenahvive Morgan
Academic Teaching Specialist

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 726 students enrolled in EGR 100 this semester.

For the final course project, the student teams selected from six project types: (i) Solar Car Competition, (ii) Cell Phone App Inventor, (iii) Robotics Competition (iv) MSU Adaptive Sports and Recreation Club Project, (v) Residence Education and Housing Services (REHS) Design and (vi) CoRe industry-sponsored projects. The Adaptive Sports and Recreation Club project involved the design of an athletic wheelchair transfer aid and the REHS project addressed improvements to the residence hall move in / move out process. CoRe industry-sponsored projects involved collaborations with ArcelorMittal on parking lot optimization and safety, Delphi on 48-volt mild hybrid architecture, and Tenneco on the design of heat pipes. Teams from each of the project types will display their prototypes at Design Day together with posters detailing their design concepts. Pre-college students will recognize the most outstanding projects with awards.

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

Fall 2016 EGR 100 Project Poster Award Winners:

l-r: Tim Hinds, Pat Walton, Kennedy Brown, Jacob Bruner, John Miller, Jenahvive Morgan, Dean Kempel Not Pictured: Myriam Sarment

l-r: Tim Hinds, Pat Walton, Emma Malik, Heidi Theisen, Ben Merrill, Brian Hofer, Jenahvive Morgan, Dean Kempel

PPG GE TENNECO UNION PACIFIC

MSU Adaptive Sports and Recreation Club

RESIDENCE EDUCATION AND HOUSING SERVICES
RESIDENTIAL AND HOSPITALITY SERVICES

Consumers Energy Count on Us ArcelorMittal DELPHI BOSCH Invented for life

EGR 102
Introduction to Engineering Modeling

Dr. Janet Lam
Academic Teaching Specialist

Course Project

EGR 102, Introduction to Engineering Modeling, is a course required of the majority of engineering students. It is a foundational course in programming, data management and numerical modeling.

This year, EGR 102 partnered with BP to solve a real-world optimization problem. BP's Whiting Plant has a range of turbines that can be run to produce energy. Students used the programming skills learned in class to develop models that would solve a variety of problems, including minimizing emissions, maximizing energy output, and minimizing waste. A select group of EGR 102 projects will be demonstrated on Design Day.

BP Whiting Plant

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

Dr. Lam with students from the BP Whiting Plant project.

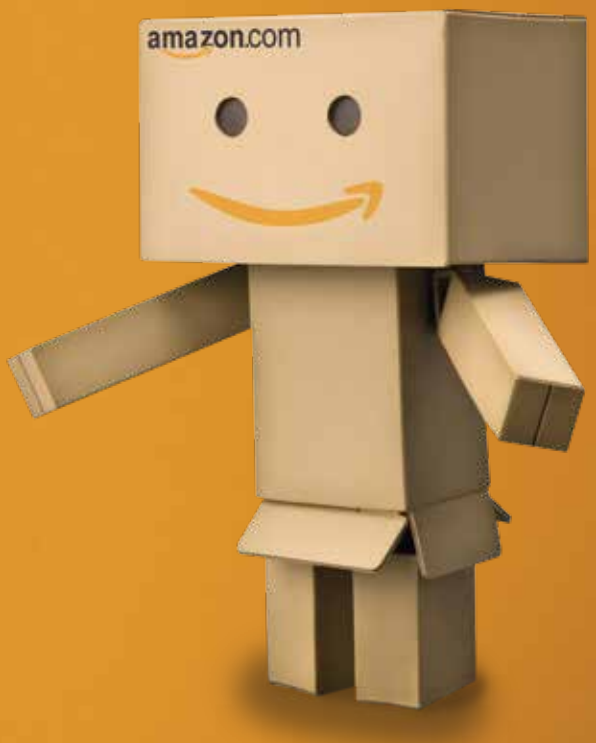
amazon detroit

Opportunities for students and new graduates

At Amazon, our evolution has been driven by the spirit of innovation that is part of our DNA. As a new college graduate or intern, you can have multiple opportunities to innovate and solve real-world, complex technical and business problems as you join us on our journey.

We strive to hire the brightest minds from the best universities globally, and have various career opportunities available for undergraduates and advanced degree students with diverse academic backgrounds.

The work environment here is fast-paced and continually evolving, and every Amazonian is passionate about ownership and delivering results for the company. If you want to work in an environment that will challenge you to relentlessly improve the Amazon experience for our customers, where each day is different from the next, and your learning never truly ends, take a look at Amazon's many university and graduate opportunities.



www.amazon.jobs

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.

American Axle Manufacturing
Detroit, Michigan

ArcelorMittal
Burns Harbor, Indiana

Asahi Kasei Plastics North America
Fowlerville, Michigan

Continental
Fort Mill,
South Carolina

Destination Kohler
Kohler, Wisconsin

Dow Chemical
Midland, Michigan

Great Lakes Wine & Spirits
Highland Park, Michigan

Hess
Houston, Texas

Ingersoll Rand
Davidson, Norh Carolina

Kohler
Kohler, Wisconsin

Intel
Chandler, Arizona

Johnson Controls
Milwaukee, Wisconsin

MSU Infrastructure & Planning Facilities
East Lansing, Michigan

Michigan National Guard
Lansing, Michigan

Ranir
Grand Rapids, Michigan

Union Pacific
Omaha, Nebraska

Applied Engineering Sciences

Dr. Laura J. Genik
Director
Applied Engineering Sciences

Dr. Srinivas (Sri) Talluri
Professor of Operations and Supply Chain Management
The Eli Broad Graduate School of Management

Graduate TAs, Supply Chain Management, The Eli Broad Graduate School of Management

Mohamed Hrezi
MBA (2018)

Ellen Kellner
MBA (2017)

Aaron London
MBA (2018)

Ana Sarabia
MBA (2018)

Time	Sponsor	Project Title
PRESENTATION SCHEDULE ANTHONY HALL 1255		
8:00 a.m.	Kohler	Space Planning
8:25 a.m.	Kohler	Hospitality and Inventory Rationalization
8:50 a.m.	Kohler	Total Cost of Ownership Analysis
Break		
9:30 a.m.	Michigan National Guard	Comparative Analysis of Resiliency Programs
9:55 a.m.	Ranir	Continuous Improvement / Lean Manufacturing Project for a Toothbrush Packaging Line
10:20 a.m.	Union Pacific	Wood Tie Disposal Optimization Project
PRESENTATION SCHEDULE ANTHONY HALL 1257		
8:00 a.m.	Ingersoll Rand	Global 3PL Landscape
8:25 a.m.	Ingersoll Rand	Logistics Inflation / Deflation Modeling
8:50 a.m.	Ingersoll Rand	Transportation Mode Optimization
9:15 a.m.	Ingersoll Rand	Global Risk to Transportation Modes
Break		
9:50 a.m.	Intel	Automated Repairable Inventory Management & Tracking
10:15 a.m.	Johnson Controls/MSU IPF	Design of a Decentralized, Decarbonized District Energy Strategy
10:40 a.m.	Johnson Controls/MSU IPF	Design of a Decentralized, Decarbonized District Energy Strategy
PRESENTATION SCHEDULE ANTHONY HALL 1260		
8:00 a.m.	American Axle	Part Standardization Project: Identify Identical Indirect Items within Database
8:25 a.m.	ArcelorMittal	Scrap Logistics Optimization & Cost Minimization
8:50 a.m.	Asahi Kasei Plastics	Logistic Network and Trailer Optimization
9:15 a.m.	Continental	Rearview Camera Market Assessment
Break		
9:50 a.m.	Dow	Extending ATP Capabilities through Improved SC Visibility
10:15 a.m.	Great Lakes Wine & Spirits	Warehouse Space Optimization
10:40 a.m.	Hess	Master Labor Material Group: Development and Implementation

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, SCM 491.

Kohler Company
Space Planning

Kohler Co. is a private company started in 1873 with more than 50 manufacturing locations on 6 continents and more than 30,000 associates worldwide. The Kohler family of businesses creates products that set the standard in kitchen and bath, engines and generators, furniture and tile, as well as resort, recreation and real estate.

Through a long-term development period, Kohler has faced many challenges and opportunities. As Kohler continues to grow, they will need a new floor plan for their offices; a plan that will attract and retain talent, as well provide the best atmosphere for collaboration and business growth.

Kohler Co. Space Planning Project (KCSP) is initiated to focus on creating a new floor plan for 400 employees in Wisconsin. The project is based on the idea of constructing a building next to the Kohler Distribution Center. This will form a comfortable and efficient office environment with more space, windows, amenities, technology and collaboration areas. The other major purpose of this floor plan is to decrease expenses by becoming more sustainable and efficient.

Both the building process and the maintenance process will be sustainable to face the growth target in next 10-20 years. The inner design of the project will improve employee work experience and associates' executive initiatives. The new floor plan's office setting will create a more effective and efficient flow of communication. Nonetheless, the new floor plan will have divided sections for each department, but will also be designed to improve interdepartmental collaboration.

Headquarters in Kohler, WI

KOHLER®

Michigan State University
Team Members (left to right)

Huaigu Xu
Yueqing, China

Shen Zhou
Hangzhou, China

Tianwei Yang
Suzhou, China

Haoran Li
Chongqing, China

Jingqi Yang
Shijiazhuang, China

Zhenghao Yu
Shanghai, China

Kohler Company
Project Sponsors

Drew Goins
Kohler, Wisconsin

Craig Lieffring
Kohler, Wisconsin

Dave Strach
Kohler, Wisconsin

Teaching Assistant

Mohamed Hrezi
Naugatuck, Connecticut

Kohler Company
Hospitality and Inventory Rationalization

Destination Kohler is a hospitality and real estate subsidiary of the well-known Kohler Company headquartered in Kohler, Wisconsin. It encompasses many elite resorts and golf courses such as the Old Course Hotel in Saint Andrews, Scotland and the Whistling Straits golf course in Sheboygan, Wisconsin.

Currently Kohler owns a warehouse located in Sheboygan Falls, Wisconsin that stores all of their attic stock from resort renovations across their 9 properties, as well as some materials for their new facility scheduled to open in July. This inventory is currently sorted by property, and racks have been installed to house all materials. However, to this point none of these materials have been documented nor has any formal inventory system been implemented.

The objective of this project is to identify proper processes, inventory levels and systems in place to manage inventory and ensure the company can continuously provide a higher level of gracious living for their Hospitality and Real Estate divisions. The solution to the current state of inventory will benefit Kohler to reduce the global environmental footprint through rationalization of current inventory. Analyzing competitors' current inventory management allows Kohler to understand the competitive advantages. Further, it is necessary to identify inventory management software to better keep track of changes in inventory. Finally, developing an action implementation plan helps bring the analysis to reality.

DESTINATION KOHLER

Michigan State University
Team Members (left to right)

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Bingyan Lin
Wuhan, China

Andrew McClennen
Rochester Hills, Michigan

Jocelyn Modelski
Brighton, Michigan

Frank Sardelli
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Beijing, China

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Farmington Hills, Michigan

Kohler Company
Project Sponsors

Darren Hermanson
Kohler, Wisconsin

Eric Phillipson
Kohler, Wisconsin

Teaching Assistant

Mohamed Hrezi
Naugatuck, Connecticut

Kohler Company
Total Cost of Ownership Analysis

For well over a century, Kohler has made the concept of gracious living their mission. With more than 50,000 locations on six continents and a team of over 30,000 associates, they have touched every corner of the world with this goal. Since the company's start in 1873, they have expanded from kitchen and bath, to furniture and decorative products, engines and generators, and golf resort destinations. Due to Kohler's global reach, the use of supply chain management is more important than ever. Thus, they have sought the help of our team to assess their SCM system.

The first task of this project was to establish a Total Cost of Ownership analysis for Kohler's Global Faucets division. The Total Cost of Ownership is a quantifiable estimation tool that incorporates the total indirect and direct costs associated with a product and its placement. This includes, but is not limited to procurement rates, operational costs, logistic costs, administrative costs, inventory costs, and other additional costs, to help Kohler determine the most efficient supply chain for a given product/part.

The second aspect of this project was to benchmark Kohler against other product-based companies using similar TCO metrics. As instructed by the Kohler team sponsors, we designed a user-friendly web based interface, which can analyze and display coherent and useful supply chain metrics based on the information and formulas previously established. For example, the interface would allow a user to input information on a certain item or product and then provide all the costs associated with the item within every process involved.

KOHLER®

Michigan State University
Team Members (left to right)

Angelina Bradley
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Jordan Lehman
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Grand Rapids, Michigan

Kohler Company
Project Sponsors

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Kohler, Wisconsin

John Sowatsky
Kohler, Wisconsin

Teaching Assistant

Ellen Kellner
Grass Lake, Michigan

Michigan National Guard

Comparative Analysis of Resiliency Programs

This past year the Michigan National Guard received a 1st place Environmental Security Award for Sustainability from the National Guard Bureau. They have published more than 15 environment related feature stories since 2009 and are a leader amongst national guards when it comes to resiliency and sustainability.

Michigan State University has pursued sustainable projects and research all over the world in an effort to increase awareness and sustainable prosperity. "Be Spartan Green" is not only a slogan for the campus but a way of life for many of MSU's researchers and innovative minds.

The Michigan National Guard has decided to partner with the College of Engineering at Michigan State University to draft a white paper for the National Guard to take to leadership. This white paper will investigate, compare and analyze different power programs that have worked or not worked and will present the best path to energy resiliency for the National Guard. The Michigan National Guard will use the analyzation of successful energy resilience programs to request additional funding for sites around Michigan. These chosen energy programs will allow certain National Guard bases to operate "off the grid" while also being sustainable and environmentally aware.

The Applied Engineering Sciences students assigned to this project look to not only improve the current projects underway at the Michigan National Guard sites but also look to more innovative energy projects in the solar, wind and other sustainable energy types. Once the best sustainable option is chosen and brought forth to the Michigan National Guard, the team hopes that this information will not only improve Michigan's National Guard sites, but also National Guard sites around the country.

MICHIGAN NATIONAL GUARD

Michigan State University
Team Members (left to right)

Steven Michos
Easton, Connecticut

Jason Humphreys
Clarkston, Michigan

Joi Taylor
Detroit, Michigan

Robert Hughes
Saginaw, Michigan

Meghana Gudivada
Bloomfield Hills, Michigan

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Ranir LLC

Continuous Improvement/Lean Manufacturing Project for a Toothbrush Packaging Line

Ranir is a leading global private manufacturer of oral and personal healthcare headquartered in Grand Rapids, Michigan. The company is driven by the belief that oral preventive care is essential to maintaining overall superior health. Recently the company has been able to expand their global footprint by innovating into new product lines and entering new global markets through acquisitions.

This project will be designed to improve the throughput and efficiency of products on this work center. Workstations that will be observed will have multiple changeovers, (such as different product being run through the line), the time impacted by those changeovers per shift, and product complexity by toothbrush style, toothbrushes per package, and tooling for the process.

Students will use an A3 form to help identify current state and future state goals. The team will be led by a Manufacturing Engineer in the toothbrush business unit. Data will be collected in the form of pictures, videos, and timing of procedures to help achieve the desired goals. Procedures and documents may need to be created to help with the training of future workers.

Students should be able to present to Ranir and to MSU leadership, the current state situation, inclusive of the impact to current production efficiencies. Data will need to be provided that supports current state situations, which will highlight the loss of production hours due to multiple changeovers. Data will also need to be provided to support the future state improvements, based upon what they come up with to help minimize the time required for changeovers.

Ranir
CUSTOMER ADVANTAGE · CONSUMER CONFIDENCE

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Union Pacific Railroad

Wood Tie Disposal Optimization Project

Union Pacific (UP) is one of the world's largest transportation companies with 8,500 locomotives and 44,500 employees nationwide. It is the largest and one of the oldest freight hauling railroad companies in the United States. The original Union Pacific was incorporated on July 1, 1862 under President Abraham Lincoln. Headquartered in Omaha, Nebraska, the company predominately serves states west of the Mississippi River. UP is constantly updating its infrastructure and, with a span of over 32,000 route-miles, has a massive demand for disposal of railroad material. One of the major extra expenditures that Union Pacific faces is handling used rail ties.

Typically made of treated wood, rail ties are the beams laid perpendicular to railroad tracks. Their purpose is to distribute weight, hold rails upright and keep them correctly spaced apart. Currently, Union Pacific removes over 4.6 million ties per year through a process that is 95% automated. After removal, ties are laid beside the tracks to await pickup from a private contractor. These contractors are hired by the company to transport and properly reallocate and/or dispose of the material. UP questions whether its disposal practices, and the practices of its contractors, are the most efficient solution in terms of cost and use of resources. Currently, it spends 10s of millions of dollars on disposal of used wood ties. Union Pacific is seeking a better, more efficient way to potentially reuse, recycle or dispose of these ties that will lower costs, increase capacity on the railroad and improve environmental sustainability.

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Ingersoll Rand
Global 3PL Landscape

Ingersoll-Rand is a global diversified industrial company formed in 1905. The company's corporate headquarters are in Dublin, Ireland, and its American headquarters are in Davidson, North Carolina. Ingersoll-Rand (IR) has been a constituent of the S&P 500 Index since 2010. IR has 51 plants worldwide and is comprised of six major subsidiaries, Club Car, Ingersoll Rand, Thermo King, Trane, Aro, and American Standard Heating & Air, all dedicated towards advancing quality of life by creating comfortable, sustainable and efficient environments. IR aims to enhance the quality and comfort of air in homes and buildings, improve the transportation and protection of food and perishables, and increase industrial productivity and efficiency.

With data from inbound and outbound warehouses, this project is aimed towards understanding Ingersoll Rand's global 3PL landscape. Using the locations of warehouses and the evaluation of their footprint (size, location, scope, owner name, provider), IR will be able to locate specific SBUs by priority and use better decision-making across the various markets that IR occupies. With this in mind, IR will be able to improve customer satisfaction and reduce operating costs by creating a comprehensive map of their global 3PL landscape. The goal of this map will be to help consolidate the smaller 3PL strategy into a more comprehensive, company-wide 3PL approach.

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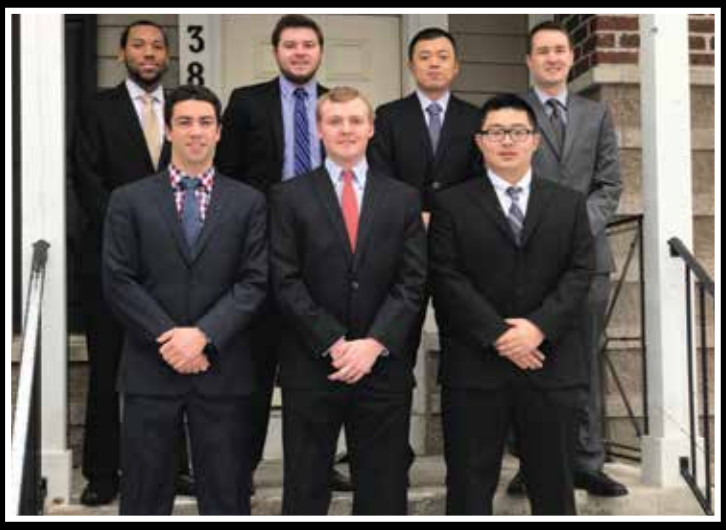
Ingersoll Rand
Logistics Inflation / Deflation Modeling

Ingersoll Rand is a global industrial company consisting of two distinct divisions. The industrial division focuses on products related to air compression and power tools. The second division is climate; it includes air conditioning, refrigeration, Thermo King, and Trane cooling solutions.

Through a logistics perspective, Ingersoll Rand strives to provide low-cost and high-quality services when moving products between factories, distribution centers and warehouses. Currently, Ingersoll Rand outsources their transportation methods through a 3PL company. Ingersoll Rand's current logistics inflation/deflation model is very generic and routinely deviates from the actual costs. Our goal is to produce a more accurate inflation/deflation model based on historic performance and future estimates to statistically derive the proper price for all cost components. The appropriate methods for retrieving marketplace insight will be discovered and will allow us to build a model that can accurately predict the cost of each transportation mode.

To develop this model, the annual reports over the past decade will be examined to identify areas that have traditionally provided inaccurate predictions. Once these problem areas are identified, the problematic data will be examined and cross-referenced with each year to help explain why the past modeling failed. Finally, the data will be compiled to help improve the analytical and predictive abilities of the modeling software. Also, it will be imperative to observe the external variables associated with logistical costs. These variables can range from specific transportation locations to specific transportation modes such as TL, LTL, Ocean, Air and railroad. Such factors will have effects on market fuel costs and other rates charged by 3PL companies.



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AESC 410/SCM 491 Anthony Hall, Room 1257 | 1st Floor **8:50 a.m.**

Ingersoll Rand: Trane
Transportation Mode Optimization

Ingersoll Rand, which started in 1871, provides market-leading solutions and services to its customers. As of May 2016, Ingersoll Rand employed 45,000 people and realized $13.3 billion in revenue. The Trane business unit is divided into two segments: Climate and Industrial. This project will focus on the climate segment of the business.

Trane Inc. is a subsidiary of Ingersoll Rand Inc., with locations at three plants throughout the United States: Tyler, Texas; Trenton, New Jersey and Vidalia, Georgia. Trane offers a wide range of energy efficient residential and commercial systems, including heating, ventilation, and air-conditioning. These finished goods and aftermarket parts are shipped multiple times from one of the three factories to their largest distribution center located in Bridgeton, Missouri.

There exists no tool today within the company to study and optimize these transportation modes for the finished goods, and as a result, cycle time is extended to deliver products to customers at higher transportation costs. An additional point to consider is that extended transportation cycle time results in holding higher inventory in the supply chain, also a cost driver, in terms of increased working capital above healthy levels.

The output of the project will be a recommendation to the Global Logistics and Distribution Team of Ingersoll Rand to change its transportation modes in a way that optimizes the on-time delivery and profitability. In addition, the team will analyze the footprint opportunity reductions of these improved routes and compare them to the routes that the company currently uses.

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Ingersoll Rand
Global Risk to Transportation Modes

Headquartered in Davidson, North Carolina and founded in 1871, Ingersoll Rand is a diversified industrial manufacturing company which advances the quality of life by creating comfortable, sustainable and efficient environments. They serve customers in global commercial, industrial and residential markets with market-leading brands such as Thermo King and Trane. For over 100 years, they have been operating as a distinguished example of integrity and product quality.

In September 2016, a major South Korean ocean carrier, Hanjin, went bankrupt. When they declared bankruptcy, they had nearly a hundred vessels full of containers on the seas around the world, which left the cargo on the ships stranded out on the water. Many companies were negatively affected by this surprise event. Hanjin's bankruptcy served as an alert to Ingersoll Rand that risks to transportation are never far away and oftentimes hard to predict; it also provided them with an incentive to assess their risk exposure in other transportation modes, namely truckload (TL) and less-than-truckload (LTL), in order to be better prepared for unexpected events.

The primary purpose of this project is to assist Ingersoll Rand in assessing and analyzing risks associated with TL and LTL transportation modes in the U.S., which comprise nearly 70% of their shipping interests in the country. There are plenty of factors that influence the trucking industry, like fuel prices, labor costs, and government regulations. This project will provide Ingersoll Rand with a comprehensive and concise risk awareness of the U.S. TL and LTL transportation modes. It will include a detailed report on events that happened in 2016 which affected the U.S. TL and LTL industry as well as potential influencing factors on the horizon for the year of 2017. In addition, a document with all of the recommendations that were generated during the research and analyses will be included. This information will provide Ingersoll Rand with a better view of the tumultuous U.S. trucking industry, allowing them to respond more effectively and to successfully mitigate risks that are associated with their domestic shipping lines.

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Intel Corporation

Automated Repairable Inventory Management & Tracking

Intel Corporation is a multinational technology company headquartered in Santa Clara, CA. It is the world's largest, and most valued semiconductor chip maker. The manufacturing of advanced processors requires expensive equipment, which regularly requires maintenance. This project focuses on the repair process for the equipment used in Intel's manufacturing factories. The current repair process requires the involvement of several third-party companies, making it difficult to maintain visibility throughout the process.

The project's goal is to decrease the time it takes for Intel's internal inventory to be repaired. To accomplish this, the visibility throughout the system will be improved by increasing automation as much as possible. This involves researching the current steps in the repair loop, performing a SWOT analysis on the possible improvements developed for each step, and analyzing the third-party companies for possible improvements. This project will require bringing in more technology to the Intel repair supply chain and improving the tracking of the inventory.

Successful implementation of this project would give a much clearer and more accurate picture of repair loop inventory leading to substantially increased throughput time and lower overall inventory requirements. This would dramatically decrease part and warehousing spends while allowing for greater availability through network optimization and live identification and management of supply chain bottlenecks.

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Johnson Controls/MSU IPF

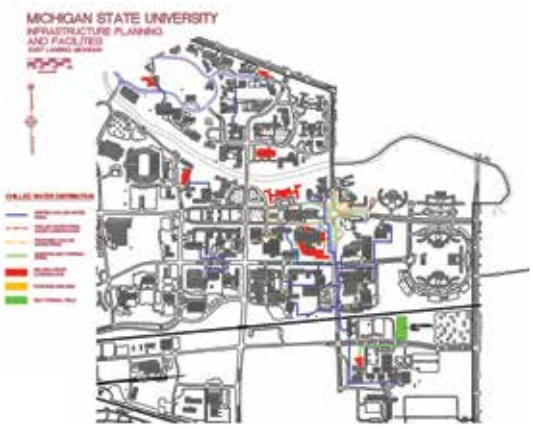
Design of a Decentralized, Decarbonized District Energy Strategy

Michigan State University is constantly on the lookout for new ways to improve its campus' sustainability, and has a multitude of goals that it wishes to reach over the coming years. As part of its effort to reach these goals, the University's Infrastructure Planning and Facilities division has instructed this team to analyze energy use data on campus and determine an effective Decentralized, Decarbonized District Energy Strategy (D3E) to improve campus energy usage.

The central area of MSU's campus, shown to the right of this summary encircled in red, was designated by IPF as a target for D3E implementation. Energy data, including heating, cooling and electricity use, was then provided for analysis. Once data had been reviewed and organized, energy use could be modeled by using inverse models. Once this was completed, the team could propose potential improvements that would be modeled in conjunction with sponsor Johnson Controls using LEAN energy analysis software.

Several determinations were made once LEAN energy modeling was complete, and the team's D3E proposal, along with additional potential improvements, were defined. The team then began using central plant optimization, a service also provided by sponsor Johnson Controls, to size the plan effectively to the target area.

With a strategy effectively modeled, and showing potential energy use improvements, it could then tackle quantifying costs and tradeoffs to implementing the plan, including those associated with implementing only parts of the D3E proposal. With this complete, MSU IPF can then use the project in the future as a potential model for improvements in energy use in the defined central region of campus.



Johnson Controls

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AESC 410/SCM 491 Anthony Hall, Room 1257 | 1st Floor **10:40 a.m.**

Johnson Controls/MSU IPF

Design of a Decentralized, Decarbonized District Energy Strategy

Throughout the semester, the team will work with Johnson Controls (JCI) in cooperation with Michigan State Infrastructure Planning and Facilities (MSU IPF). Johnson Controls is an industry leader in building efficiency and has earned its spot in the Fortune 500 for its integrative facility management. JCI has integrated a variety of buildings in more than 500 locations worldwide, ranging from industrial to healthcare buildings. Infrastructure Planning and Facilities (IPF) maintains the integrity of MSU's buildings, they pride themselves on the key values of stewardship, innovation, and service excellence.

The overall goal of the project is to complete a conceptual design of a decentralized, decarbonized district energy strategy for a collection of buildings on Michigan State's campus. There are two distinct steps within the project, which are achieved through Johnson Controls' tools: LEAN Analysis and Optimization Solutions.

First, the collection of annual heating, cooling and energy costs will be used with local weather data in the LEAN Analysis tool. This tool will produce information, which will allow the team to further analyze areas of improvement for the buildings. Next, Optimization Solutions will provide further information on the possible solutions.

With the information from the LEAN Analysis and Optimization Solutions, the team will evaluate potential environmental, economic and educational impacts of the proposed design. The proposed design will evaluate trade-offs in relation to costs and operations with the ultimate goal of reducing costs and improving efficiency.

Johnson Controls

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American Axle & Manufacturing

Part Standardization: Identify Identical Indirect Items within Database

The Michigan State University Team will benefit American Axle & Manufacturing by driving down cost within AAM's MRO (Maintenance, Repair & Operations). This will be achieved primarily by developing a parts standardization program. They will complete this project in two phases:

The first phase is to analyze AAM's master data and develop a methodology for identifying duplicate items in the database that are made by different OEMs. After, they will report their findings and calculate the inventory reduction opportunity due to the consolidation of common items.

The second phase is to be able to implement this newly created methodology throughout the company. This will eliminate any coding duplicates in AAM's database. It will also prevent duplicate coding when requests for any new items are submitted.

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ArcelorMittal

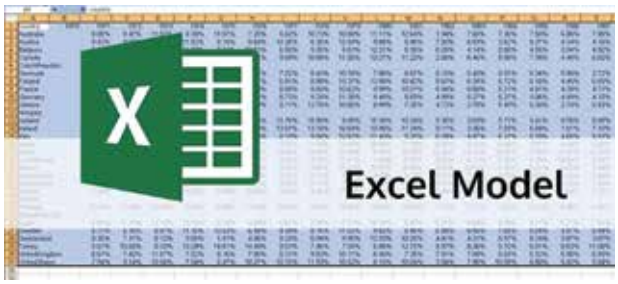
Scrap Logistics Optimization and Cost Minimization

The ArcelorMittal Scrap Purchasing Team is responsible for procuring scrap steel for seven of their USA plants. Scrap steel is an input in the manufacturing of steel. Each month, they look at production levels and forecast how much scrap will be required to produce the expected tonnage. They try to use internally generated scrap first, and then any excess needs must be bought on the market.

There are several scrap commodities that are priced differently according to their grade. "Prime" scraps are the most expensive, "Cut" or "Obsolete" grades are the least expensive and the "Shred" grade can vary. Each plant has a different mix of commodities that they use for their scrap input. Additionally, some of their facilities only accept certain types of scrap because of the type of steel that they make.

The goal is to create a model in Microsoft Excel that incorporates the various prices of the scrap commodities, the levels of inventory at each site, and the constraints in the scrap mix. The model will be constructed for various site locations. It needs to be noted that the ideal inventory levels should be maintained throughout the month as the sites do not want to run out of scrap but also do not want to keep too much on-site. In addition, the company wants to purchase as much non-prime scrap as possible in order to decrease the purchasing cost.

The final Excel model will have the capability for adjustments in prices and tonnages. This model will be used to track, purchase and plan for scrap across each ArcelorMittal USA Plant.



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Asahi Kasei Plastics

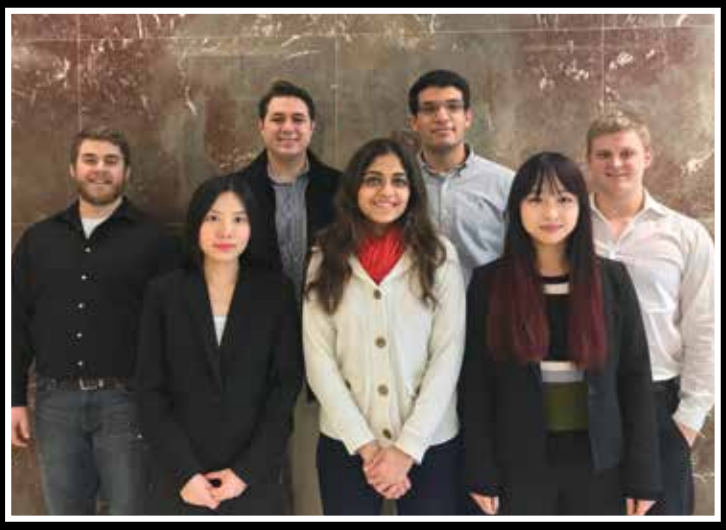
Logistic Network and Trailer Optimization

Asahi Kasei Plastics is a highly competitive manufacturer of high performance plastic compounds for OEMs and suppliers globally. Asahi Kasei's materials are used to make a wide variety of products ranging from automotive parts to spa and pool components, while still offering the highest degree of customizability for their customers.

With manufacturing plants and warehouses across the United States, Asahi Kasei Plastics must maintain a highly versatile and efficient supply chain to provide excellent service to their customers located around the world. Over the last 5 years Asahi Kasei plastics has been growing rapidly, and this has caused the logistics team to search for even more efficient solutions and tools to optimize their current supply chain network.

To assist with this challenge, Asahi Kasei Plastics has enlisted our team to analyze current logistics operations, and identify cost-saving opportunities that currently exist within the logistics network as Asahi Kasei Plastics moves towards leaner and more competitive carrier operations. This project includes analyzing the modes of transportation currently utilized by the Asahi Kasei Plastics logistics team, as well as material and packaging costs, and historical shipping data. Truckload (TL) and Less than Truckload (LTL) carrier pricing are also crucial variables considered in the analysis along with customer order frequency, due dates and ship-to locations. Using this analysis, the team is engineering macros within Microsoft Excel that will automate reporting and optimize current routing capabilities. Such automation will help Asahi Kasei Plastics realize cost- saving opportunities in their logistics network.

ASAHI KASEI PLASTICS
Advanced Material Solutions



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Continental
Rearview Camera Market Assessment

Hello from the Continental rearview Market Analysis Team! Throughout the semester, our team has produced a front-to-back market analysis on rearview camera systems which involved 4 major milestones:

1) Consumer Feedback: What do customers think about various rearview camera systems?
2) Aftermarket opportunities: In terms of vehicles without rearview camera systems, what aftermarket opportunities exist? How big is this market? Where should we price the rearview camera?
3) Competitive camera teardown analysis: How is the camera packaged? What key attributes exist with these cameras?
4) Vehicle performance benchmarking: Who is providing cameras to customers in North America? What other features could be added?

Continental left the project completely open-ended and said they are looking for a fresh perspective on this market. The project entails utilizing knowledge in various fields in order to come up with the best possible snapshot of the market for rearview cameras. This is especially important now that all cars are mandated to have some form of camera system integrated into the car. The rearview camera is still relatively new to cars. This means we need to have a better understanding of the market, the wants and needs of various consumers to give Continental a better competitive advantage.

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Dow Industrial Solutions

Extending ATP Capabilities through Improved Supply Chain Visibility

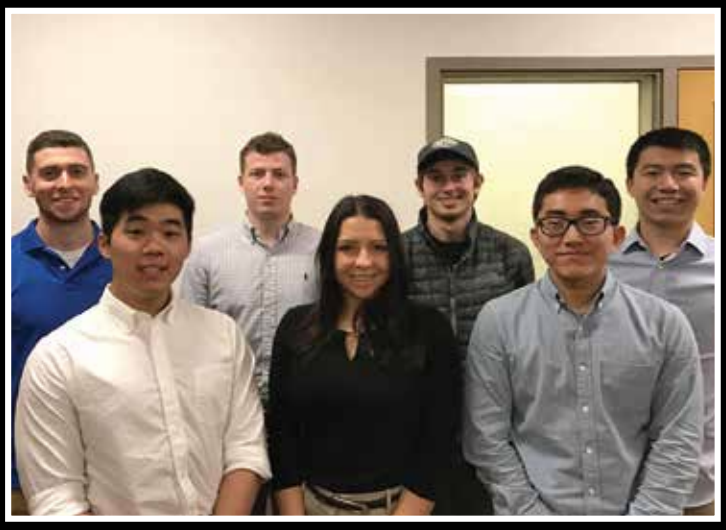
The Dow Chemical Company is the second largest chemical manufacturer in the world and is based an hour and a half north of East Lansing in Midland, Michigan. With 2016 sales totaling $48.2 Billion, Dow is responsible for sending chemical-based products all over the globe. Internally, they are divided into 9 key divisions such as Agriculture, Automotive, Consumer and, our division of focus, Industrial Solutions.

Dow, like many other industry leaders, utilizes an internal enterprise resource planning system called SAP ECC. Every time a finished product moves within their network a data point is created. All of this data allow Dow to see how much of each finished good they have so that when a customer submits a purchase order, they know immediately if they have the inventory to fill the order. This finite amount of inventory is referred to as available to promise inventory (ATP). The current equation in SAP ECC to calculate ATP is the amount of inventory on hand in the warehouse plus the amount of material that the onsite plant is producing. This gives their planning teams a good amount of inventory to work with, but it is missing a key element. That element is Finished Good inventory that is currently in transit and has not arrived at the warehouse yet. Dow, a global company, has in-transit materials from all regions of the globe and via many different modes of transportation.

Our project will focus on analyzing the different modes of transportation used by Dow and determining the confidence level that will ensure on-time arrival of material in order to add it to the ATP equation. The main modes that we will analyze are truck, rail, marine pack cargo, and deep sea vessels.

We will be analyzing historical delivery data to see which modes yield the most consistent on-time delivery for both domestic and international shipments.

By determining which modes of transportation are most reliable using their confidence level, Dow will be able to utilize those formulas in SAP ECC to add the in-transit shipments to their ATP equation. This will result in a decrease in the amount of inventory Dow needs to hold in their warehouse without decreasing their high level of service.



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Great Lakes Wine & Spirits
Warehouse Space Optimization

Great Lakes Wine & Spirits represents Michigan's largest wine and liquor distributor spanning a reach that services all 83 Michigan counties with its headquarters located within Highland Park. Currently, the company serves approximately 10,000 customers while carrying about 6,000 unique wine items as well as over 3,000 various spirits. With an ever-increasing supply chain network, the company works to accommodate all of its customers by supplying its inventory in three distinct ways. Customers can place orders for entire pallet picks and case picks, as well as individual bottle picking, through "split cases" all based on the desired quantities requested. The company also supplies the smallest of community stores all the way to industry retail giants such as Sam's Club and Costco. With countless orders, dispatch locations, and quantities, the company strives for complete accuracy, as well as swift turnaround times, with orders being placed and filled overnight via deliveries. Currently, the company is facing an issue with space within their Highland Park and Detroit warehouses.

Vast amounts of products and increasing customer demands have led to problems with stocking product in-house to be able to fill the demand of customer orders. In recent years, the holiday bustle of the industry-known October, November, and December (OND) months has led to the biggest spatial issues with the alcohol sales spikes nearing holiday seasons. The goal Future 4 Solution faces is to optimize the current space that GLWAS houses within these two main warehouses given the current constraints. The team will encounter spatial reorganization, optimizing of layouts following safety specifications and codes, as well as monitoring and adjusting capacity to correct this current concern. Finally, measurements will be recorded in the form of inventory quantities as well as time with intake and turnaround to better optimize space and capacity of the GLWAS facilities.

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GLWAS
Project Sponsors

Pete Domas
Highland Park, Michigan

Reva Smith
Highland Park, Michigan

Chris Venuti
Highland Park, Michigan

Teaching Assistant

Aaron London
Ann Arbor, Michigan

Hess Corporation

Master Labor Material Group: Development & Implementation

Hess Corporation is a global exploration and production company in the business of developing and producing crude oil, natural gas liquids and natural gas. Headquartered in Houston, Texas, Hess has a global presence in their onshore, offshore and exploration of natural gas and crude oil. The objective of this project is to enhance Hess' lean processes and procedures.

At the beginning of the project, Hess had inconsistencies within their SAP system, which resulted in incomplete and inaccurate spend data for their labor categories. In the first month, the team spent time analyzing Hess' initial state of labor classifications, which allowed the creation of a high-level, standard definition of labor to use consistently throughout the company. The second phase dealt with exploring Hess' data structure and spend data to understand and identify areas of concern. In the third phase, there was a proposed updated labor material groups from the team suggested labor definitions. The last phase was spent sorting the material groups into sub-categories for improved visibility of non-employee labor spend.

To aid Hess in the long term, the team established guidelines to provide alignment across all functional areas, which will allow them to accurately capture and classify global labor spend data. The completion of this project will provide the foundation for improved visibility of non-employee labor within SAP.

Michigan State University
Team Members (left to right)

Samuel Hansen
Harbor Springs, Michigan

Jessica Totten
Grand Rapids, Michigan

Justine Adamo
Saginaw, Michigan

Michael Baron
West Bloomfield, Michigan

Julia White
Franklin, Michigan

Mara Murray
Livonia, Michigan

Erika Lentz
Applegate, Michigan

Hess
Project Sponsors

Connor Fast
Houston, Texas

Magda Kendrick
Houston, Texas

Geoff Tonini
Houston, Texas

Morgan Towsen
Houston, Texas

Teaching Assistant

Ana Sarabia
Lima, Peru

AESC Awards 2016

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 2016 Most Impactful Award:

The winners are team Hess "Master Logistics Plan Optimization for Well Wastewater"

Wenqian Ni, Evan Thomas, David Torres, Cameron Buchanan, and Eugene Amponsah

The 2016 Most Sustainable Award:

The winners are Team MSU IPF "Analysis Tool Development for Air Filtration System Optimization"

Alexander Thaden, Yutong Zhao, James Rohloff, Brett Londos, and Matt Goertz

Dr. Dana Kirk, PE
Asst. Professor of Biosystems & Agricultural Engineering

Dr. Luke Reese
Assoc. Professor of Biosystems & Agricultural Engineering

About the Program

Graduates of the MSU Biosystems Engineering (BE) Undergraduate Program are expected to succeed in diverse careers where they integrate and apply principles of engineering and biology to a wide variety of globally important problems. MSU Biosystems Engineering graduates are expected to attain that success by:

- identifying and solving problems at the interface of biology and engineering, using modern engineering techniques and the systems approach;
- analyzing, designing, and controlling components, systems, and processes that involve critical biological components; and
- demonstrating 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. Holly Bowers - Consumers Energy
Ms. Lisa Buchholz - Dow AgroSciences
Ms. Michelle F. Crook, PE - MDNR
Mr. Cassaundra Edwards - Bimbo Bakeries
Mr. Bryce Feighner, PE - MDEQ
Mr. Gene Ford - Nestlé Nutrition
Ms. Ashley Julien - 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.

Project Evaluators

Mr. Dylan Comer - JBT FoodTech
Ms. Shelly Crawford - Kellogg
Mr. Patrick Ertel - MDNR
Mr. David Filipiak - FTCH
Mr. Jim Green, Jr. - Milton Manufacturing
Mr. Norm Lenhart - Perrigo
Ms. Jesse McGowen - Perrigo
Mr. Steve Miller, PE - MSU
Ms. Amber Mostiller - Grobbel's
Mr. Kevin Muckey - Perrigo
Mr. Michael Olson - Public Works – Mackinac Island
Dr. Ajit Srivastava, PE - MSU
Mr. Ned Stoller - Easter Seals Michigan – AgrAbility
Mr. Kevin Ullrey - Kellogg

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

Soil Phosphorus Management Strategy for Food Manufacturer

Team Name – Spartan Soil-utions
Sponsor – Michigan Milk Producers Association (project under NDA agreement)
Faculty Advisor – Dr. Steve Safferman, PE

The Spartan Soil-utions were challenged with remediating a former food manufacturing wastewater spray field irrigation site with elevated soil phosphorus levels. The site was used for more than 30 years before discontinuing. The client desired a solution that would return the soil phosphorus levels to the agronomic range with minimal maintenance and oversight. A hybrid poplar planting strategy was chosen for two of the three fields due to its phosphorus uptake ability and low maintenance requirements. The two varieties of poplar will be harvested after ten years and sold as wood chips. The third field will be leased to a neighboring farmer with a recommended corn-soybean rotation to maximize phosphorus uptake.

(L to R) Nicholas Morlock, Daniel Buhr, Sean Brown & Danielle Smith

Sugar Recovery from Kellogg's Cereal Waste

Team Name – Sugar BAE's
Sponsor – Kellogg (project under NDA agreement)
Faculty Advisors – Dr. Yan (Susie) Liu & Dr. Kirk Dolan

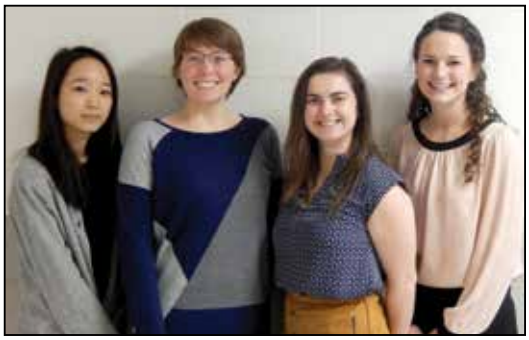
The Kellogg Company is increasing their focus on environmental and economic sustainability. The Sugar BAE's were tasked with reclaiming sugar waste from cereal production lines. This waste, called "cereal fines," is a mixture of sugar, starch, vitamins, and other non-sugar impurities, and is currently sold as animal feed. Through a series of separation techniques, sugar is reclaimed from the cereal fines. The reclaimed sugar solution is reinjected into the primary sugar coating stream. The process aims to reduce costs and use of raw materials, while maintaining sugar purity standards.

(L to R) Andrew Juergens, Karis Middleton, Joanna Carroll, & Renee Schwartz

Water and Wastewater Reduction at a Food Manufacturing Facility

Team Name – Meijer Water Unicorns
Sponsor – Meijer (project under NDA agreement)
Faculty Advisor – Dr. Steve Safferman, PE

What is the best way to reduce environmental impact and save money? Modify water management strategies! This project aimed to minimize water consumption, reduce wastewater surcharges, and determine efficient water management procedures for Meijer plants. A basic water audit was performed at the Meijer Central Kitchen that focused primarily on the deli processing lines. The audit helped determine areas of high water consumption and high strength wastewater generation. Ultimately, three process lines and the facility wastewater system were further examined to determine the greatest potential benefits. Through sample collection, plant observations, and data analysis, it was determined that wastewater system design upgrades will have the largest positive economic and environmental impacts.

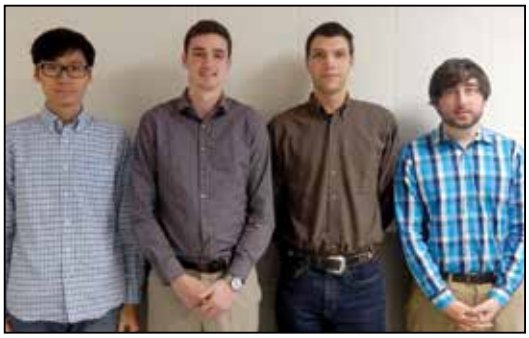


(L to R) Hwa Hsiung, Sarah Dobrenski, Olivia Wodek & Rebecca Prouty

Development and Implementation of Energy Conservation Protocol at a Food Manufacturing Facility

Team Name – Meijer Energizers
Sponsor – Meijer (project under NDA agreement)
Faculty Advisor – Mr. Aluel Go and Dr. Truman Surbrook

This project involves the development of an energy management plan and funding application to support its implementation. Activities included the performance of a certified energy audit on Meijer's largest food manufacturing facility augmented by two professional energy auditors. The facility's energy consumption has been broken down into four major categories: 1) Processes and Controls, 2) HVAC, 3) Lighting, and 4) Weatherization. The audit evaluates recommended energy conservation measures (ECMs) for all the facility's operations that use energy. Our goal was to reduce energy consumption by 36 %. The funding application will be sent to the USDA Rural Energy for America Program.



(L to R) Jiaming Li, Kyle Nussdorfer, Benjamin Vanzweden & Eric Wiitanen

Waste Handling Process Design Considering Food Safety and Volume Reduction

Team Name – Meat The Spartans
Sponsor – Grobbel's (project under NDA agreement)
Faculty Advisor – Dr. Dan Guyer

The project was to design a system for collecting and compacting plastic waste directly from the processing line of a corned beef manufacturer. The primary focus was to reduce the possibility of cross-contamination when considering the worker handles both the plastic waste and the food product. Included in the design process was the potential of reducing waste removal costs for the client by increasing the density of the plastic waste. The team delivered the client a detailed analysis of three design alternatives that varied in cost, versatility and complexity.

(L to R) Lauren Costantini, Jillian Toaso, Hannah Baker & Dennis Reaume

Linear Conveyor Hygienic Design

Team Name – The Conveyors
Sponsor – JBT FoodTech (project under NDA agreement)
Faculty Advisor – Dr. Brad Marks, PE

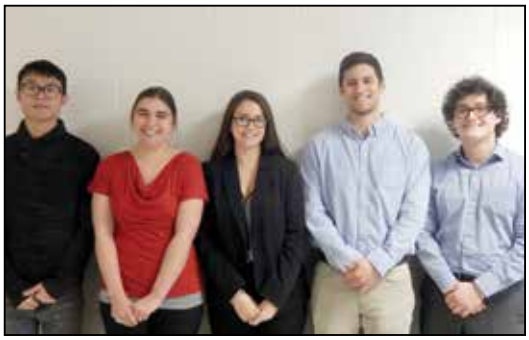
The objective of this project was to optimize the JBT FoodTech SaniClean conveyor to increase system hygiene and gain certification from NSF International. NSF certification adds value to food processing equipment. NSF is an internationally accepted certification that the equipment has a reduced risk of foodborne illness by microbial contamination. Cleaning the SaniClean is quick, easy and effective. Modifications further increased the functionality and operational performance of the equipment with regard to sanitary design. The team modified the design to decrease liquid collection, increase material compatibility and create a cleaning protocol validated by riboflavin and ATP swab testing. The conveyor is currently undergoing NSF certification.

(L to R) Shuman Zhang, Joseph Kretowicz, Philip Steinbrunner, & Breanna Earls

Pharmaceutical Machine Internal Cleaning

Team Name – Go Clean
Sponsor – Perrigo (project under NDA agreement)
Faculty Advisors – Dr. Vangie Alocilja & Dr. Tim Whitehead

Perrigo is a global supplier of over-the-counter pharmaceutical goods. Highly technical equipment is used to bottle and package pharmaceuticals that are in tablet form. Perrigo tasked the GoClean team with reducing labor costs during equipment cleaning while maintaining their same high standard of cleanliness. The current cleaning procedure is a very time-intensive process. The team designed a cleaning fixture that adapts to Perrigo's current cleaning tools that reduces cleaning time and provides better ergonomics for their cleaning specialists.



(L to R) Zhe Wang, Rachel Streufert, Madison Wheeler, Hunter Hoogakker & Yannis Papoulis

Evaluation and Reduction of Hazardous Waste Generated During Pharmaceutical Operations

Team Name – PNL
Sponsor – Perrigo (project under NDA agreement)
Faculty Advisors – Dr. Darrell Donahue, PE & Dr. Jade Mitchell

Perrigo Company is a world leader in the manufacture and distribution of nicotine replacement therapy ("NRT") products. The Perrigo facility in Holland, Michigan manufactures a portion of the nicotine lozenge product line. EPA classifies nicotine as a hazardous waste. Normal losses, associated with manufacturing and packaging, contribute to a hazardous waste stream. Perrigo desires to minimize this waste stream to reduce their social and environmental impacts. The team designed and implemented a plan to reduce the generation of nicotine hazardous waste by 15% in the packaging process.

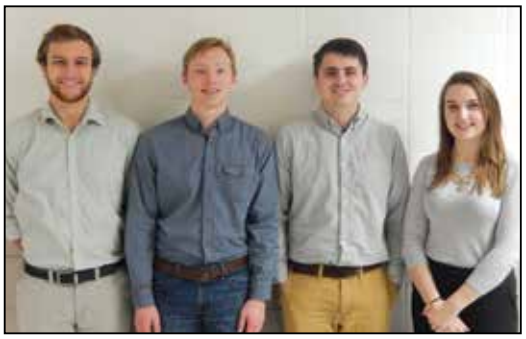
(L to R) Kayla Cascarilla, Nathan Majeski, Rachel Baker & Michael Kalabat

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

Red Cedar River: Restoration and Naturalization

Team Name – Destination Restoration
Sponsor – Michigan Department of Natural Resources
Faculty Advisor – Dr. Pouyan Nejadhashemi

The Michigan Department of Natural Resources has consulted with the Ingham County Drain Commissioner to restore the portion of the Red Cedar River between Harrison Road and Kalamazoo Street. The project objective is to design a plan to restore the natural physical features of the river. These features include bankfull dimensions, average river velocity, stream bank stability and an equal inflow and outflow of sediment. The team used the hydraulic modeling software, HEC-RAS, together with Rosgen's Natural Channel Design to develop a river restoration plan.



(L to R) Connor Bartle, Paul Fowler, Jacob Cochrane & Hannah Guyer

Urban Storm Water Management and Beneficial Reuse in Urban Agriculture

Team Name – Runoff Rangers
Sponsor – Milton Manufacturing
Faculty Advisors – Mr. Matt Herman & Dr. Fei Pan

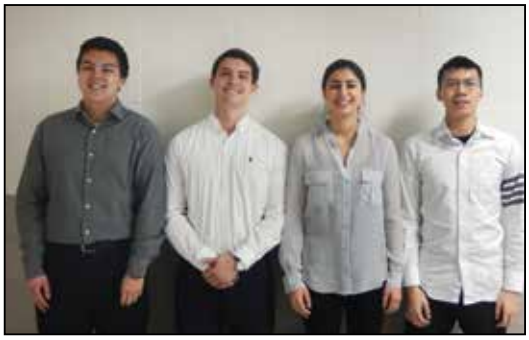
The Detroit Water and Sewage Department (DWSD) has introduced an initiative that charges all Detroit property owners $750 per impervious acre per month to combat stormwater management expenses. Milton Manufacturing is comprised of 9.96 impervious acres, which would amount to a $7,500 monthly bill. Our team created a low impact development (LID) design to reduce their drainage bill by reducing their impervious footprint. The team developed a combined LID design to effectively collect stormwater and then reroute it to urban farmland at Pingree Farms. This design will be comprised of downspout disconnection, capture reuse tanks and permeable pavers. After review and approval by a professional engineer and any required permitting, the implementation of this optimal design would generate green infrastructure credits, which will reduce the client's DWSD bill.

(L to R) Mitchell Kelley, Justine Williams, Megan Morley & Peter Drogosh

Tractor Seat Modification for Farmer with Leg Injuries

Team Name – Eleven
Sponsor – Easterseals Michigan – AgrAbility
Faculty Advisor – Mr. Phil Hill

This project was to design a seat suspension system to assist a farmer with leg injuries who has difficulty getting on and off his tractor seat while stepping over a gearshift. The team designed and installed an electric-powered seat that can raise and lower him, thus reducing the stress on his legs to cross the gearshift. The seat was attached to a bracket base held to the original tractor seat by clamps, making it a semi-permanent solution. The clamps can be modified in different shapes and sizes to allow the base to be attached to other tractor seats, adding adaptability to the design. This modified seat allows our client to continue his farm work and enjoy his lifestyle.

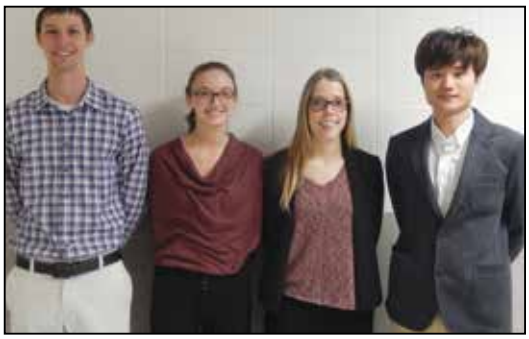


(L to R) Matthew Vasher, Patrick Keane, Yara Fakhoury & Zhiheng Wan

Development of a Potable Water Treatment System for a Small Farm and Children's Home in Belize

Team Name – Team Hope
Sponsor – Hopewell, Belize
Faculty Advisor – Dr. Wei Liao, PE

Hopewell is a small children's home and farm in rural Belize operated by Harvest Expeditions, a U.S.-based 501(c)(3) non-profit. Due to a contaminated well, the facility had to purchase city water at a significant cost to their operating account. Hopewell relies heavily on donations to operate, so the added water cost has added pressure to the facility's financial stability. The team designed a water treatment system featuring hollow fiber filtration to provide Hopewell with clean potable water from the original on-site well. This design provides the client with a safe, cost-effective, low maintenance and sustainable solution.



(L to R) Ryan Ziegler, Carly Daiek, Madeline Labelle & Injoon Oh

Mackinac Island Biosolids Management

Team Name – Mackinac Biosolids Initiative
Sponsor – Mackinac Island Department of Public Works
Faculty Advisor – Dr. Dana Kirk, PE

Mackinac Island is spending approximately $50,000 annually to transport and landfill biosolids from the Wastewater Treatment Plant in the Upper Peninsula. The Mackinac Public Works challenged MBI with finding an alternate use for the biosolids that is more cost-effective, provides for a better beneficial reuse and reduces environmental risk associated with transport. Through research and discussion with the client, aerated static pile composting was found to be the most economical and environmentally friendly solution. Composting converts the material into a Class A Biosolid that is safe for use on lawns and gardens as a carbon rich fertilizer. Utilizing the Class A compost on the Island will reduce costs and enhance environmental sustainability.

(L to R) Holly Halliwill, Anna Oslapas, Scott Schultz & Madison Padilla

Irrigation System for Vegetable Production in Burkina Faso

Team Name – Burkina Faso Friends (BFF)
Sponsor – USAID Appropriate-Scale Mechanization Consortium (ASMC)
Faculty Advisor – Dr. Ajit Srivastava, PE

To produce vegetables in Burkina Faso during the dry season, Team BFF designed an irrigation system for a ¼-hectare vegetable farm. The main goals were to improve nutrition, health and income for smallholder farmers with a local sustainable, appropriate-scale mechanized irrigation system. Combining a modified treadle pump and drip irrigation technology powered by solar energy, the team designed a system that will facilitate vegetable production with better water use efficiency and reduced manual labor compared to current practices. Team BFF collaborated with students at University Polytechnic Bobo-Dioulasso to implement the system with the hope of widespread adoption by farmers through demonstration.

(L to R) Iember Hemben, Hannah Robar, Taylor Koonce & Davis Roeser

BE Showcase Public Presentations - April 27, 2017

BAE 2016-17 Industry Advisory Board

If you are interested in sponsoring a BE 485/487 capstone project for the 2017-18 Senior Design teams, please contact Dr. Dana Kirk at kirkdana@msu.edu or Dr. Luke Reese at reesel@msu.edu.

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The Capstone Projects

Faculty Advisors:
Professors Haider, Hashsham, Ingle, Kutay, Li, and Lu

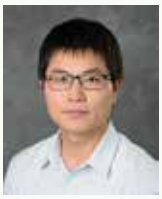

Haider


Hashsham


Ingle


Kutay


Li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Presentation Schedule – Room 1538

Time	Team	Room
8:00 a.m.	Team 8 – Milo Constructions Inc.	First Floor Room 1538 EB
9:20 a.m.	Team 7 – Spartan Consulting	First Floor Room 1538 EB

Presentation Schedule – Room 3400

Time	Team	Room
8:00 a.m.	Team 6 – Capital City Consulting	Third Floor Room 3400 EB
9:20 a.m.	Team 5 – McManus & Associates	Third Floor Room 3400 EB
10:40 a.m.	Team 4 – Civil Principals	Third Floor Room 3400 EB

Presentation Schedule – Room 3540

Time	Team	Room
8:00 a.m.	Team 3 – Great Lakes Consulting, LLC	Third Floor Room 3540 EB
9:20 a.m.	Team 2 – 1855 Design Firm	Third Floor Room 3540 EB
10:40 a.m.	Team 1 – M.A.C. 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

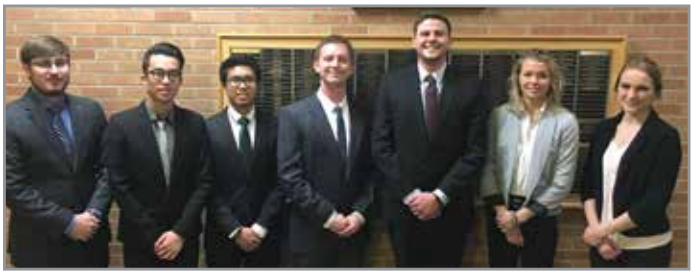
Haslett Village Square, Meridian Township, MI
Mixed-use Development

Images: Apartment floor plan, and preliminary site plan

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

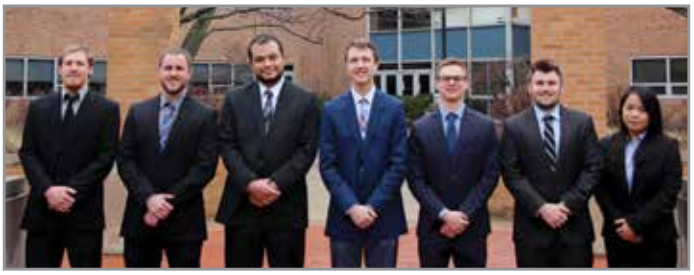
The project development must include both residential and commercial land uses. Additionally, the site incorporated installation of a new craft brewery with production and distribution facilities. The objective of this project was to provide Meridian Township Planning Commission with a Preliminary Engineering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

CE 495 Engineering Building, Rooms 1538, 3400 & 3540 | First & Third Floors 8:00 a.m. – Noon



Team 1: M.A.C. Engineering

Left to Right: Shane Snyder (T), Rui Wang (P), Mohammad Karim (S), Tyler Davidek (PM), Alex Oosterhoff (G), Hannah Sailar (E), Ashley Brendel (H)



Team 2: 1855 Design Firm

Left to Right: Nolan Mullet (E), Jordan Southwell (H), Micah Norwood (G), Eric Kastelic (PM), Matt Olinik (P), Alex Mullen (T), Charlotte Fung (S)

Team 3: Great lakes Consulting, LLC

Left to Right: Joe Juronoc (E), Nan Yang (P), Zhaolun Zhang (T), Joseph Kuehnlein (PM), Andrew Panetta (S), Mohammed Aldhabiki (G), Ian Schmitz (H)

Team 4: Civil Principals

Left to Right: Top Row: Pranav Shah (P), Shiwen Tang (T), Conner Langendorf (S) Bottom Row: Catherine Kirkland (H), Leah Giacobassi (E), Fernanda Jeffers (G), Jake Maise (PM), Richard Villarreal (S), Kyle Savoie (S)

Team 5: McManus & Associates

Left to Right: Han Zheng (S), Louis Rote (T), Andrew Johnstone (E), Lucas Driesenga (G), Hannah McManus (PM), Colton Kahrs (H), Jingyao Xia (P)

Team 6: Capital City Consulting

Left to Right: Bon Fitzgerald (G), Khalid Alajaji (T), Megan Grohnke (H), Steven Turzewski (E), Kelli O'Brien (PM), Tom Sheldon (S), Dave Fennell (P)

Team 7: Spartan Consulting

Front: Matthew Kovalick (P), Jacob Kramer (H), Alec Simonds (S), Katerina Tsou (E), Scott Pressey (PM), Junior Soto Reyes (G), Thuyen Dang (T)

Team 8: Milo Constructions Inc.

Left to Right: Emily Slater (E), Xiaoyu Chen (H), Tyler Fredrick (P), Sankalp Saste (PM), Nathapol Wisanphokha (S), Josh Heinze (G), Raymond Vonck (T)

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

CE 495 SENIOR DESIGN IN CIVIL & ENVIRONMENTAL ENGINEERING

PROFESSIONAL SEMINAR SPEAKERS

Michele Buckler, P.E.
Detroit Diesel

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

Iman Harsini, Ph.D.
Michigan State University

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

Mike Lanotte, Ph.D.
Michigan State University

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

Leah Tapp, P.E.
HNTB

Daniel Thome, P.E.
Nicholson Construction Company

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

Mark VanPortfleet, P.E.
Michigan Department of Transportation

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.

Sam Baushke, P.E.
Barr Engineering Co.

Erik Carlson, P.E.
Michigan Department of Transportation

Rick Chelotti, P.E.
Bergmann Associates

Daniel Christian, P.E.
Tetra Tech MPS

Brian Davies, P.E.
Hubbell, Roth & Clark

Tyler Dawson, P.E.
NTH Consultants

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

Matt Hill, P.E.
WSP Parsons Brinckerhoff

Peter Johnson, P.E.
RS Engineering, LLC

Matt Junak, P.E.
HTNB

Peter Margules, P.E.
NTH Consultants

Beverly McCready, P.E.
U.S. Army Corps of Engineers

George McKenzie, P.E.
Consumers Energy

John O'Doherty, P.E.
National Center for Pavement Preservation

Mario Quagliata, P.E.
Bergmann Associates

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

Michael Thelen, P.E.
Consumers Energy

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

Brad Venman
NTH Consultants

Phillip Vogelsang, P.E.
URS Corporation

Jon Ward, P.E.
Rowe Professional Services

Design Day Awards Fall 2016

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 2016

Team 4: Ember Engineering

Left to Right: Sheng Chen, Michael Stevens, Brandon Vasher, Andrew Bertapelle, Katie Haynes, Jerome Rogers

Process Design and Optimization II

Dr. Mark Worden
Professor and Class Instructor of Chemical Engineering and Materials Science

Paul Sharpe
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). Skills developed in earlier chemical engineering courses are applied to a problem that extends over a longer period of time and requires more initiative, investigation, accuracy, and individual responsibility. For the 50th successive year, we have worked on the American Institute of Chemical Engineering (AIChE) Student Contest Problem. We use these open-ended, industry-based problems for three reasons: 1) they provide real-world design challenges, 2) they indicate the skill set current industries require in chemical engineering graduates, and 3) they serve as a national benchmark for MSU chemical engineering students to demonstrate their professional skills.

Eight proposed solution posters from four teams and four individuals were selected for presentation on MSU's Design Day. Of these final groups, two teams and two 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.

National Award Winners from 2016!

In 2016, MSU won two first-place national awards for their solution to the problem entitled, "Cell Therapy for Spinal Cord Injuries: Commercial Manufacturing Facility." Rebecca Carlson and Ariel Rose (left) were awarded the William Cunningham Award for first prize in the team category. Rebecca Jacobs (inset) was awarded the Walter Howard Design Award in the SAChE Student Competition for Safety in Design. Additional details of these students' accomplishments are given at the URL below: http://www.egr.msu.edu/news/2016/10/17/national-alche-honors

AIChE®

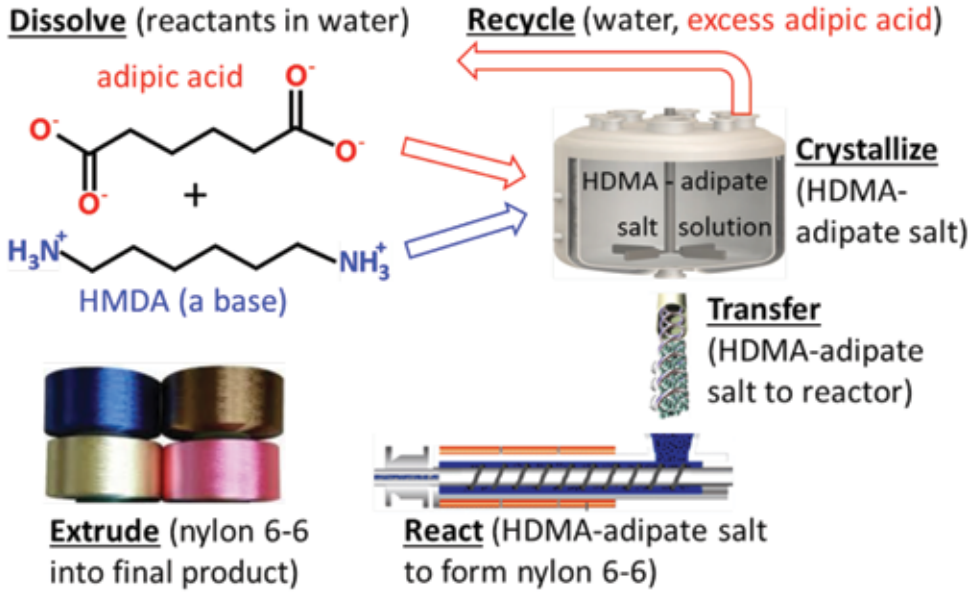
Manufacturing Facility for Nylon 6-6

In 2017, AIChE Design Competition participants are required to design a safe and sustainable chemical plant to manufacture the polymer Nylon 6-6. About 2 million tons/year of this polymer are produced for a wide range of commercial applications, including textiles.

This project allows students to showcase their comprehensive set of skills, including literature search, process design, reactor design, process hazard analysis, etc. Students must incorporate a wide range of approaches related to chemical process and product design, e.g. flowsheet synthesis and simulation, heat and mass integration for resource conservation, process optimization, process economics, and also environmental, health and safety related issues.

In this open-ended project, students are encouraged to take the project in almost any direction they consider promising within the specified constraints. However, all design choices must be fully justified. Like most real-world design projects, students are not given all the data and information they would like. As a result, they need to make assumptions and provide justification for those assumptions. After choosing a process flowsheet, students must determine the capital and operating costs and compare alternatives to optimize the process economics while meeting safety and sustainability standards.

Process Overview



2017 Winning Individual Solutions


Kelly Potts


Stephanie Enloe


Jadel Hughes Davis


Eric Monville

2017 Winning Team Solutions


Margaret Durbin and Dalton Stetsko


Marissa Beatty and Ana Veskovic


Ethan Brummel and Laura Azouz


Brooke Gundersen and Kaitlyn Bourque

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 ten teams working on ten 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 20-minute presentations. For 2017, the ten teams are conducting the following failure analysis investigations:

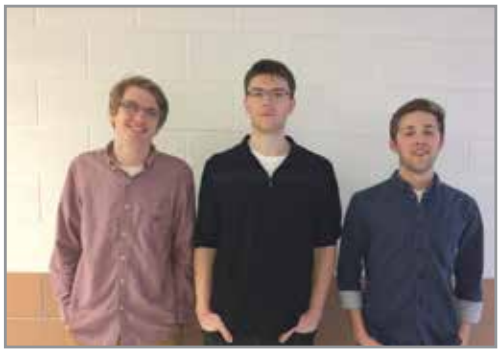
Presentation Schedule – First Floor Room 1145

Time	Team	Project
8:20 a.m.	The Block Heads	A Die Block Failure: Classical or Unique
8:40 a.m.	Los Tres Amigos	Converse Eyeglasses Hinge Failure
9:00 a.m.	D-Fence	Investigation of the Cause of Failure and Associated Mechanisms in Fencing Blades
9:20 a.m.	Cranky Engineers	Ford Crankshaft
9:40 a.m.	Escape from Kroger	Ford Escape Rim Fracture Analysis
10:00 a.m.	Brace for Impact!	Failure Analysis of an Upper Puck Pan from a Cirrus SR22 Aircraft
10:20 a.m.	Breaking Waves	Failure Analysis of an SEI Propeller Shaft
10:40 a.m.	The Spaghetti Monsters	Ceramic Dinner Plate Failure Analysis
11:00 a.m.	Shearing Hubs	Metallographic Failure Analysis of a Shear Hub
11:20 a.m.	Don't Die (Casting)	Die-cast Aluminum Idler Wheel Mount Failure

(left to right) Johnathon Burke, Young Kim, Adam Marsh

Team Name: The Block Heads
Project Name: A Die Block Failure: Classical or Unique
Time: 8:20 a.m.

An H-13 steel forging die block that had catastrophically failed was selected for further study. The fracture is thought to have occurred during a routine high stress load. Charpy and fatigue bars were created using material from the failure to examine the die block's fracture toughness and fatigue life. Other samples were prepared and mounted in order to observe the microscopic aspects of the failure. The failure as a whole was thoroughly macroscopically studied in order to find any anomalies. Through all of these experiments, the team will draw a sound conclusion on the cause of failure and design preventative measures in order to ensure a failure such as this will not again occur.



(left to right) Joseph Bourns, Tyler Lacy, David Warner

Team Name: Los Tres Amigos
Project: Converse Eyeglasses Hinge Failure
Time: 8:40 a.m.

This project investigates a broken hinge on a pair of eyeglasses. The glasses had a thin stainless steel insert into an acetate frame that failed after several years of everyday use. The exact type of stainless steel is unknown. Fracture occurred in a low-stress situation that the glasses experienced semi-frequently. Although the hinge experienced some stress during its lifespan, as with any frequently used object, this would not be enough to cause failure normally. There are no known significant events preceding failure that could have drastically weakened the part. Considering this information, tests will be run predominantly to determine corrosion and fatigue levels.

(left to right) Kyle Thomason, Elissa Klopfer, Victoria Toomajian

Team Name: D-Fence
Project Name: Investigation of the Cause of Failure and Associated Mechanisms in Fencing Blades
Time: 9:00 a.m.

Catastrophic failures in fencing blades are a well-documented occurrence in the sport, potentially causing serious injuries, if not fatalities. The current project is interested in uncovering any specific factors that may lead to these fractures. Specifically, the potential fracture modes will be investigated by examining the fracture surfaces of several sabre and epee blades, in particular focusing on two sabre fractures. Blades were shown to fracture either in the hilt or near the tip of the blade, thus both will be examined. First, the steel grade of the blades will be identified. Then, investigations will examine the following potential features: the surface condition of the blades, the effect of fatigue versus sudden impact, and the potential for bending in the blades.

(left to right) Corrine Calhoun, Kelsey Gibson, Juan E. Donoso

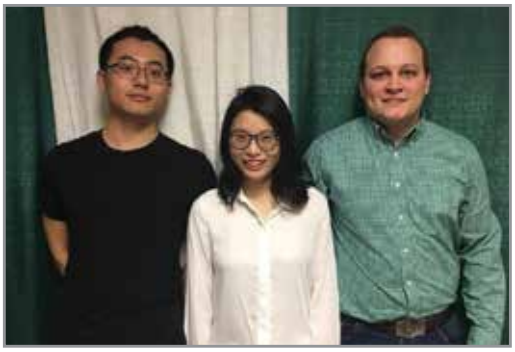
Team Name: Cranky Engineers
Project Name: Ford Crankshaft
Time: 9:20 a.m.

The crankshaft in question failed while the engine was under load. The failure likely caused catastrophic damage to the lower engine block webbing, requiring a full engine swap. Additionally, a failure of this magnitude could have caused injuries or worse to the person(s) in the vehicle, depending on the driving situation. A full failure analysis of this part is imperative, in order to draw valid conclusions about how failure occurred. A series of experimental tests and their respective interpretations will be conducted by the team to that end. These tests include stereo microscopy, ultrasonic crack detection, dye penetrant inspection, scanning electron microscope (SEM) observation, energy dispersive spectroscopy (EDS) and other metallographic inspection techniques. Over the course of ten weeks, the Cranky Engineers Team will perform these tests to better understand how this potentially catastrophic failure occurred.

(left to right) Yiwen Qian, Nate Yenor, Mike Williams, Erik Skutnick

Team Name: Escape from Kroger
Project Name: Ford Escape Rim Fracture Analysis
Time: 9:40 a.m.

During a cold night in a Kroger parking lot, the driver of a 2003 Ford Escape was turning left and unexpectedly hit a patch of black ice. This caused the car to slide and hit a curb resulting in a fracture on the front right rim of the car. A group was then formed to plan and execute an array of destructive and non-destructive testing methods to explain the causes of failure and speculate upon its implications and potential material/design improvements. Additionally, this project aims to provide MSE 466 students with a valuable learning experience regarding failure analysis techniques that can be applied throughout their careers.



(left to right) Yalun Cai, Wanyue Zhong, Skeeter Judd

Team Name: Brace for Impact!
Project Name: Failure Analysis of an Upper Puck Pan from a Cirrus SR22 Aircraft
Time: 10:00 a.m.

An upper puck pan is considered a critical component in the front landing gear of a Cirrus 22 aircraft. Due to the importance of the part, it is checked routinely and, if it has failed, a new upper puck pan is installed. In this case, an upper puck pan failed in two different welded areas. Welds on the top face of the puck cracked at the weld toe while welds on the outer edge of the puck cracked through the weld metal. In this analysis, both welded areas were evaluated to determine the root cause of the failure through metallography and fractography.

MSE 466 First Floor | Room 1145 8:20 a.m. - 11:40 a.m.

(left to right) Jacob Kuehnlein, Tianyu Wang, Yun Hsiung, Tyler Clifford

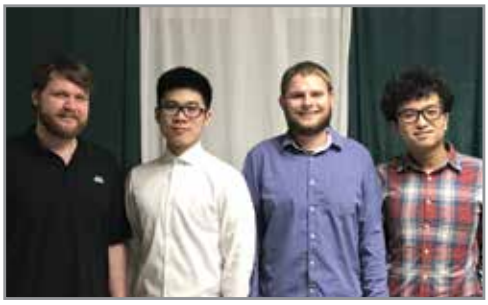
Team Name: Breaking Waves
Project Name: Failure Analysis of an SEI Propeller Shaft
Time: 10:20 a.m.

All devices will fail at some point. The goal is to make that failure predictable, occurring after the design life of the product. When failures occur before the design life, or in an unpredictable manner, they must be analyzed in order to seek out the root cause of the failure. In August of 2015, a Sterndrive Engineering Inc. propeller shaft failed well before its design life by fracturing at the rear oil seal of the sterndrive. To find the origins of this failure, various tests and calculations were performed. Once the failure circumstances were better understood, design changes were specified to ensure that this failure does not occur again.

(left to right) Andrew Coger, Jovanka Koprivica, Philip Brinks, Todd Skarvan

Team Name: The Spaghetti Monsters
Project Name: Ceramic Dinner Plate Failure Analysis
Time: 10:40 a.m.

A common dinner plate with a 'microwave-safe' sticker on the bottom cracked while a serving of spaghetti was being heated in the microwave, depleting a young college student's hard-earned savings. The plate remained intact, though five obvious cracks diverged in the center of the plate. One of the cracks breached the outer circumference. Needless to say, the plate was decommissioned. The specimen did not appear to be in imminent danger of shattering, which allowed ample time to examine it. Utilizing their years of experience in the lab, the Spaghetti Monsters established a meticulous series of state-of-the-art tests under the watchful eye of seasoned material scientists in order to determine the cause of failure.



(left to right) Larry Schulze, Kaige Zheng, Adam Devine, Yu-Chieh Wu

Team Name: Shearing Hubs
Project Name: Metallographic Failure Analysis of a Shear Hub
Time: 11:00 a.m.

For our Failure Analysis and Design (MSE 466) project, we are evaluating the failure of an industrial parts-autoloader's shear hub that fractured a large portion of the shear hub, instead of the shear pin as intended. To analyze the cause of fracture, we will be doing many different tests such as Ultra-Sonic Testing, Hardness Testing (of the shear hub, shear pin, and shear sleeve), Electron Microscopy, and Chemistry Analysis. After preliminary inspections, we predict that it will be, at least in part, due to fatigue and will be looking for evidence that either supports or debunks this hypothesis.

(left to right) Caleb Andrews, Nicholas Mancini, Demetrius Moncrease

Team Name: Don't Die (Casting)
Project Name: Die-cast Aluminum Idler Wheel Mount Failure
Time: 11:20 a.m.

Idler wheel blocks used on snowmobiles are subject to vibrational and dynamic forces due to the distributed load from the track. Early failure analysis of the idler wheel block found that the part failed along the thinnest section at 45° to the spacing along the snowmobile rail. Upon stereomicroscopy and macrophotography, it was discovered that the sample had a large amount of porosity. These pores can lead to micro-cracks that grow during cyclic loading and ultimately result in failure. The cold environment likely contributed to the failure because of an increase in brittleness and a mismatch in coefficient of thermal expansion between dissimilar materials. Destructive testing was done on exemplars of the idler wheel blocks including Charpy, tensile, and Microhardness testing. The data collected during destructive testing was used to analyze how temperature affected the amount of fracture, how hardness of interior of the specimen defers from the surface, and the three-dimensional stress state of the part.

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yello

Chicago, Illinois

The Capstone Projects

Dr. Wayne Dyksen
Professor of Computer Science and Engineering

Spencer Ottarson
Teaching Assistant

Presentation Schedule – Engineering Building, Room 3405

Time	Team	Project
7:30 a.m.	Amazon	ACRA: Amazon Customer Review Analyzer
7:45 a.m.	Auto-Owners	Location-Based Services Mobile App
8:00 a.m.	GE	PETT: Predix-Enabled Toy Train
8:15 a.m.	GM	GM Transportation Experience App
8:30 a.m.	Humana	Humana Kids
8:45 a.m.	Meijer	MyMeijer: Crowdsource Shopping
9:00 a.m.	Michigan State University	CATAlyst: Mapping CATA Buses in Real-Time
9:15 a.m.	Microsoft	Intune Company Portal Helper Bot
9:30 a.m.	Mozilla	Improvements to Firefox's about:preferences
9:45 a.m.	MSUFCU	Banking with Amazon's Alexa and Apple's Siri
10:00 a.m.	Rook	Force Platform Ingestion Tool (PIT)
10:15 a.m.	Spectrum Health	Resident Physician Tracking
10:30 a.m.	TechSmith	Teacher's Virtual Toolbelt
10:45 a.m.	TWO MEN AND A TRUCK®	MobileMini "Movers Who Care"
11:00 a.m.	Union Pacific	Learning New Train Routes
11:15 a.m.	Urban Science	Real-Time Ad Campaign Management
11:30 a.m.	Whirlpool	Commercial Laundry Dashboard
11:45 a.m.	Yello	YelloVision: Career Fair Augmented Reality App

CSE 498 Collaborative Design

CSE498, Collaborative Design, provides the educational capstone for all students majoring in computer science. Teams of students build software systems for corporate clients.

During the capstone experience, students

- design, develop, debug, document, and deliver a comprehensive software system,
- work in a team environment,
- develop written and oral communication skills,
- become proficient with software development tools and environments,
- build and administer computer systems, and
- consider issues of professionalism and ethics.

Our clients are local, regional, and national including Amazon, Auto-Owners Insurance, Avata Intelligence, Boeing, Bosch, Chrysler, Electronic Arts, Ford, GE, General Motors, Google, Humana, IBM, Meijer, Michigan State University, Microsoft, Mozilla, MSU Federal Credit Union, Quicken Loans, Spectrum Health, Rook Security, Symantec, TechSmith, TWO MEN AND A TRUCK®, Urban Science, Whirlpool and Yello.

Amazon

ACRA: Amazon Customer Review Analyzer

Amazon, the largest online retailer in North America, sells a large variety of products. After a sale, customers may post reviews related to all aspects of the sale. On average, users write millions of reviews per year.

With the large number of reviews posted, the likelihood that customers encounter reviews unrelated to product quality is high. Without an automated way of classifying reviews, customers may have to sift through many useless reviews when researching a big-ticket item.

Our Amazon Customer Review Analyzer, ACRA, automatically classifies customer reviews into two categories, those related to product quality and those unrelated to product quality. To do so, ACRA uses natural language processing and machine learning.

This automatic classification of reviews allows Amazon shoppers to focus only on reviews that are relevant to product quality, thereby enhancing their shopping experience.

Amazon shoppers can search for products using our ACRA iPhone app, which separates reviews into product quality and non-product quality categories. Additionally, users can report misclassified reviews to refine and crowdsource our classifier's performance.

Our iPhone application is written in Swift and communicates with our backend using API Gateway and Lambda hosted on Amazon Web Services (AWS). Amazon Machine Learning and Python's NLTK library are used to classify reviews hosted in AWS's S3 and DynamoDB.

amazon

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Auto-Owners Insurance
Location-Based Services Mobile App

Auto-Owners Insurance is a Fortune 500 company that celebrated its 100th anniversary in 2016. Auto-Owners Insurance employs over 4,500 associates in 26 states.

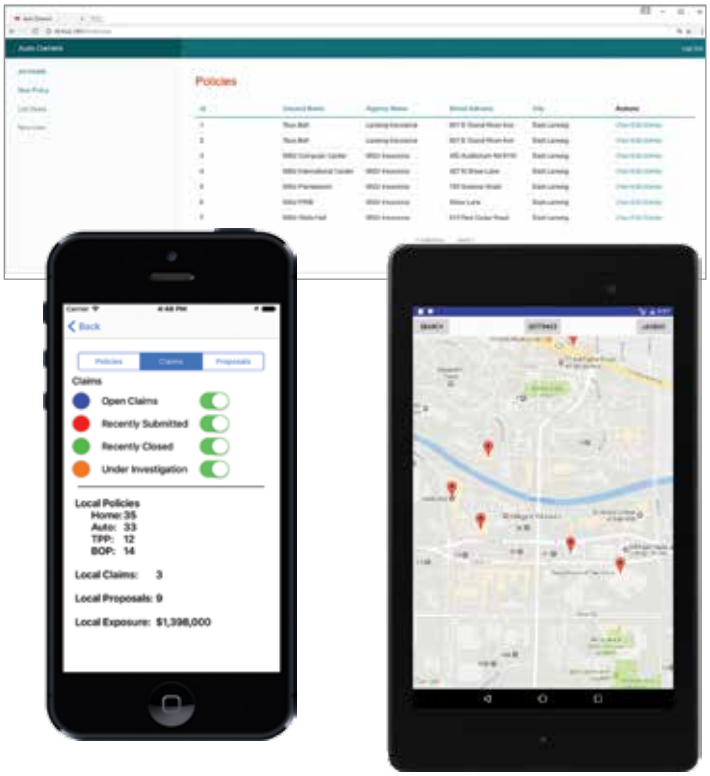
Auto-Owners representatives often need to access their customers' information while they are out in their community. Our Location-Based Services Mobile App enables Auto-Owners employees to view customers' information wherever they are.

Our app shows a map of the user's location along with all nearby addresses that have policies, claims or proposals through Auto-Owners. A user can customize what information is shown on the map such as all local policies of a certain type or all claims above a certain dollar amount.

When a specific location is selected on the map, the app displays the details about that address, including current and past policies and claims. A representative can submit a new claim for review and send notes to the underwriting department, thus enabling Auto-Owners to be more responsive to their customers' needs.

Our system is managed by our companion web app with which Auto-Owners administrators create and update a customer's insurance information. Accounts for new Auto-Owners representatives are created using the web app, which determines what information they can access using the mobile app.

Our Location-Based Services Mobile App is written in Swift and Java, and runs on Apple iPhone (iOS) and Google Android devices. Our web app, written in CakePHP, runs on all modern web browsers. Our apps connect through a MySQL database hosted on a Microsoft 2012 R2 server.



Auto-Owners INSURANCE
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GE
PETT: Predix-Enabled Toy Train

General Electric is the leading digital industrial company in the world, transforming the industry with software-defined machines and solutions that are efficient and predictive.

GE Digital's Predix platform is a purpose-built, hardened cloud platform that provides the connectivity, security and performance needed to drive advanced industrial applications.

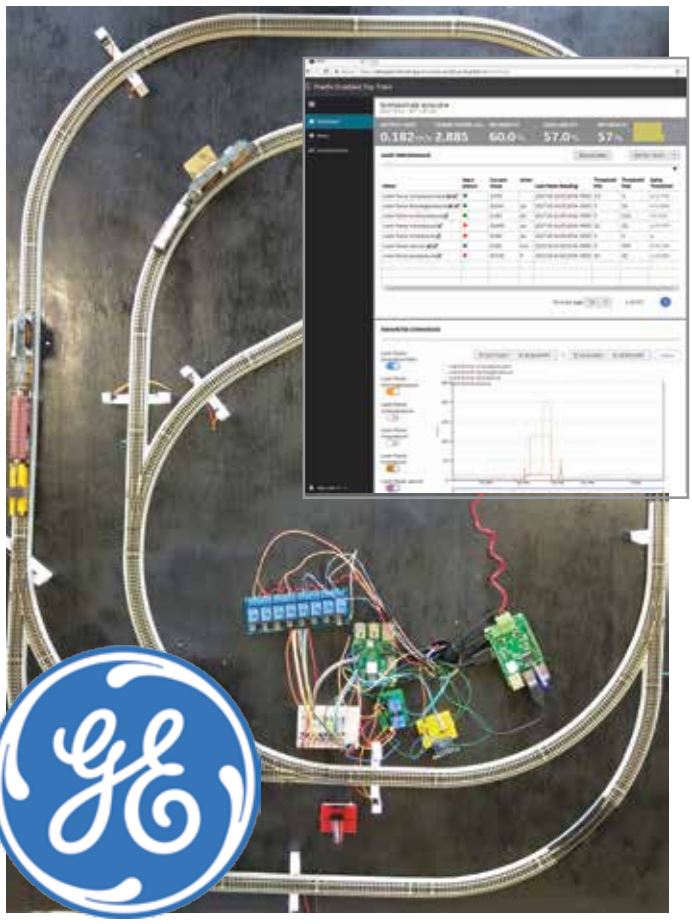
Our PETT, Predix-Enabled Toy Train, is a model train setup that demonstrates the capabilities of Predix. PETT uses multiple sensors including beam breakers, RFID reader-writer modules and tags, a multi-sensor and more to record data about the location of the moving trains and the state of the track.

Data from the PETT sensors is collected and sent continuously to the Predix Cloud, which analyzes it and visualizes it. Predix's predictive analytics determines potential train collisions and other possible problems with sensors, track and trains.

Based on the feedback from Predix, PETT controls the running trains by sending signals using Digital Command and Control (DCC) to the train engines and the track switches.

Our PETT provides GE with a visual and interactive way to showcase Predix to potential customers at their Digital Hub in Detroit and a fun way to inspire young people to pursue careers in engineering at fairs like the Maker Faire in Detroit.

Two Raspberry Pis read data from sensors using Python. One Raspberry Pi is connected by Pi-SPROG to the DCC track and sends commands with Jython. The data is displayed on a Predix machine using a web browser.



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General Motors
GM Transportation Experience App

Founded in 1908 and headquartered in Detroit, General Motors designs and manufactures a wide variety of vehicles that meet the needs and expectations of drivers around the globe. With a passion to earn customers for life, GM is always working to improve their driving experience.

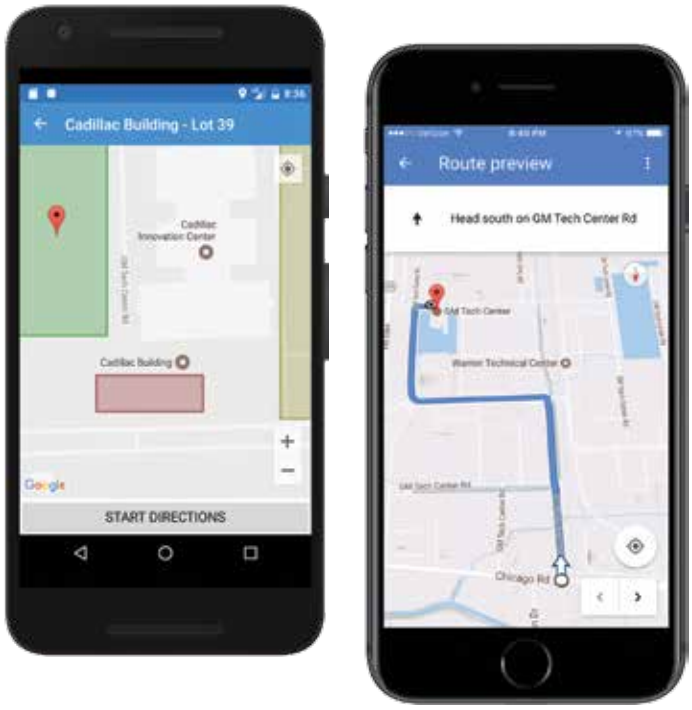
The GM Technical Center, located in Warren, Michigan, is the heart of the company's engineering effort. Consisting of 38 buildings and housing over 21,000 employees, the campus spans 710 acres.

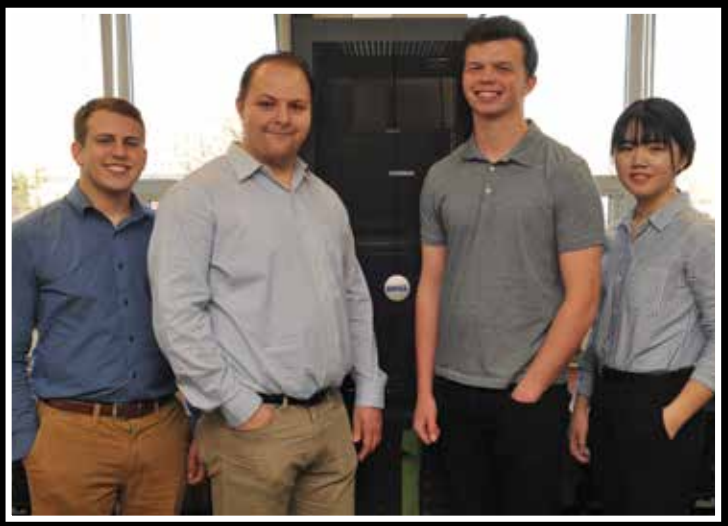
Our GM Transportation Experience App is designed to ease the stress that comes with navigating the large GM Technical Center campus by guiding drivers to a parking lot with open spaces that is near their destination.

After a user selects a building destination, our app finds the parking lots within the proximity of that building and analyzes historical data associated with those lots to determine which lot has the highest chance of containing an open parking spot. The user is then directed to this lot via Google Maps.

Since our app is intended for use primarily while driving, a key component to its design is simplicity. Users enter their destination building before driving. While driving, our app guides them with voice prompts to the best parking lot for their building destination on the GM Technical Center campus.

Written using Xamarin, the GM Transportation Experience mobile application runs on both Apple iPhones (iOS) and Google Android devices.





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Vince Cogswell
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Phyllis Jin
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Humana
Humana Kids

Humana provides many innovative products, services and business practices that help consumers make healthcare decisions with confidence.

As one of its goals, Humana aims to improve the health of their members by 20%. With childhood obesity doubling in children and quadrupling in adolescents, there is a need to counteract the recent growth of unhealthy lifestyles.

Our Humana Kids Android mobile app educates children and parents about nutrition and exercise through a series of pop-up surveys, tips and challenges that promote healthy living.

Humana Kids allows parents to switch our app to "Child Mode" in which health and exercise related pop-ups appear while their child uses their device. To incentivize children to make healthy choices, coins and badges are awarded for positive responses on surveys, which determine their ranking compared to other users.

Parents view their child's health trends through our companion web app. Graphs generated from their child's responses visualize the current results. Parents receive tips tailored to their child to promote further healthy choices.

Humana administrators use our companion web app to view graphs displaying general health trends of all users. Humana administrators can modify and add surveys, tips and recipes.

Our mobile app is written in Java and runs on any Android device. Our web app is written in Python and utilizes the Django framework. Both are interfaced with a REST API connected to a SQLite database.

Humana

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Erin Wycoff
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Meijer

MyMeijer: Crowdsource Shopping

Meijer is a large supercenter chain located in the Midwest. With over 200 stores, Meijer is one of the largest retailers and private companies in the nation.

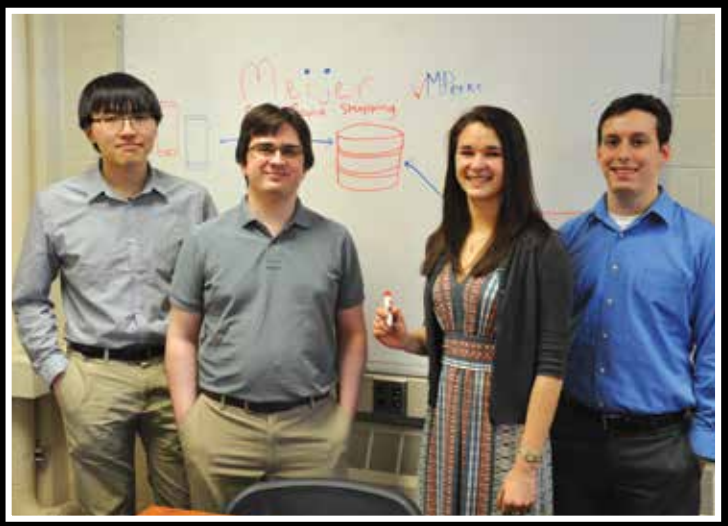
Our MyMeijer Crowdsource Shopping mobile app improves the shopping experience at Meijer stores by enabling customers to report potential issues within the store to Meijer team members immediately so they can be resolved quickly. Issues may include out-of-stock merchandise, spills or any other hazards.

Customers use Meijer's mPerks loyalty program to save money by redeeming digital coupons and rewards. Customers can now earn mPerks points toward rewards by using our MyMeijer app to report issues while shopping.

Meijer in-store team members use our companion Bluebird mobile app to respond quickly to push notifications sent to them by our system about issues noticed by shoppers.

All reported issues and resolutions are logged in a central Meijer database. Meijer managers use our companion Corporate Scoreboard app to detect frequently out-of-stock items and issues at Meijer stores across the country. It displays statistics collected from the customer reports, which assist Meijer management in running their stores efficiently.

Our MyMeijer Crowdsource Shopping system is written using Xamarin. The customer app runs on Apple (iOS) and Google Android devices; the Meijer team member app runs on Windows. The Corporate Scoreboard web app is written using .NET framework and hosted on Azure Cloud Services.



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Michigan State University

CATAlyst: Mapping CATA Buses in Real-Time

Michigan State University has one of the largest campuses in the nation, with more than 500 buildings on 5,000 acres. The Capital Area Transportation Authority (CATA) is the public transit service that services both Michigan State University and the greater Lansing area.

With over 30 routes, the CATA bus system is complex. Our mobile app CATAlyst enables riders using CATA to navigate the bus system easily and to arrive at their destination on time.

CATAlyst users select and view bus routes integrated within Google Maps. They can view all buses moving in real-time and all stops on a particular route. The arrival time of the next bus is displayed simply by selecting a specific stop.

Users can create and save weekly scheduled trips for classes and other events. CATAlyst maps out the best routes for a trip based on all available routes and the time of day.

CATAlyst sends a push notification to a user's mobile phone, notifying them when to leave for a scheduled trip. The push notification includes the time it takes to walk to a specific bus stop from their starting location and the total estimated trip time.

CATAlyst is a mobile app written in Swift for Apple iPhones (iOS) and Java for Google Android phones using CATA real-time data. The server side utilizes RESTful APIs written in Java, using Maven and Spring Boot on an Ubuntu 16.04 Server with a MySQL database.

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Microsoft
Intune Company Portal Helper Bot

Headquartered in Redmond, Washington, Microsoft is one of the largest software and hardware companies in the country. They are leaders and innovators in all areas of technology.

Microsoft's Intune provides mobile device management, mobile application management and PC management capabilities from the cloud. Using Intune, organizations can provide their employees with access to corporate applications, data and resources from virtually anywhere on almost any device, while helping to keep corporate information secure.

Our Intune Company Portal Helper Bot is an automatic chat bot that interacts with users when they experience problems inside the Microsoft Intune Company Portal app, which connects to Microsoft's internal Intune mobile management system.

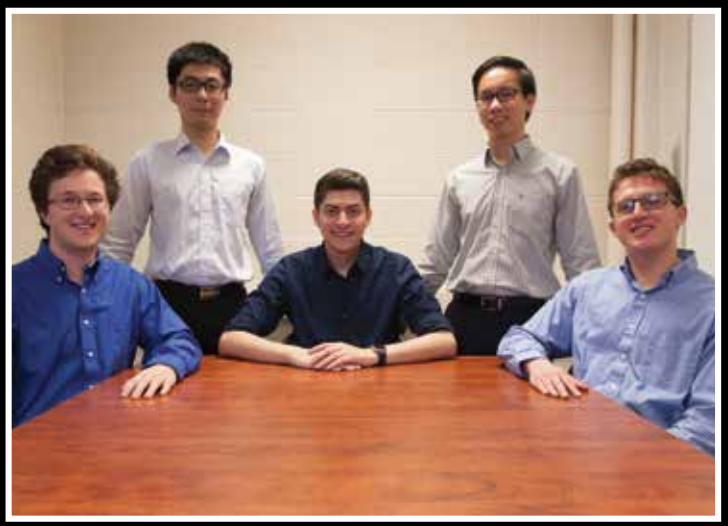
As the Intune user base grows, the need to assist individual users experiencing issues grows as well. To help meet this increasing demand, our helper bot provides automated real-time help to Intune users to resolve their problems.

Users ask our bot questions related to their issue. Our bot searches through its curated database of documents to find articles related to the user's problem. The bot sends the articles it finds to the user for review.

If our helper bot is unable to find an article that resolves the user's issue, the user can submit a bug report for the Microsoft Intune Company Portal team to investigate further.

Our bot is written using .NET, Java and Microsoft's Bot Framework. The app runs on Android devices and is deployed using Microsoft Azure cloud services.

Microsoft



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Mozilla Corporation

Improvements to Firefox's about:preferences

Web browsers are an integral part of everyone's internet experience. Mozilla's Firefox is a leader in the web browsing community. With an international community of developers, Firefox is one of the world's largest open source projects.

Firefox users can change Firefox's default look and feel using about:preferences, which enables users to change anything from the default font to the default search engine.

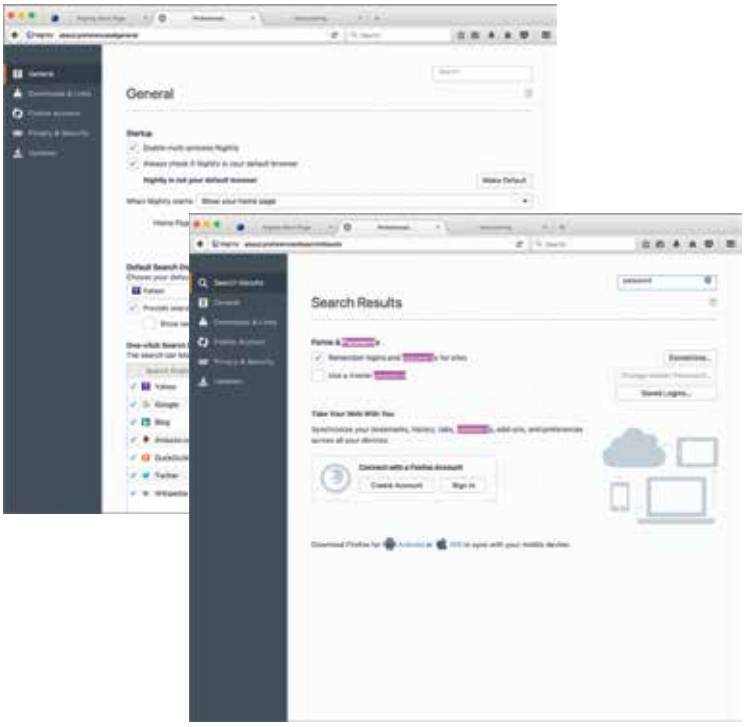
Our improvements to Firefox's about:preferences give Firefox's 450 million users an enhanced customization experience on macOS, Windows and Linux.

Firefox users must navigate a series of tabs and pages in about:preferences to find a particular preference they wish to change. With design specifications from the User Experience team at Mozilla, these tabs and pages are now organized to make it easier for a user to find particular preferences.

Even with the improved organization, finding a particular preference among so many can still be a challenge. To this end, our improvements include a new search functionality with which users can find preferences easily and quickly.

We use Mozilla telemetry probes within Firefox to measure the impact of each of our improvements to about:preferences to determine their effectiveness.

Our code is written in JavaScript, CSS and XUL. XUL is the user interface markup language that Mozilla uses to develop Firefox.



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MSU Federal Credit Union

Banking with Amazon's Alexa and Apple's Siri

Founded in 1937, Michigan State University Federal Credit Union offers financial services to Michigan State University and Oakland University faculty, staff, students, alumni association members and their families. With 230,000 members and over $3.3 billion in assets, MSUFCU is the largest university-based credit union in the world.

MSUFCU currently offers mobile banking apps on both Apple (iOS) and Google Android devices for members to access their funds and perform banking transactions at any time.

Our Banking with Amazon's Alexa and Apple's Siri systems maintain MSUFCU's technological edge by expanding their banking offerings to voice-controlled smart devices such as Amazon Alexa-enabled devices, Apple Watch and Android Wear.

Voice-controlled technologies give MSUFCU members new ways to interact with their accounts, including accessing their account balance, transferring money and obtaining information about recent transactions. Members can request other information about MSUFCU such as branch hours, current loan rates and the location of the nearest ATM or Branch.

Our companion administrative web portal enables MSUFCU staff to manage the available information and services offered by these voice technologies. Frequently asked questions can be added to the apps in minutes to improve the user experience.

The Alexa skill is written in Python, Apple Watch in Swift and Android Wear in Java. All three contact a MySQL database through JSON. The administrative web portal is written in PHP.

MICHIGAN STATE UNIVERSITY
FEDERAL CREDIT UNION
Building Dreams Together

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Rook Security
Force Platform Ingestion Tool (PIT)

Rook Security, based in Indianapolis, Indiana, is a managed threat response force that is dedicated to providing global IT security solutions that anticipate, manage and eliminate threats.

As the number and types of devices connected to the Internet increase, the need to protect those devices from attackers is increasing as well.

To this end, Rook Security provides their Force platform, which is a tool that streamlines the process of handling incoming security alerts, thereby increasing the efficiency of Rook's in-house security analysts and lowering response times to threats.

Our Force Platform Ingestion Tool with Alert Correlation system is a tool that processes security alerts from Rook clients for ingestion into the Force platform.

When a security alert is received by the Force platform, our system processes the alert by extracting key information and by analyzing the alert to determine whether it relates to other recent alerts, potentially grouping it into a larger case automatically.

Rook security analysts view these security alerts and respond accordingly depending on the type of attack, the source of the threat, the threat level and other relevant information.

Our system also enables Rook analysts to create connections with new clients to route their alerts into Force to be monitored.

Our Force Platform Ingestion Tool with Alert Correlation system runs on a Python Django web platform, using React/Redux JavaScript libraries, and is accessible by any modern web browser.

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Spectrum Health
Resident Physician Tracking

Spectrum Health provides high quality healthcare in Western Michigan through 10 hospitals, 7 urgent care centers and 33 laboratories. Together, Spectrum Health employs nearly 3,100 physicians, residents and advanced practitioners.

After graduating from medical school, physicians train for a number of years as resident physicians at hospitals before becoming certified in their field of specialty.

Hospital resident physicians are limited by federal regulations in the number of hours they may work in a single shift, so they must keep track of their shift times accurately.

Resident physicians click the Start button on our mobile app to begin their shift. Push notifications alert the resident if they are approaching a shift time limit per federal regulations. Clocking out is as simple as pressing the Stop button. Our app provides for manual time entry if the resident forgets to start or end their shift.

Administrators called Resident Coordinators use our companion web app to manage groups of residents. Resident Coordinators can view clock-in and out times, see shift data by resident, and select a date range for the shift display. An Export button exports data for importing into Excel.

Our Resident Physician Tracking system utilizes Swift for Apple (iOS) devices and Java for Google Android devices. It uses ASP.NET Core MVC with .NET Core and Entity Framework for its API.

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TechSmith
Teacher's Virtual Toolbelt

TechSmith provides simple and intuitive visual communication software for both academic and business environments.

Teaching some subjects, such as physics, is often a challenge. It is difficult to depict physical forces and objects visually.

Our Teacher's Virtual Toolbelt uses the Microsoft HoloLens augmented reality device as a teaching tool to better illustrate challenging subjects and concepts using holograms. By combining a HoloLens app and a web app, this tool allows for collaboration between students and teachers.

Our HoloLens app is used by the teacher. It provides a set of basic holograms such as cubes, spheres and arrows. The HoloLens enables the teacher to interact with these holograms in a 3D space using hand gestures and voice commands.

The teacher uses our web app to plan lessons that include quizzes and textual reference material. Students use the web app to view live lessons and take quizzes. Students submit questions that are visible to the teacher in the HoloLens. The teacher starts the lessons and quizzes using voice commands.

The teacher's augmented view of the holograms is streamed from the HoloLens to the web application, allowing students to see the holograms as the teacher conducts the lesson. This mixed reality stream lets an entire group of students benefit from the capabilities of one HoloLens device.

Our HoloLens app is written in Unity. Our web app uses the .NET Web API framework, and is written in C# and JavaScript. The web app and SQL database are hosted on the Microsoft Azure Cloud.

TechSmith®

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TWO MEN AND A TRUCK®
Mobile Mini "Movers Who Care"

TWO MEN AND A TRUCK®, founded in 1985, is the largest franchised moving company in the United States. Headquartered in Lansing, Michigan, it has franchises located throughout four different countries.

TWO MEN AND A TRUCK® has grown its operations considerably over the years and prides itself on providing friendly and efficient services to their customers.

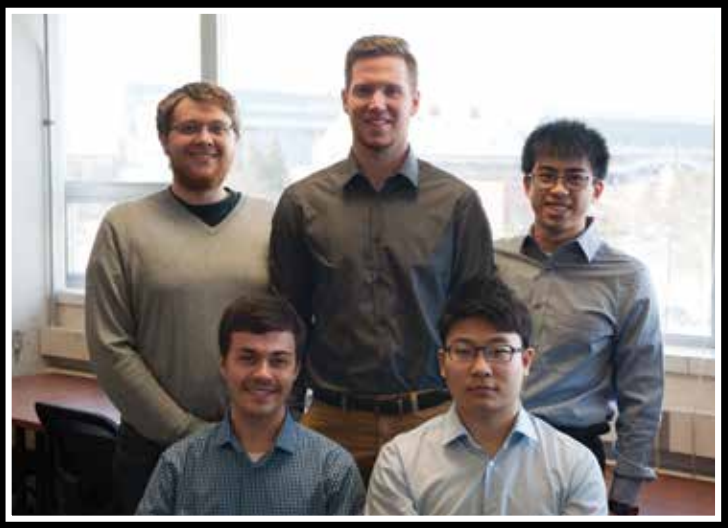
Our Mobile Mini "Movers Who Care" is a mobile 2D driving game that enhances the company's friendly image by focusing on children during a move. Moving can be a difficult and often times boring process for a child, so this mobile application serves as the perfect distraction.

Game users drive a moving truck, playing through five levels, each with different terrain, and three difficulties, each with different box types. The objective of the game is to deliver as many boxes to the house as possible. Points are earned based on the time taken to complete the level, the selected difficulty and the number of boxes kept intact.

Players collect coins in each level. Collecting and saving coins enables players to purchase one-time use items and permanent truck upgrades from the store. These upgrades help them complete more challenging levels and difficulties.

Mobile Mini "Movers Who Care" works on both Apple iPhones and iPads (iOS) and Google Android devices. Players have the option to compete by posting scores to a leaderboard via Facebook. The game is written in Unity's version of Microsoft Visual Studio using C#.

TWO MEN AND A TRUCK®
"Movers Who Care®"



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Union Pacific
Learning New Train Routes

Union Pacific is a leading transportation company headquartered in Omaha, Nebraska. Union Pacific has over 8,500 locomotives running on 32,100 miles of track across 23 states with over 44,500 employees.

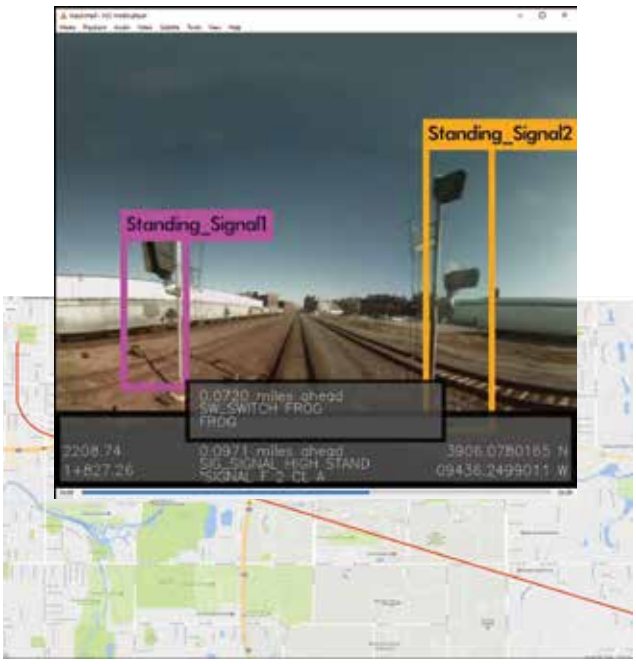
When Union Pacific assigns an engineer or conductor to a new train route, they must learn the new route by riding along on a train with another engineer or conductor who already knows the route. This process can take days for each new train route to be learned, resulting in millions of dollars spent annually as multiple engineers and conductors learn multiple routes.

Our Learning New Train Routes system is an augmented reality software that uses actual video of the train route taken by cameras mounted on engines. Our software overlays this video with important information including mile markers, train speed and important landmarks such as signals and switches.

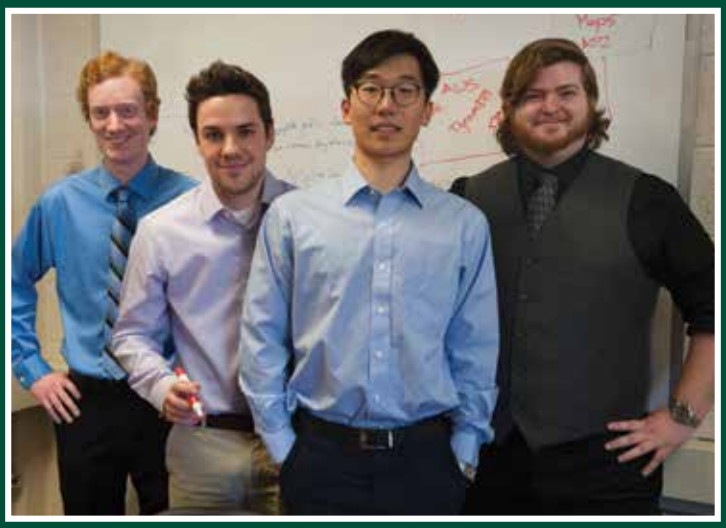
Engineers and conductors use our companion web app to view an augmented reality video of a new train route. They can view videos from anywhere, at any time, and on any web-browsing device.

A Google Maps display shows the train's progress along the route. Engineers and conductors can move around in the video by clicking on the map. In particular, they can replay sections of track to ensure that they learn the new train route well.

Our Learning New Train Routes system is written in Python and utilizes OpenCV and Darknet for image recognition. HTML, CSS and JavaScript are used for the web app.



BUILDING AMERICA®



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Urban Science
Real-Time Ad Campaign Management

Urban Science is a global consulting firm headquartered in Detroit, which specializes in industries that include automotive, health and retail. Urban Science uses the combination of science and technology to identify and improve market share, sales, profitability and customer loyalty.

Within the automotive industry, Urban Science aims to improve marketing campaign efficiency for which a common challenge is to target potential likely buyers while avoiding advertising to customers who are not interested in buying a new vehicle.

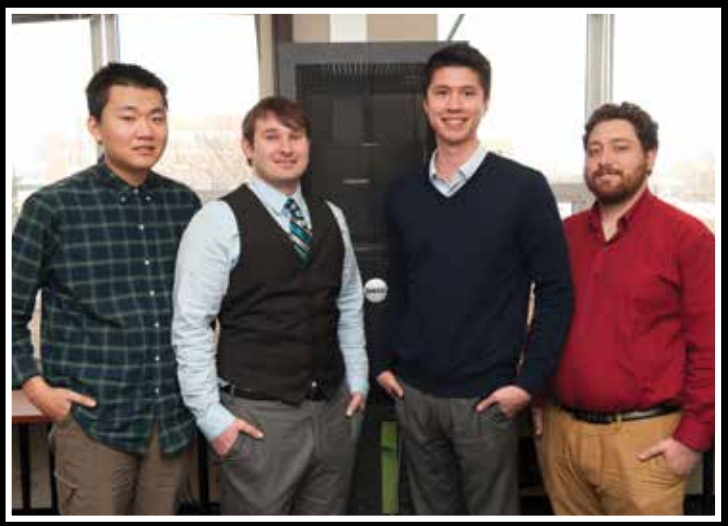
Our Real-Time Ad Campaign Management recommendation system helps automobile ad campaign managers optimize their marketing campaign budgets by targeting optimal potential buyers.

Our system uses various real-time online and offline marketing data to improve marketing campaigns by making various recommendations such as removing customers from mailing lists and accurately predicting which customers would be most likely to purchase a vehicle.

Using our intuitive interface, ad campaign managers have the option to implement the recommended improvements to their campaign allowing them to make tactical decisions and impact campaign execution and results in real-time.

Our Real-Time Ad Campaign Management recommendation system is written in C# using .NET Core 1.0 as a platform. The control panel interface is built with HTML, CSS and JavaScript with the Vue.js framework. Data is stored in a Neo4j graph database.

URBAN SCIENCE



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Whirlpool Corporation
Commercial Laundry Dashboard

The 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 sells commercial laundry equipment to a number of trade partners including apartment complexes, laundromats, hotels, hospitals and more, which creates a large global fleet of appliances.

Whirlpool's commercial laundromat equipment is connected to the Internet via a black box called the MC360, which enables Whirlpool to gather data from all of this equipment from all over the world in real time.

Our Commercial Laundry Dashboard provides Whirlpool administrators with the ability to view the collective data from all of their machines. Our intuitive visual interface enables them to monitor the equipment of their trade partners and alert them to potential problems through the use of push notifications.

Users can customize their dashboard by adding and removing visual features, filtering among various options, and switching between the dashboard and an interactive map of their trade partner locations.

In addition, users can organize important data by creating custom dashboards where static filters are set.

Our Commercial Laundry Dashboard runs on Apple (iOS) devices, on Google Android devices and in modern web browsers. It is developed using Google App Engine, Cordova Ionic, Flask, D3.js and PostgreSQL.

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Yello

YelloVision: Career Fair Augmented Reality App

Yello, headquartered in Chicago, Illinois, provides software solutions to enable companies to hire new employees as quickly and efficiently as possible.

While there exist numerous software systems for companies to manage information about applicants at career fairs, there is a lack of software for applicants to manage information about companies.

While attending a career fair, applicants have limited time to explore dozens or even hundreds of companies, forcing them to make important life decisions quickly, based on limited information.

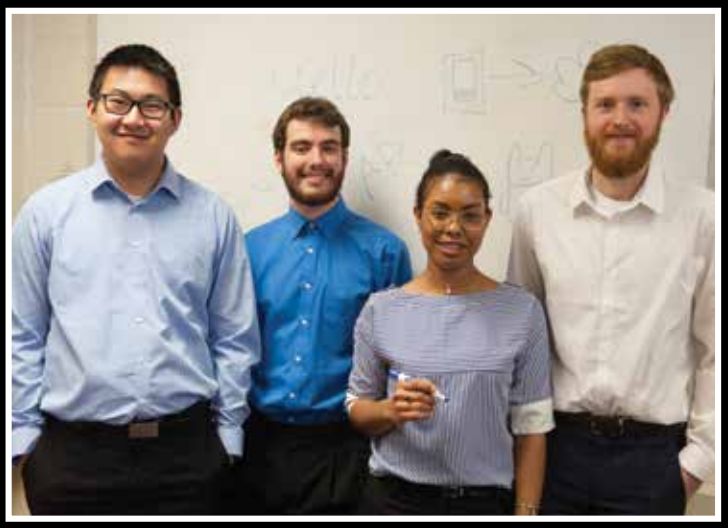
Our YelloVision Career Fair Augmented Reality app is designed to help applicants to make informed decisions about potential employers while attending a career fair.

Using YelloVision, a career fair applicant looks up information about a company simply by using their phone camera to scan a company's logo at their booth. After identifying a company by its logo, our app displays the company's name, locations and the majors it is looking to hire. A "More Details" button provides access to more comprehensive information.

In addition to its augmented reality feature, YelloVision supports searching by company name in cases when an applicant does not want to use the logo search feature or the applicant cannot find a logo at a company's booth.

Our YelloVision Career Fair Augmented Reality app is built using Objective C in Xcode for Apple (iOS) devices and using Java in Android Studio for Google Android devices.

yello



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Design Day Awards

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

Auto-Owners Insurance Exposition Award

Auto-Owners INSURANCE
LIFE • HOME • CAR • BUSINESS

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 Whirlpool
Mooch

Adam Schoonmaker, Noah Hines, Daniel Jiang, Laura Robb, Caleb Swanson
Presented by Scott Lake and Ross Hacker

MSU Federal Credit Union Praxis Award

MICHIGAN STATE UNIVERSITY
FEDERAL CREDIT UNION
Building Dreams Together

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 Rook
Anomaly Detection Suite v2.0

Zach Rosenthal, Grant Levene, Brian Harazim, Cam Gibson, Andrew Werner
Presented by Samantha Ambergy

Fall 2016

Design Day Judges

Samantha Amburgey
MSU Federal Credit Union

Louise Hemond-Wilson
IBM

Rob McCurdy
Michigan State University

J.J. Thompson
Rook Security

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Michigan State University

Fred Killeen
General Motors

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Karen Wrobel
Fiat Chrysler

Adam Haas
Ford Motor Company

Terry Ledbetter
Meijer

Marty Strickler
Rose Packing Company

Doug Zongker
Google

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 Ford
SYNC Calendar

Avery Yue, Brett Durlock, Jack Zaidel, Eric Pressey, Cam Rooks
Presented by Wendy Hamilton and Dean Craven

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 Amazon
Asa: Your Amazon Shopping Assistant

Sam Chung, Yiming Li, Aaron Beckett, Renee Dennis, Evan Moran
Presented by Linda Koeppe and Elizabeth Klee

Microsoft

Be one who empowers billions

ECE 101
Introduction to Electrical and Computer Engineering

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

PROBLEM STATEMENT

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

Grad Student Assistant: Yunting Liu

Team Members	Project Title
Team #1 Chyle Johnson Alyssa Maldonado Sergio Sanchez	**Wind-powered Water Filter**
Team #2 Yuxin Chen Paul Hasson Zhaoqi Huang	**E-bike**
Team #3 Steven Keeler Michael Vitale Huiyu Zhao	**Sun Finder**
Team #4 Jiaxin Fang Madison Glardon Jonathan Ryan	**Natural Battery**
Team #5 Chaoyi Chen Donghui Feng	**Shut-up Robot**
Team #6 Rashed Alabdullatif Devon Thompson Deion Williams	**Wind-powered Phone Charger**
Team #7 Noor Ali Camron Barksdale Kurtis Kuzniar Chi Lin	**Mood Determiner App**

ECE 410
VLSI Design

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

A Programmable (adaptive) Filter in CMOS ICs

Integration of sensors, e.g., microphones, accelerometers, and/or photo-sensors (cameras), 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 last year's 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, and other resources) a programmable FIR filter (with at least 64 taps). The FIR filter architecture will be designed into an IC chip-die guided by 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. A team's Project Design outcome will be judged on their ability to satisfy several competing performance metrics: (i) low-power consumption, (ii) execution speed, and (iii) total die (module) area.

For the ultimate challenge, and for extra credit, teams have the option of incorporating adaptive techniques in determining the filter taps towards a modular adaptive neural network architecture.

Group 1	Group 2	Group 3	Group 4
Kyle Davis	Haitai Ng	Zachary Bates	Yinghao Hu
Ryan Gallant	James Pitcher	Samuel Gasiorowski	Guanyu Lu
Samuel Selyutin	Austin Ratts	Jon Klapatch	Yuzhou Wu
Tommy Sereseroz	Nur Shahmir	Alex Masakowski	Weili Xu
Wesley Spain	Ryan Siegler	Michael Straub	Xiaohan Zhang

Group 5	Group 6	Group 7	Group 8
Philip Dooley	Abdelruhaman Alsnayyan	Yuhao Chen	Austin Brune
Rachel Moses	Jack Christie	Hyung Oh	Camaron Hodgson
Eric Ofori	Jiahu Lu	Frank Riviera	Peter Jones
Sanh Phan	Sky Patel	Stephanie Saumier	Jason Merlo
Anton Schlegel	Yifan Yu	Kevin Scott	Steven Yik

The Capstone Projects

Dr. John Albrecht
Associate 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
8:30 a.m.	NDE Lab at MSU	3D Sensing Platform
8:55 a.m.	ECE Dept.	Human-Robot Integration System
9:20 a.m.	MSU	Quadcopter with Robotic Arm
9:45 a.m.	MSU	Diamond Surface Measurement
10:10 a.m.	Techmark	Fruit and Vegetable Damage Detection
10:35 a.m.	MSU Office of the Executive VP	Distributed Natural Gas Detection System
11:00 a.m.	MSU IPF	Micro-Grid Control

Room 2250	Team Sponsor	Project Title
8:30 a.m.	Daifuku	SmartCart Predictive Diagnostic Software
8:55 a.m.	Consumers Energy	AMI Smart Meter Data
9:20 a.m.	Delphi	Low-Cost Watchdog Controller
9:45 a.m.	MSU Office of the Executive VP	WiMAX Communication System
10:10 a.m.	MI Pork Producers/MSU College of Veterinary Medicine	Pig O'Vision
10:35 a.m.	ArcelorMittal	Optical Verification of Steel Coil Rail Car Loads
11:00 a.m.	MSU	Simulation Software for Crack Detection in Materials

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, intellectual property, accommodation issues and entrepreneurship;
- Polishing their communication skills – individual and team – on proposals, reports, résumés, evaluations, posters, web pages, and oral presentations; and
- Requiring each student to complete four individual hardware/software laboratory assignments.

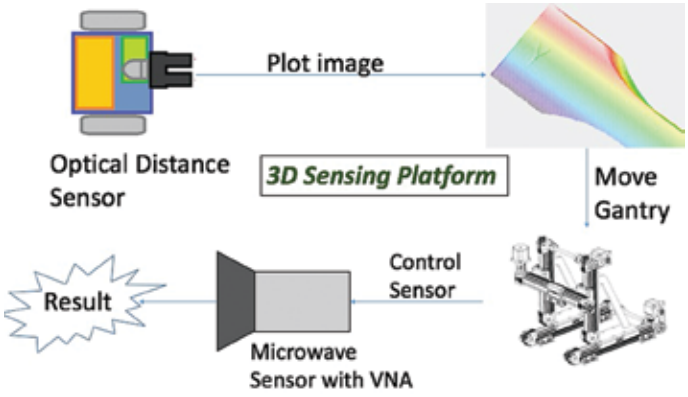
Team sponsors are local and national, including ArcelorMittal, Consumers Energy, Daifuku/Jervis B. Webb Co., Delphi, Michigan Pork Producers, Michigan State University, MSU Electrical Engineering Department, MSU Infrastructure and Planning Facilities, NDE Lab at Michigan State University, MSU Office of the Executive Vice President, MSU College of Veterinary Medicine, Techmark, Inc. Thank you to each of these team sponsors.

ECE 480 Room 2205 | 2nd Floor **8:30 a.m.**

NDE Lab at Michigan State University
3D Sensing Platform

Non-destructive examination is a group of analysis techniques used in industry for evaluating the integrity of a material, component or system without causing any physical damage. NDE is used as quality control in advanced manufacturing. There is a wide choice of measuring techniques available to meet the demand of examining a wide variety of materials such as metals, plastics and rocks, as well as different structures and sizes ranging from semiconductor chips to nuclear reactors. At the same time, physical measuring techniques are used to examine parts of construction assemblies for hidden imperfections and defects.

The NDE Laboratory asked our team to design a single-channel, multi-band, and multi-resolution sensing system that includes a prototype of a single-channel probe and a platform that is geometrically flexible for complex structures and materials that can move sensors in an x-y-z direction. Two sensors: 1) LiDAR, to plot the 3D surface image of the object, and 2) microwave sensor, to show the surface and subsurface of the object, will be implemented in this platform. VNA will be used to integrate the signal from EM sensors at different frequencies, and we will develop a software to collect the data and process it into images.



MICHIGAN STATE UNIVERSITY

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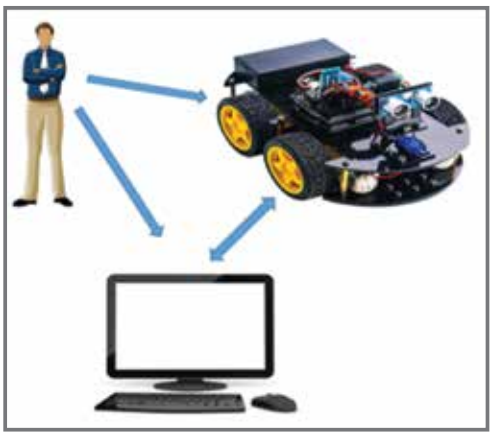
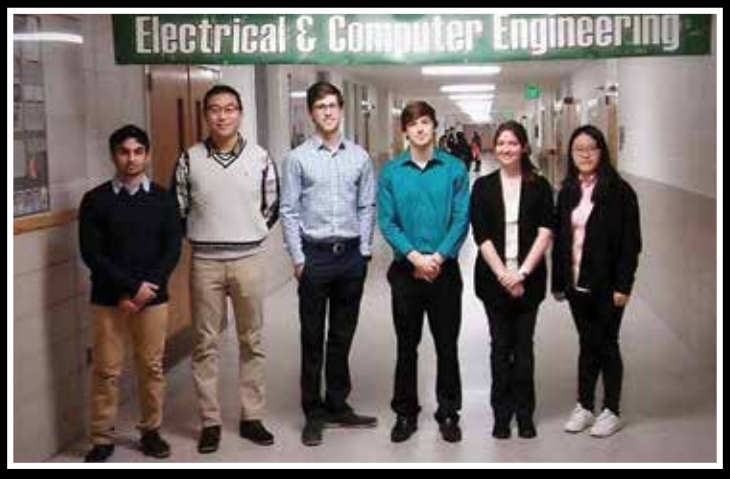
MSU Electrical & Computer Engineering
Human-Robot Integration System

Michigan State University is interested in developing a human-robotic integration system. This technology will use human gestures and eye-movement to control a ground robot, providing solutions in a wide variety of applications. It could be used to aid in the mobilization of the physically disabled, where paralyzed individuals could transport themselves using limited body movement. The system could also be used in industry to explore or operate under conditions not suitable for humans. Whether the application is the deep sea, outer space, or in your living room, humans and robots need the capability to communicate effectively. A human-robot integration system aims to accomplish this task. There is a lot of potential for a system like this.

Our team is particularly focusing on developing an eye-tracking system and a head-motion tracking system to control the robot and a camera mounted on it. This will involve two subsystems responsible for different types of commands. The head motions detected with the system correspond to different movements of the physical robot. The eye-tracking system will measure the user's eye positions to control movement of the robot's camera, and the robot's camera will send the real-time video footage back to the computer. Then, the computer will display the video footage on the screen so that the user has a clear idea of what the robot is looking at and where to move it accordingly.



MICHIGAN STATE UNIVERSITY



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Michigan State University
Quadcopter with Robotic Arm

Nowadays Quadcopters are being used increasingly in a wide variety of applications. They can easily travel to heights humans can not easily reach, and they can travel across great distances.

The purpose of our project is to design a Quadcopter that is capable of autonomous flight and that has the functionality of transporting different objects. The basic task for the Quadcopter is to transport a 30g object with its robotic arm to a specific location and to achieve a flight time of at least 8 minutes.

The Quadcopter will include a Flight Control Unit (FCU) for autonomous flight. The FCU communicates with onboard sensors such as a gyroscope, an accelerometer, and a barometer to keep the copter stable in flight. To navigate, the FCU also communicates with information from external sensors such as cameras or GPS, depending on whether the flight is indoors or outdoors. The FCU also communicates with an Arm Control Unit (ACU) to tell the arm where an object is and when to pick it up. Our final designed product will satisfy all the requirements and minimize the cost of our Quadcopter system

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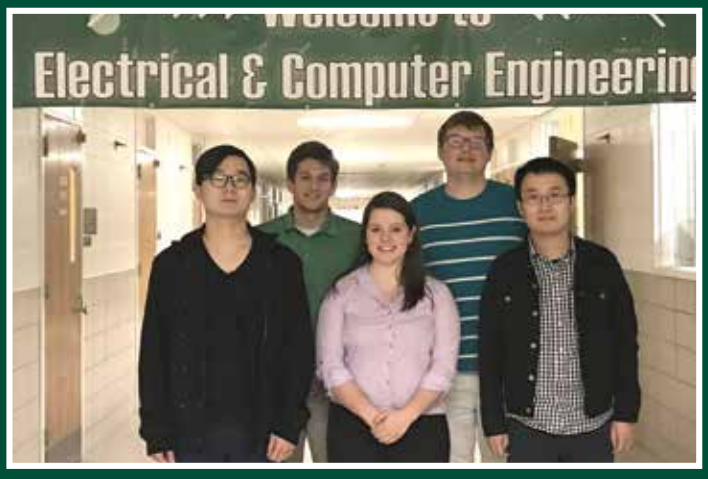

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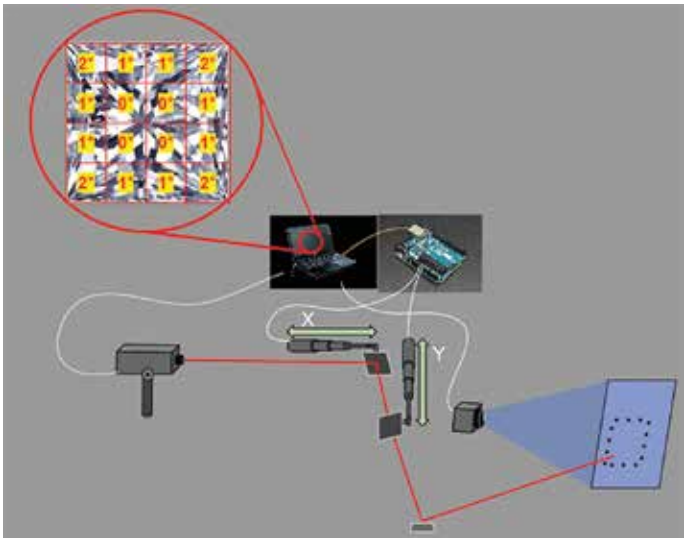
Michigan State University
Diamond Surface Measurement

Diamond has numerous electronic properties which make it very attractive in semiconductor technology. Compared to the most common semiconductor material used today (silicon), diamond is superior in many aspects. The process of growing diamond is accomplished by a chemical vapor deposition process and MSU's ERC has been a part of this process since the early 1980's.

Currently, constant feedback is needed to ensure the diamond will grow to their satisfaction. The primary objective of Team 4 is to provide information about the diamond surface as it is growing (i.e. in real time). We will implement a laser measurement system that will scan the top surface of the substrate and give slope information (angle/direction) at various points. Since growth rates are on the order of a few microns per hour, maintaining a high degree of accuracy as well as repeatable measurements is paramount. In addition, sample sizes ranging from 3mm x 3mm to 25mm by 25mm must be scanned in 200 seconds or less. In the future, this project will be implemented as a feedback subsystem for the chemical vapor deposition process.



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Techmark, Inc.
Fruit and Vegetable Damage Detection

Techmark, Inc. is interested in designing an impact recording device (IRD) for measuring the bruising of fruits and vegetables that occurs while being processed from the farmer to the consumer. Techmark, Inc. currently has an IRD product in place that works with large fruits and vegetables like potatoes, tomatoes, apples, etc, but they would like a new IRD for smaller fruits and vegetables such as mushrooms, blueberries and strawberries. The goal of this project is to create a small IRD capable of measuring impacts for the smaller size fruits. Continuing of the project started in Fall 2016, our team will create an IRD that will meet all requirements from Techmark, Inc. With the new IRD, farmers will have an easier time detecting when and where the most bruising to their products occurs during the handling process.

The IRD will have one 3V battery, a centralized accelerometer, a micro-USB port, and a 4-layer PCB to accommodate and perform as required. The sensor will last 3-4 hours and accumulate voltage drops and other useful information via the accelerometer. Once the sensor completes the process, the microcontroller will send the data to the PCIRD sponsor software for further action.

TECHMARK, INC.

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Techmark, Inc.
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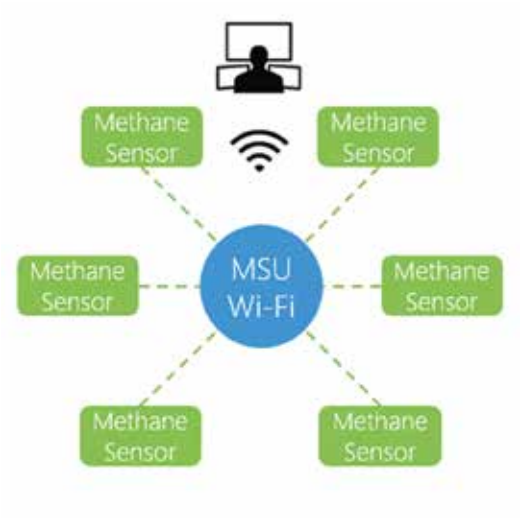
James Dyson Foundation/MSU
Distributed Natural Gas Detection System

Natural gas has positioned itself to become the primary fuel source for electricity generation in the United States. Originally designed for coal, MSU's TB Simon Power Plant converted to 100% natural gas fuel to generate electricity and steam in 2016. This increased use of natural gas has made the detection of leaks a necessity for both safety and environmental reasons.

The current sensors in use at MSU's TB Simon Power Plant are less than ideal. The plant currently operates with two different sensors: handheld and hardwired. Handheld systems must be manually operated and are not ideal for use in hazardous areas. Hardwired solutions are very costly to implement and placement becomes the driving factor in its overall effectiveness.

The main objective of the project is to develop an array of low-cost wirelessly connected sensors that notify users when dangerous levels of natural gas are detected. The product will utilize preexisting Wi-Fi networks to ensure a completely mobile and adaptable detection system. The user will then be able to find the location of a leak with relative accuracy.

Our group will utilize an MQ4 methane sensor connected to a Raspberry Pi Zero microcontroller. The microcontroller will process the data gathered from the sensor and transmit it over Wi-Fi to the monitoring application.



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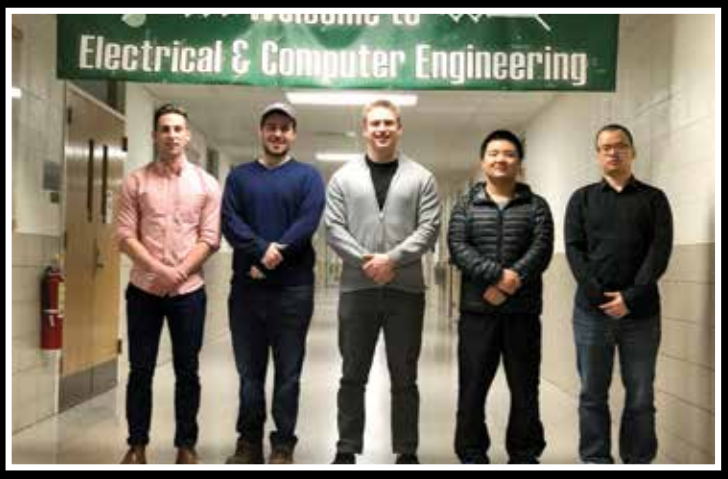

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Michigan State University Office of the Executive Vice President & James Dyson Foundation
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ECE Project Facilitator

Dr. Chuan Wang
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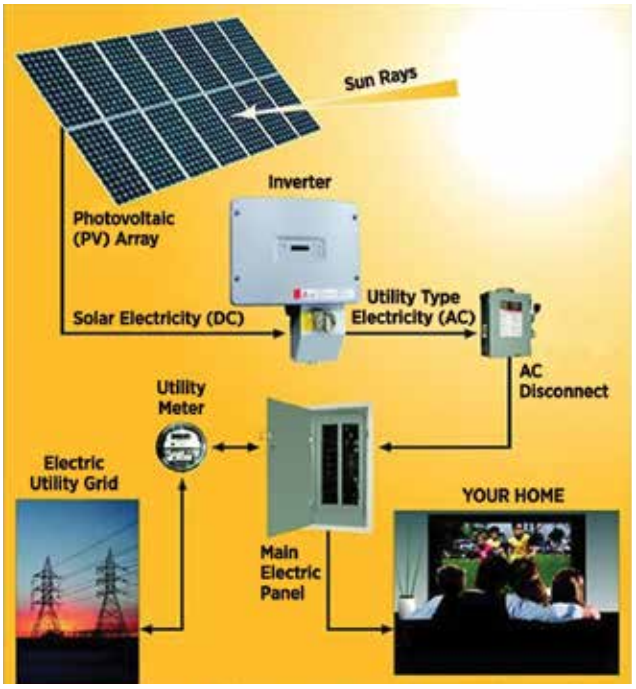
ECE 480 Room 2205 | 2nd Floor **11:00 a.m.**

Michigan State University
Micro-Grid Control

MSU is currently constructing a 10 MW solar array in parking lots 83, 89, 91, 92 and 100. IPF (Infrastructure Planning and Facilities) is looking for a technical solution to increase the reliability of the micro-grid system and to reduce the total cost of utility operation. Our team is consulting with MSU in order to determine viable solutions that can provide stability when operating the solar array.

Our team is developing solutions to reduce costs and power fluctuation in the solar array. We are also considering methods to predict cloud covering weather patterns.

In addition, we are developing solutions to implement external power sources such as batteries, capacitors, or hybrid energy systems in the solar array. We brainstormed multiple power systems and analyzed the pros, cons and cost-efficiency of each item. We then simulated electric and steam load shedding systems that would help conserve power across campus. As a side project, we are developing ways to predict coarse weather patterns either by using detection sensors or cloud image processing.



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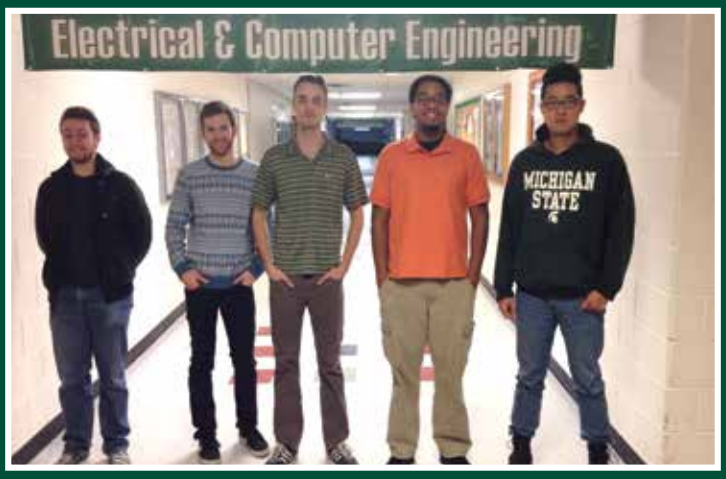

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Michigan State University Infrastructure and Planning Facilities
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Daifuku/Jervis B. Webb Company
SmartCart Predictive Diagnostic Software

Jervis B. Webb, an industry leader in factory automation and material handling, has tasked our team with performing predictive maintenance on their SmartCart line of automated vehicles. With the ability to detect abnormality in subsystems before failure, downtime is minimized, as there is an opportunity to pull the SmartCart off the factory floor before progress is halted, increasing efficiency in productivity.

The deliverables to Jervis B. Webb include a set of general failure modes and an algorithm to detect these failure modes for any component. This way the software can be applied to any new component added. The goal is not to detect a specific failure for a specific component, rather to develop detection methods that can be applied to any component.

Also, there is a desire to integrate this software solution into Jervis B. Webb's existing codebase. To facilitate this, a solution will be developed in C++ on a Linux Debian platform. A Raspberry Pi Model 3 B was chosen to be the platform for this software solution.

DAIFUKU
JERVIS B. WEBB COMPANY

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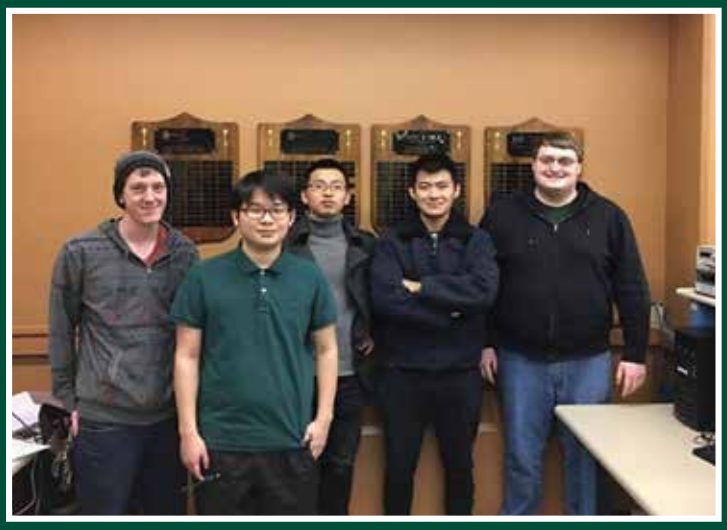
Consumers Energy
AMI Smart Meter Data

Advanced Metering Infrastructure (AMI) technology allows for two-way communication between utility meters and their companies. Consumers Energy has begun to implement AMI smart meters across their market but currently lacks any meaningful analysis or visualization of the collected data and information. By analyzing and utilizing this data, Consumers hopes to better service customer demands. Consumers Energy has asked us to develop a tool to assist in data utilization as well as to simplify data visualization. They would particularly like to focus on the most important events, which may require immediate elicited response from Consumers.

Our team has chosen to focus on three types of events: power loss and outage, tampering and major voltage changes. For each event, we plan to create software that will simplify/break down large datasets, analyze the event capture and flag the event occurrences of great significance. Flagged events are those that need attention, due to the possibility of theft or vandalism or repeated power outages. Our software will contain a simple graphical user interface (GUI) to display our results and use latitude and longitude data to place event occurrences onto a map. In addition, important flagged tampering events, those we consider very likely to be theft, are marked for review operations personnel by our GUI accessible function for easy access and rapid response.

Consumers Energy
Count on Us



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Delphi
Low-cost Watchdog Controller

Delphi is currently developing advanced powertrain systems that are one-of-a-kind with few spare parts available. To protect these engines, Delphi has implemented a watchdog controller to shut down the engine in order to reduce damage to these prototype engines. The current controller is effective but expensive. Delphi is looking to develop a low-cost watchdog controller. The new controller will provide the same functionality as their current controller but reduce the cost of future builds.

Our team will be developing a custom Printed Circuit Board using TI's TMS320F28377SPZPQ 32-Bit microcontroller to meet the requirements specified by Delphi. A JTAG debugging port will be included in the design to facilitate flashing via Simulink. Implementing bulk converters will allow the watchdog to operate at a 9-16 V range. Other additional circuitry includes 2 CAN channels, 16 analog inputs and 12 analog outputs. Constructing an adapter harness enables the new watchdog to interface with the existing components. Our goal is to design a working watchdog controller that mimics the functionality of the existing controller within the budget of $500. Lowering the cost of the controller will allow Delphi to implement the prototype engines in more vehicle applications.

DELPHI

Innovation for the Real World

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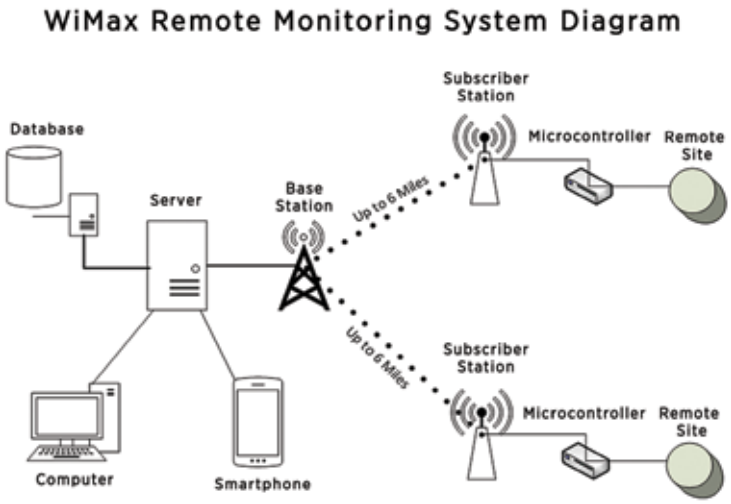
ECE 480 Room 2250 | 2nd Floor **9:45 a.m.**

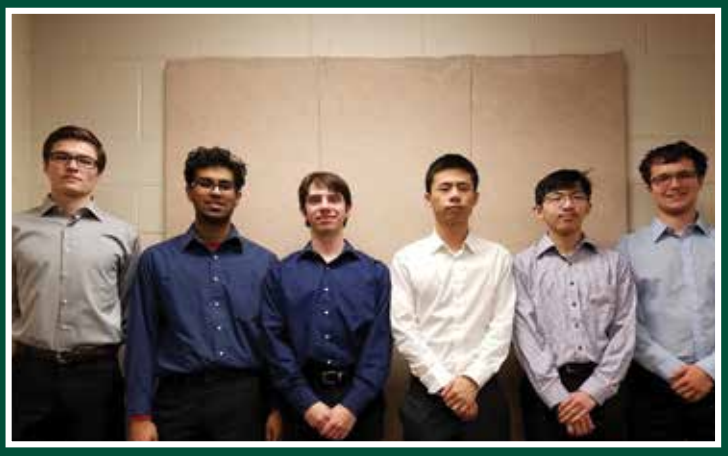
MSU EVPAS/IPF
WiMAX Communication System

Communication systems are essential for a variety of applications, ranging from small- scale video surveillance to large-scale utility monitoring systems. Michigan State University currently relies on fiber connections for adding new applications to the network. Laying fiber is both time-consuming and expensive because of the obstacles that the urban campus presents. Additionally, many of the applications do not require the throughput and bandwidth available through the fiber connections. Additionally, many wireless point-to-point connections currently on campus utilize Sub 1Ghz technology that only provide limited throughput for small applications.

MSU is interested in testing and exploring the potential of using a WiMAX communication system over campus. For a proof-of-concept, MSU is looking to set up a wireless connection between the sensors at the wells that supply water to MSU. The WiMAX 007 team has been tasked to research and set up a WiMAX network that would replace the current system for adding network applications. This wireless network would be a time-saving and cost-effective solution for the current system. Our team is also going to be laying the foundation for a larger WiMAX communication system that would work with other utility applications such as traffic intersection surveillance, parking lot surveillance, etc.



MICHIGAN STATE UNIVERSITY



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Mike Tracy
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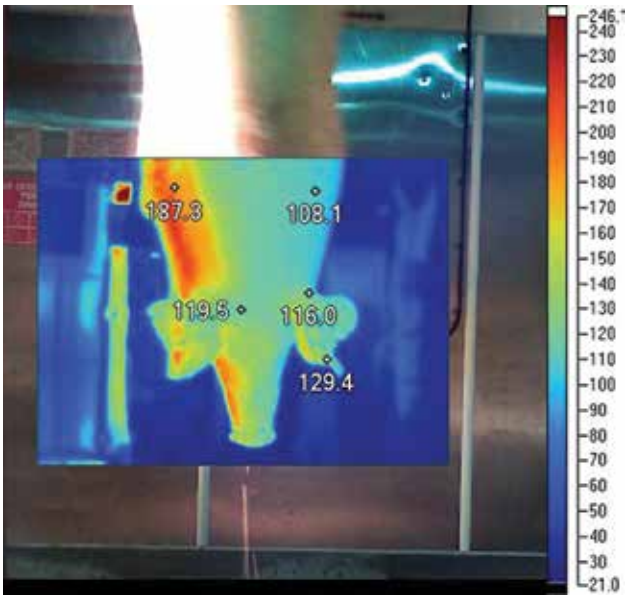
Satish Udpa
Executive Vice President

Michigan Pork Producers Association/MSU College of Veterinary Medicine & Large Animal Clinical Sciences: Pig O' Vision

The pork industry is faced with increasing regulations and laws relating to the safety and wellbeing of animals. MSU and the Michigan Pork Producers Association want to be on the forefront of modern technology to be prepared for those regulations when they are implemented in 2020. They desire a product that can gather data on pig size and weight without physical contact to make the process as simple and as safe as possible for both the animal and user. Using cameras and sensors, the system will take pictures, depth measurements, and thermal images to assess the health and biometrics as the pigs are moved from one location to another in the farm. With this data they hope to be able to raise a healthier and happier pig with less food and resources being wasted.

Our team understands the needs and requirements of the industry and is designing a system that will benefit not only the producers and researchers, but also the consumer. The pork industry, with the help of the system, will be able to raise animals in a more uniform process that also relies on individual needs of each animal as they grow. By lowering the price of raising a pig, the industry can pass the saving onto the consumer with lower and more consistent pricing.



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ECE 480 Room 2250 | 2nd Floor **10:35 a.m.**

ArcelorMittal

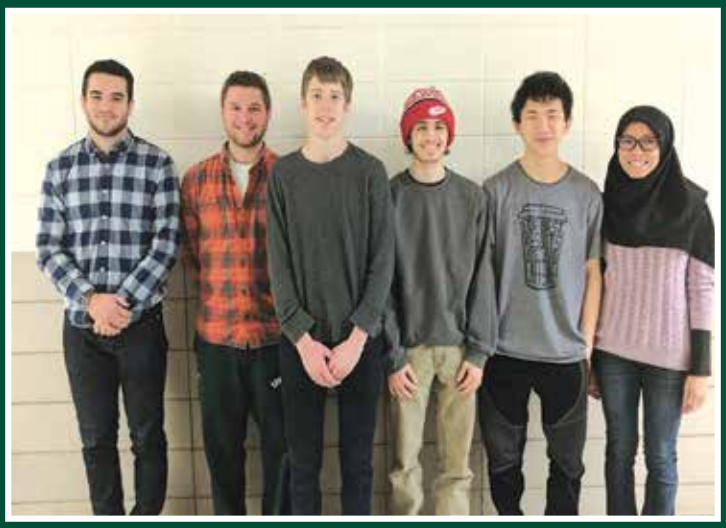
Optical Verification of Steel Coil Rail Car Loads

ArcelorMittal is one of the largest steel companies in the world, producing over 100 million tons of steel every day. With steel prices expected to rise in the upcoming years, it is vital for each coil of steel to be accounted for. Also, to remain competitive in the steel industry, all processing and shipping times must be made as efficiently and quickly as possible.

A record is created for every rail car that leaves ArcelorMittal. It keeps track of which steel coils are loaded onto a given railcar. This data must be compared to what is actually in the rail cars that are ready to be shipped out. Currently, a technician is tasked with reading each railcar ID, then checking that each steel coil is in the correct rail car. This process slows down shipping time and is vulnerable to errors by the technician. ArcelorMittal does have technology that can scan a barcode on a steel coil. A way to quickly identify the railcar would able to further improve their shipping process.

Our team is designing a system to improve the accuracy and efficiency in the steel coil verification process. To solve the issue of railcar recognition, an Optical Character Recognition, or OCR, software would be implemented into the design. For mobility within the ArcelorMittal plant, the software will be programmed into a rugged industrial tablet. The tablet will be able to identify the railcar ID number with just a photo; then the steel coils within the railcar can have their barcodes scanned. This recorded data will be checked together with the data of what the railcar is intended to have in it. If all of the steel coils are in the right car, the technician will receive an immediate confirmation from the tablet and can then proceed to the next car. The new process will greatly reduce the time it takes to verify the location of the steel coils, and well as reduce possible errors in manually reading the ID numbers.

ArcelorMittal



Michigan State University
Team Members (left to right)

Ryan Flanagan
Northville, Michigan

John Dorosa
St. Charles, Illinois

Evan Daykin
Beverly Hills, Michigan

Wyatt Roehler
Traverse City, Michigan

Sunho Choi
Troy, Michigan

Nur Shahmir
Kuala Lumpur, Malaysia

ArcelorMittal, USA
Project Sponsor

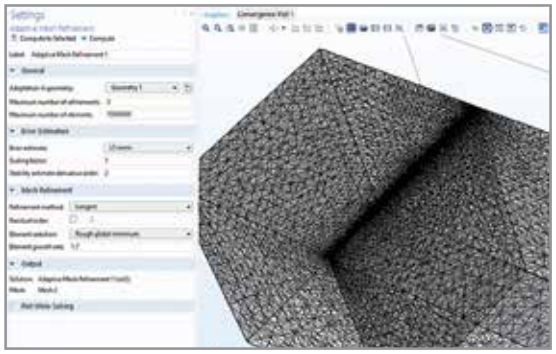
Jim Lang
East Chicago, Indiana

Michigan State University

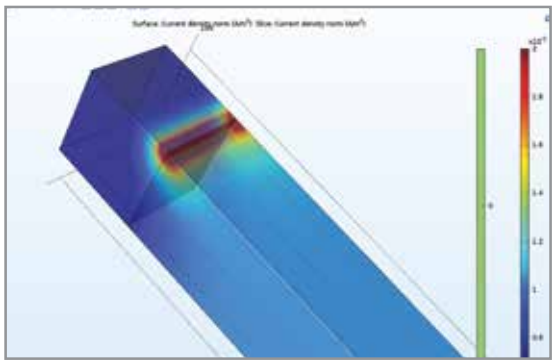
Simulation Software for Crack Detection in Materials

Cracks in structures such as airplanes can propagate and lead to catastrophic failures - it is critical to detect cracks in early stages. A commonly used approach to detect and size cracks is based on the relation between the crack size and the local electrical resistance of materials. When a voltage is applied across a material with a crack present the current density through that material will be higher around the crack, which is the current crowding effect. It will result in the constriction resistance which increases the total resistance of the material. In this project we will demonstrate how to evaluate cracks in a samples, by simulating the current crowding and constriction resistance for a variety of crack geometry using COMSOL.

We first use theoretical formulas given in Dr. Peng Zhang's paper, "On the Spreading Resistance of Thin-Film Contacts," IEEE Trans. Electron Devices, 59, 1936 (2012), [1] to solve for the resistance of a sample material. We then validate the model by simulating current conduction in the same geometry using the AC/DC module in COMSOL and comparing with theoretical results. The validated model can then be used to predict the resistance due to different crack geometry. These results can be used to find the correlation between the electrical resistance and the crack size and geometry. The results will be very useful to prevent failure of critical structures.

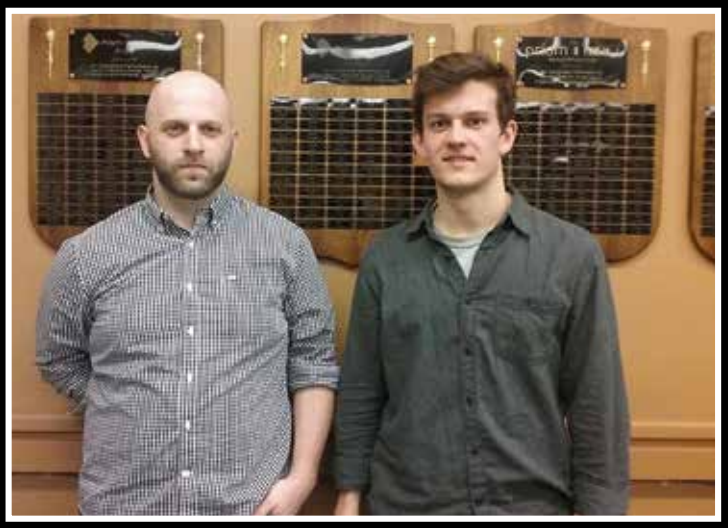


Adaptive mesh shown in COMSOL used for calculation



COMSOL current density plot featuring current crowding

MICHIGAN STATE UNIVERSITY



Michigan State University
Team Members (left to right)

Alex Olivero
Macomb, Michigan

Mark Noto
Grand Rapids, Michigan

Michigan State University
Project Sponsor

Project Facilitator

Peng Zhang
East Lansing, Michigan

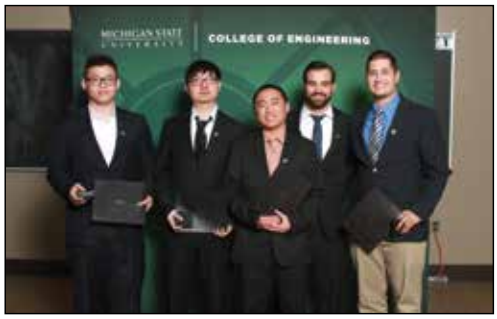
Design Day Awards Fall 2016

Electrical & Computer Engineering Winners, Fall 2016

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.

First Place:
Team Techmark, Inc: Impact Recording Device (IRD)

Left to Right:
Jiale Hu, Yue Chen, Yuping Liu, Josh Buchalski, Manuel Fores



Second Place:
Team TI/MSU RCPD/MSU Demmer Center: Precision Pointing Device for the Blind

Left to right:
Brett Rowland, Robert Marsack, Barbara Lance, Yunjie Shi, Tian Xie

Third Place:
Team Great Lakes Controls & Engineering, LLC/Panther Global Technologies: Orthopaedic Exercise Feedback

Left to right:
Rafee Mahmud, Joe Fabbo, Glen Simon, Michael Juricny, Erica Ramsey

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ME 371 Mechanical Design I

Michael Lavagnino
Academic Specialist
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
Mitchell Agrwal
Shwan Al-Howrami
Michael Bigelow
Drew Daily

Team 2
Michael Bergeron
Peter Chew
Jim Geddes
Andrew Palucki

Team 3
Prakash Agrawal
Ben Beckas
Jacob Bullard
Simone Young

Team 4
Nan Chi
Andy Dong
Quanjing Li
Shuang Liu
Chengming Zhang

Team 5
Jackson Garber
Anuj Vyas
Jonathan West
Chun-Kit Yung

Team 6
Madison Case
Alex Clark
Grant Gibson
Joel Todd

Team 7
Stephanie Close
Tristan Eggenberger
Hunter Jenuwine
James Morey

Team 8
Curtis Carne
Samuel Greenwald
Brandon Miller
Patrick Milyamoto

Team 9
Matt Lawrence
Gabe Lefere
John Schumaker
Henry Wikol

Team 10
Kole Brunsman
Will Hartnagel
Jack Leckner
Spencer Thompson

Team 11
Majed Almughair
Val Gueorguiev
Adri Johari
Diamant Topllari
Miranda Whah

Team 12
Emily Duddles
Genevieve Kobrossi
Krishnan Luhar
Maria Magidsohn

Team 13
Sultan Alrubaei
Brent Diamond
Reison Gjolaj
Brian Pieciak
Michael Walicki

Team 14
Jae Kang
Justin Ngo
Shiyuan Zhong
Paul Zhuang

Teams and members: Section 2

Team 1
Tecumseh Hakenjos
David McCriston
Mauricio Pons Martinez
Antonio Ulisse

Team 2
Evan Lile
James Moran
Matt Rimanelli

Team 3
Holly Iglewski
Dean Kuharevicz
Jack Michalski
Andrew Webb

Team 4
Kyle Bauer
Nick DeLang
David Mackens
Evan Paupert

Team 5
James Breen
Hyeungsuk Kim
Shiyu Liu
Bill Pittman

Team 6
Lance Haner
Edward Kennedy
Spencer Miller
Brice Wade-Shaner

Team 7
Yibin Cheng
Mirza Al Amin Saifulbahri
Yuexing Sun
Matthew Weber
Jianan Yao

Team 8
Ian Albert
Yuhao He
Duy Nguyen
Owen Parmeter

Team 9
Zach Bowling
Robert Cortese
Alex Kerns
Danny McCarty

Team 10
Stuart Gadigian
Kory Iott
Robert Pizzimenti

Team 11
Evan Finses
Anna Robinson
Brock Walquist
Levi Zimmerman

Team 12
Mojtaba Almiskeen
Mohammed Bomoza
Li Ren

Team 13
Andrew Biggie
Sawyer Dmoch
Aaron Feinauer
Tyler Smith

Team 14
Samantha Brown
Luke Crompton
Jeff Masten-Davies
Philipp Waeltermann

Team 15
Justin Barg
Michael Bertrand
Brandi Mazzella
Austin Miller
Najah Mubashira

Team 16
Jake Blankemeier
Robert Chaney
Morgan Ergen

ME 471 Mechanical Design II

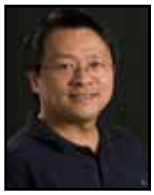
Dr. Alejandro Diaz
Professor of Mechanical Engineering

Dr. Yang Guo
Assistant Professor of Mechanical Engineering

Horizontal Motion Conveyor

In a horizontal motion conveyor, product is loaded into a long pan that is usually made of stainless steel or a coated composite material. A drive motor repeatedly pushes the pan forward and then pulls it back. The forward motion is slow enough that product moves forward along with the pan. The rearward motion is sufficiently fast to cause slipping between the surface of the pan and the product, so the product does not move rearward during this motion. This repeated motion of the pan causes the product to flow along the length of the pan. The goals of this project are to design, build and test a small scale horizontal motion conveyor system, including (1) the pan, (2) the supports, (3) the drive mechanism, and (4) all associated hardware.

Time	Team	Section	Team members
8:00	1	1	Jack Kuerbitz, Matthew Rist, Tyler Sloan, Jake Wojnicki, Oliver Xu
	1	2	Luke Boulter, Hunter Gvozdich, Daniel Middleton, Tyler Smith, Yitian Zhu
8:20	2	1	Tanner Ellens, Ruichen Li, Hassan Olaiwat, Andrew Tran, Nicholas Wojno
	2	2	Omar Alhammadi, Benjamin Childs, Shane Neal, Vincent Pahl, Mitchell Pollee
8:40	3	1	Bridget Anderson, Jacob Flight, Ihn Hur, Eric Martin, Hang Zhao
	3	2	Michael Accettura, Ryan Boutet, Edward Clark, Leah Mondro, Michael Okuniewicz
9:00	4	1	Andres Garciasalazar, Yurun Gu, Zack Lapinski, Eric Lindlbauer, Cody Lysher, Reed Williams
	4	2	Farhan Ahmed, Muhammad Djafri, Marissa Meaney, Kyle Raden, Lingfeng Wang
9:20	5	1	Matthew Auvenshine, Austin Klump, Jessica Lo, Andy Stamm, Matthew Walz
	5	2	Jon Andrejczuk, Syunsuke Hata, Austin Nicholsen, Jeri Sutter, Adam Ziemba
9:40	6	1	Roobin Arbab, Brandon Jett, Christian Luedtke, Thomas Robertson, Gino Wickman
	6	2	Jennifer Carmichael, Darren Harnden, Mitchell Holt, Jason Moll, Michael Williams
10:00	7	1	Matthew Cassiday, Charlie Guidarini, Thomas Obrien, Jeffrey Pattison, Becky Reneker
	7	2	Manea Alhammadi, Heather Raymor, Douglas Kubiak, Jacob Smyth, Michael Vanbemmelen
10:20	8	1	Zachary Engen, Meredith Jonik, Chase Quencer, Jason Sammut, Nick Santi, Courtney Zimmer
	8	2	Adnan Alhuwait, Christian Genord, Anxhelo Lalaj, Kanshu Mori, Taojun Wanyan
10:40	9	1	Jason Kim, Ian Lindsley, Melissa Oudeh, Trey Pfeiffer, Brendan Webberly
	9	2	Pronob Biswas, Paul Ferraiuolo, Nicholas Raterman, Justin Suh, Jiaji Zhang
11:00	10	1	Phillip Erickson, Bram Parkinson, Robbert Schmit, Patrick Sharp, Kayla Starr, Jacob Wilson
	10	2	Megan Friedrich, Logan Kincaid, Laura Nye, Byeong Park, Amad Wahib
11:20	11	1	Emily Donohue, Jean Klochko-Bull, Jiajun Lu, Hoa Nguyen, Colby Williams, Carly Wolf



ME 478
Product Development

Dr. Patrick Kwon
Professor of Mechanical Engineering

3D Printing Machine

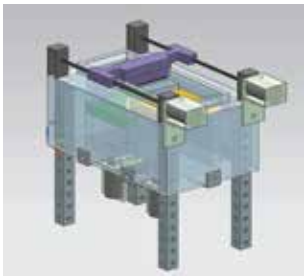
The objective is to design, produce and demonstrate a 'simplified version' of a 'metallic' 3D printing machine whose requirements are: 1) the minimum build envelope must be 10cm x 10cm with the height up to 10cm; 2) the powder must be deposited in a layer-by-layer fashion with the maximum thickness of each layer of 1mm; and 3) the electric motors must be controlled by MyRio which will be provided.

Starting from an individual project and progressing into a team project, each team must produce the machine through a series of design and manufacturing tasks. Each student needs to contribute individually as well as collaboratively to accomplish a series of tasks. CAD/CAM packages, CNC machining, rapid prototyping, testing, etc., will be used to produce the machine. Finally, selected teams will demonstrate their machines on Design Day.

Teams and Members

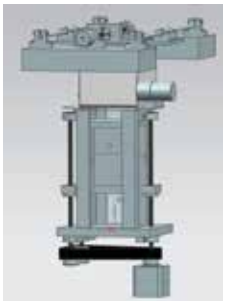
Beach Builders:

Bridget Anderson
Andres Garcia
Nicholas Mancini
Adam Marsh
Kristian Rego
Ricky Simon



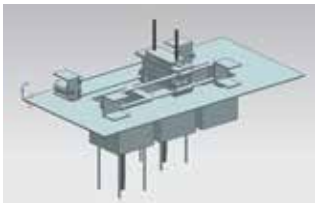
Spartan Print:

Farhan Ahmed
Ed Clark
Darren Harnden
Alex Holtshouser
Shiyao Liu
Shenzhou Xin



Shine:

Stephen Camilletti
Tobin Egger
Tanner Ellens
Cody Lysher
Yu Sang
Daniel Setili

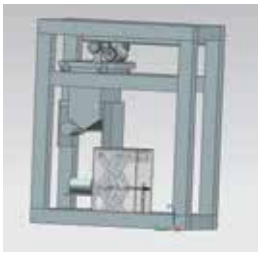


Superduper-sandcastler:

Adam Anderson
Kathleen Noblet
Jonathan Ristola
Andrew Wandor
Zirui Wang
Ashley Wilkey

SomethingFancy:

Allison Bakka
Alex Caine
Jenny Carmichael
Tony Etheridge
Brooke Otterbein



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 biomechanical function. Students work in inter-disciplinary teams of engineers and marketers and 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. This year General Motors sponsored an in-class competition providing awards to the top three product ideas. Dr. Bush also received NSF support for class components that foster creativity and innovation (NSF Award 154-647).

Team members	Team Slogan
Megan Beisser, Sophie Moss, Kelly Patterson, Jason Sammut, Jake Wojnicki	**HEAT.** Hand Extension Acceleration Tracker. This revolutionary device will transform therapy for patients with hand synergies. A tensioning device with an adjustable spring system allows for a customizable fit, and accelerometers allow therapists to see what motions challenge the patient, providing a more customizable therapy experience.
Brian Clark, Yiran Gao, Brady Nagel, Carly Wolf	**The Handy Track.** The Handy Track allows users in wheelchairs to easily access their belongings by cranking a handle to slide their belongings down a track around to the side where they can reach on their own.
Manea Alhammadi, Marissa Cooke, Alexander Kowal, Karri Perion, Andrew Roach	**The Move-Over**. A hand truck that attaches to the front of a wheelchair and allows the user to set items in front of them on a platform. A wench is used to pull back the hand truck, which lifts the object so the user can use both hands to propel the wheelchair.
Rachael Kain, Leah Mondro, Lindsay Nault, Trevor Ploucha, Hannah Tubbs	**The Free Loader.** A mechanism that solves all your car loading needs, making it easy and effortless to lift all sorts of objects into any vehicle.
Alec Czanderna, Joshua Dewys, Tobin Egger, Kyle Moeller, Jacob Pasek, Jonathan Ristola	**Pop-A-Squat.** A device that assists in the lowering of a person from a standing to sitting position, suspended above a toilet.
Omar Alhammadi, Adnan Alhuwait, Celine Parisot, Li Ren	**COAL Bulbers.** Product allows consumer/user to change canister lights using a crank instead of hand rotation. It also allows the user to adjust the bulb size holder accordingly using another crank without crushing the lightbulb.
Brennen Burns, Tanner Ellens, Ian May, Spencer Smith, Sarah Sonego	**Wellness Chair.** An accessory for office chairs which promotes physical activity/ movement while at work.
Janosch Baer, Abraham Esa, Kylie Shae Vradenburg, Abigail Wulf	**Fr-Easy Roll**. An automated brace that massages and ices leg muscles.
Angela Dobrzelewski, Hunter Gvozdich, Connor Kenrick, Matt Marsh, Thomas Obrien	**Drawn-2-A-T.** An innovative tool that assists individuals with limited motor skills and range-of-motion to create their own masterpiece.
Joshua Borton, Zachary Brewer, Tyler Draggoo, Johnathan Katt, Richard Simon	**Pack Rack**. The Pack Rack is a simple, efficient device that allows wheelchair users to access all of their belongings at a finger's touch. This will revolutionize the ability of wheelchair users to be independent.
Alexander Athens, Conor Edmonds, Marissa Grobbel, Chris Lukas, Laura Nye, Jeri Sutter	**Galen's GH Reprieve.** A portable device for use in shoulder stretching as required by physicians after shoulder replacement or to regain range of mobility due to muscular atrophy.
Samuel Greenwald, Eric Martin, Breanna Osborn, Sreeram Paidemarry, Austin Payne	**The Reach Around.** It is a simple mechanical device that assists wheelchair users with limited mobility in accessing their bags and the contents within the bag.
Phillip Erickson, Zhaoyuan Li, Trey Pfeiffer, Zachary Sadler, Robert Schmit, Ting Yang	**Rise Assist.** A product that assists elderly, disabled, or injured persons in rising from a seated or lying position to a standing position.

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The Capstone Projects

Dr. William Resh
Professor of
Mechanical Engineering

Presentation Schedule – Engineering Building, Room 1202

Time	Team Sponsor	Project Title
7:30 a.m.	Slabtown Paper Shapes	Cat Scratch Saw
8:00 a.m.	Slabtown Paper Shapes	Corrugate Sheet Transfer System
8:30 a.m.	EPA	Test Article Tracking System
9:00 a.m.	Meritor	Gogan Fixture Design for Brake Lining Blocks
9:30 a.m.	Ford	Chassis Dynamometer Vehicle Restraint System
10:00 a.m.	Tenneco	Liquid Gas Separator Test Bench
10:30 a.m.	Ingersoll Rand - Trane	Fan Isolation and Attenuation Device
11:00 a.m.	Ingersoll Rand - Trane	Casing Stiffeners of Air Handler Units
11:30 a.m.	Detroit Bikes	Bicycle Frame Preparation Machine
12:00 p.m.	General Motors	Baja SAE CVT Dynamometer

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 USA, Bosch, Detroit Bikes, Environmental Protection Agency, Fiat Chrysler Automobiles, Ford Motor Company, General Motors, Heartwood Schools, Hitachi Automotive Systems Americas Inc., Ingersoll Rand - Trane, Meritor, Michigan AgrAbility, MSU Adaptive Sports and Recreation Club, MSU Sailing Center, Peckham, Inc., Packsize, Slabtown Paper Shapes, Tenneco, Inc. and Whirlpool Corporation.

Slabtown Paper Shapes
Cat Scratch Saw

Our team was tasked with improving the manufacturing processes for Slabtown Paper Shapes, the Midwest's leader in corrugated and honeycomb internal packaging. Specifically, the task was to improve the production process for cutting Cat Scratch Corrugated Build Up Blocks. The aim of the project is to develop a process allowing Slabtown to cut these blocks in a method producing less dust, increasing production time, and reducing operator risk as well as required skill.

Currently, an industrial band saw is used to accomplish the job, but the team hopes to build a design using multiple blades outfitted with variable blade spacing; this enables the machine to handle a variety of cutting jobs on the factory floor. A design that will focus on simplicity and ease-of-use will be the premier choice for Slabtown Paper Shapes. Unprocessed blocks of cardboard will need to be fed onto a belt and into the cutting area of the saw, emphasizing the least number of steps possible, thus lowering the complexity of the operation. Safety guards are installed on the machine with the health and safety of the operators and shop floor workers in mind. Increasing the overall production speed will lower the front-end production costs, enabling a higher profit margin for the business. Increasing automation of the process and lowering hands-on aspects of it can reduce worker fatigue and cut down on production time. Through innovation and integration, the MSU team strives to improve upon the manufacturing of Slabtown Paper Shapes' product line.

SLABTOWN PAPER SHAPES

Michigan State University
Team Members (left to right)

Alex Arcaro
Iron Mountain, Michigan

Kevin Rogers
Williamston, Michigan

Brian Clark
Clinton Township, Michigan

Hanis Hashim
Malaysia

Thomas Griffith
Eaton Rapids, Michigan

Slabtown Paper Shapes
Project Sponsor

Bob Rulison
Lansing, Michigan

ME Faculty Advisor

Andre Bénard
East Lansing, Michigan

Slabtown Paper Shapes
Corrugate Sheet Transfer System

Slabtown Paper Shapes is a small company located in Lansing, Michigan, that specializes in the production of corrugated industrial packaging. At the beginning of the manufacturing process, stacks of corrugated cardboard sheets are brought into the facility and run through a roll coater to create glued stacks. A two-man gluing process has been utilized for over twenty years. This process includes one operator loading cardboard into the infeed, and one operator stacking glued sheets at the outfeed. This operation accounts for 60 percent of production time, and the team's focus is to make it more efficient through automation. If the process is reduced to one operator, it will allow multiple roll coaters to be in production at a time. This would substantially increase Slabtown's production rate, therefore allowing them to be more competitive in the packaging industry.

The MSU team was tasked with designing a fully automated infeed and outfeed system for the gluing process. This system must be able to meet all of Slabtown's production constraints, which includes corrugated sheets ranging in size. An automated system would allow just one operator to oversee this process. There are many solutions available in the industry today, but they require a large initial investment. Our goal is to design a cost-effective and low-maintenance solution.

SLABTOWN PAPER SHAPES

Michigan State University
Team Members (left to right)

Andrew Wandor
Midland, Michigan

Michael Sanchez
Jackson, Michigan

Brittany Galliers
Plymouth, Michigan

Michael McAtee
Jackson, Michigan

Faisal Alhuwemel
Saudi Arabia

Slabtown Paper Shapes
Project Sponsor

Bob Rulison
Lansing, Michigan

ME Faculty Advisor

Xinran (Sharon) Xiao
East Lansing, Michigan

ME 481 Room 1202 | First Floor **8:30 a.m.**

U.S. Environmental Protection Agency
Test Article Tracking System

The U.S. Environmental Protection Agency (EPA) was established on December 2, 1970, to consolidate in one agency a variety of federal research, monitoring, standard setting, and enforcement activities to ensure environmental protection. Since its inception, EPA has been working for a cleaner, healthier environment for the American people.

The MSU team will focus on developing an efficient vehicle tracking system to monitor progress of test articles through the vehicle testing processes defined in NVFEL's quality system. The project will give the EPA the ability to track the progress of test articles, starting with vehicles, in the EPA laboratory. The integration of this semi-automated tracking system with our existing processes will lend greater traceability to our laboratory quality system through each step of the testing process, and will lower overall testing costs by greatly reducing the probability of human error in the data collection process.

Michigan State University
Team Members (left to right)

Saul Makanga
Kampala, Uganda

Shiyao Liu
Shanxi, China

Simba Chidyagwai
Marondera, Zimbabwe

Curtis Hsiung
Troy, Michigan

Gueorgui Tzourov
Shelby Township, Michigan

U.S. Environmental Protection Agency
Project Sponsor

Tom Veling
Ann Arbor, Michigan

ME Faculty Advisor

Andre Bénard
East Lansing, Michigan

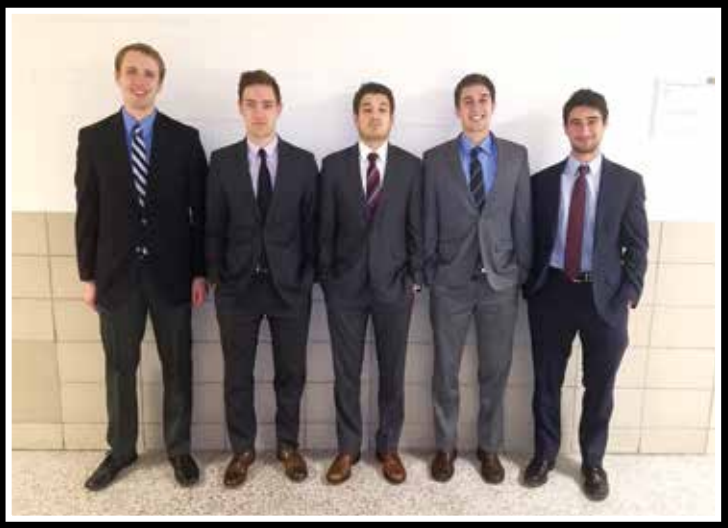
Meritor

Gogan Fixture Design for Brake Lining Blocks

Meritor is a tier one supplier of drivetrain, mobility, brake systems, and aftermarket solutions for commercial truck and industrial applications. Meritor is able to reach markets around the globe with locations in North America, South America, Europe, and the Asia-Pacific region. Meritor's Brake Systems division provides dependable performance in the areas of stopping distance and reliability. Brake pad linings are crucial for slowing down and stopping a vehicle. Meritor purchases brake linings, also known as blocks, from a friction supplier. Both Meritor and their suppliers run many tests on these parts to verify they meet performance and product life expectancy requirements. One test, Gogan Hardness, measures the localized compressibility of brake linings. Meritor does not own a Gogan test machine, however, and has been performing similar compressibility tests using an Instron machine. Test results have indicated that considerable test-to-test variation exists. One contributor to the variation is the lack of repeatability for the fixture to locate and constrain the brake lining during testing.

Our team has been tasked with developing an Instron test fixture that will reduce measurement variation. The fixture design should ultimately be adaptable to both Instron and Gogan machines. Finite element analyses will be performed on each design concept to illustrate the effects of varying critical features of the fixture. The final design will allow Meritor to effectively measure the localized compressibility of brake linings.

MERITOR



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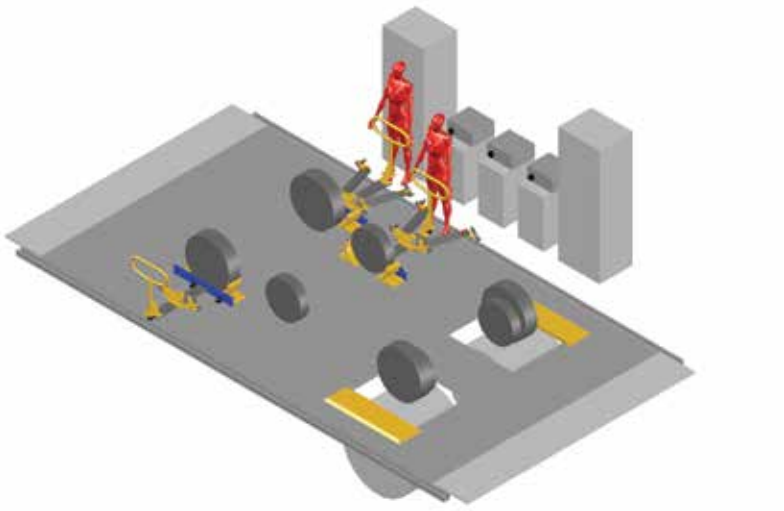
Ford Motor Company
Chassis Dynamometer Vehicle Restraint System

Chassis dynamometer testing is an integral part of measuring fuel economy for new vehicles entering the marketplace as well as demonstrating compliance to emission requirements. In a chassis dynamometer test, the vehicle is typically restrained to the test site with wheel chocks immobilizing the non-drive wheels and straps immobilizing the rest of the car with an opposing force. The drive wheels are aligned on the dynamometer, and the dynamometer and the drive wheels rotate in opposite directions to simulate driving on a road. Although the vehicle is strapped down, changes in acceleration by the vehicle during testing can cause the vehicle to rock forward/rearward or sway laterally. On top of the movement, the current restraint system may also generate a downward force on the drive wheels that can impact the test results. Current systems require substantial time and energy from the operator to set up, and they take up valuable space in the test site. Due to these factors, the presently used restraint system is not logistically ideal and can be a source of unwanted test-to-test variability.

Ford has tasked our team with providing a CAD design for a simplified restraint system that can be easily implemented into their current two-wheel drive dynamometer test sites. The main functions for the new design are eliminating downward force on the drive wheels, reducing lateral motion of the vehicle, and creating a timely operator-friendly installation.



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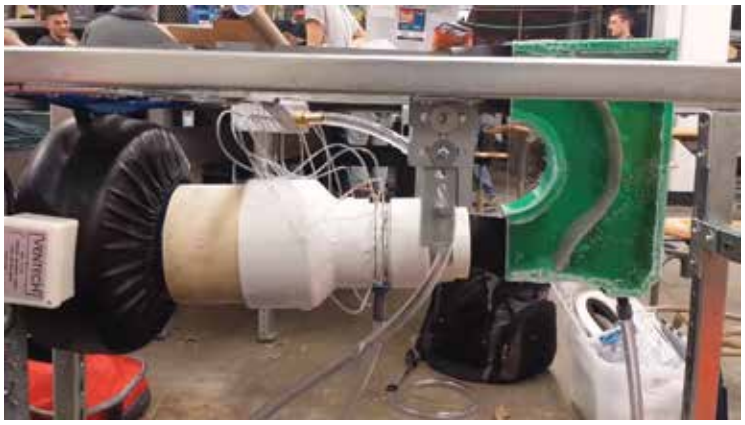
Tenneco, Inc.
Liquid-Gas Separator Test Bench

Tenneco, Inc. is one of the world's leading designers, manufacturers, and distributors of clean air and ride performance products for the automotive, commercial truck, off-highway, and large engine markets and aftermarkets. As a global manufacturing company, it strives for innovative global initiatives with respect to cleaner air and smoother, quieter, and safer transportation. Headquartered in Lake Forest, Illinois, Tenneco, Inc. has 30,000 employees located in 24 countries across six continents. As a global presence, Tenneco, Inc. has various ongoing products in many different areas, one of which is a device called a liquid-gas separator.

Our team has been tasked with the specific goal of creating an innovative liquid-gas separator test bench design. A liquid-gas separator can be used to remove liquid particles from a gas flow. A device such as this normally utilizes gravity, impact force, or centrifugal force to separate the liquid from the gas. Some applications include compressor systems, oil refineries, gas pipelines, and refrigeration systems. As for Tenneco, Inc., its main use of this device is central in exhaust gas recirculation in car engines. It uses this device to filter out and redirect the liquid in the exhaust system in cars, as quickly-moving liquid droplets could collide and cause damage to blades moving at high angular velocities. The team's design was to maximize the system's efficiency while minimizing its size.



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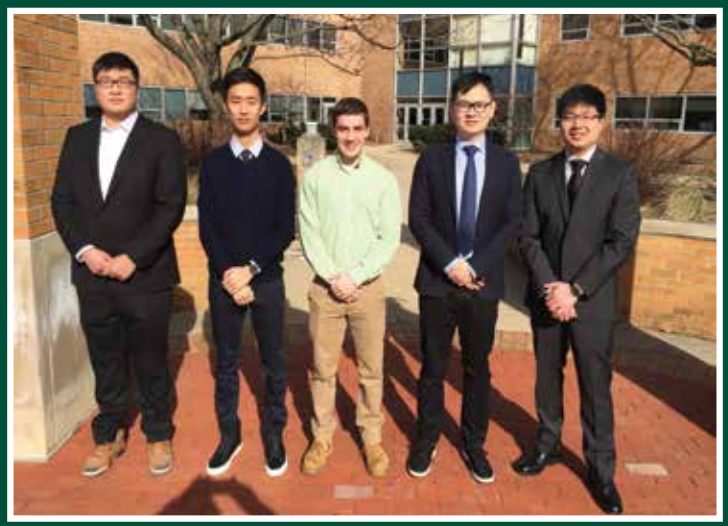
Ingersoll Rand - Trane
Fan Isolation and Attenuation Device

Trane is a world leader in heating, ventilation, and air conditioning (HVAC) systems. It supplies many of the world's largest and most prestigious companies and institutions with their HVAC units. The problem that the team has been given to solve is to create a device to prevent backflow caused in the event of a fan failure in their HVAC systems, while also operating quietly. It is crucial that the system performance is not compromised in the event of single component failure. However, by adding a device such as the traditional backdraft damper, the airflow can cause the fan to produce a loud humming noise. Too much noise can be very distracting in settings such as schools or hospital operating rooms where maintaining focus is extremely important.

The team's solution is an automatic system, such as a damper, that closes to prevent backflow if a fan should fail. The source of the noise has been identified as turbulent airflow entering the fan. A simple way to accomplish the objective of reducing noise is to redesign or optimize the current design of the damper and air inlet to smoothen the airstream. To accomplish the objectives, the group will utilize computational fluid dynamics programs such as ANSYS CFX to perform the analysis and optimize the design.



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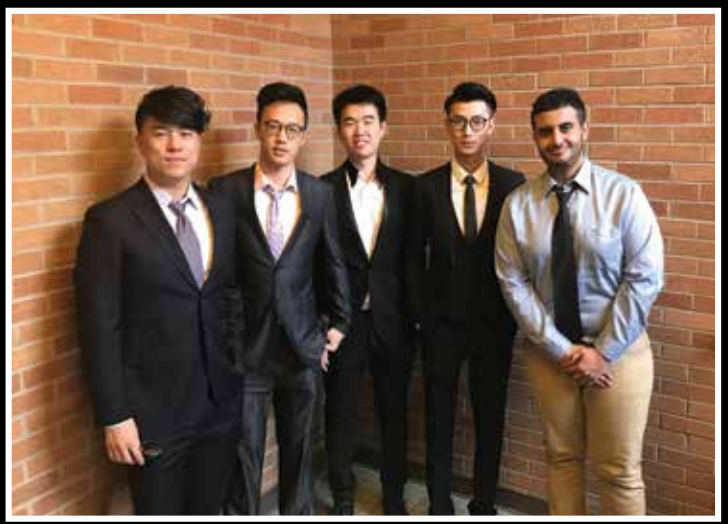
Ingersoll Rand - Trane
Casing Stiffeners of Air Handler Units

Trane, a subsidiary of Ingersoll Rand, is one of the world's leading manufacturers of air conditioning systems. Trane produces custom air handler units at its plant based in Lexington, Kentucky. Trane produces other products, although its main manufacturing focus is air handler units. Trane's focus is producing a cost-efficient air handler system to stay competitive in the industry. Trane's air handler unit uses a skin of sheet metal, which is made of galvanized steel that is enclosed with three casing stiffeners and primarily held together by a foam injection. The panel assembly area is composed of five primary actions: foam injection, skin setting, spot welding, part selection and measurement, and final bending/shaping of parts.

The task assigned to our team by Trane is to develop alternative solutions for their current casing stiffener. The major criteria for the new stiffener is to ensure the air handler's casing deflects no more than L/240 at 8" water gauge positive or negative static pressure. The ultimate goal for our team is to redesign a cost-effective casing stiffener for Trane. The L-shaped stiffeners currently being used by Trane are primarily produced by using carbon steel. Based on the detailed size of the current stiffener provided by Trane, our team is developing three main improvements: the material being used, the reshaping of the case stiffener, and the stiffener's location on the air-handler unit.



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Detroit Bikes
Bicycle Frame Preparation Machine

Detroit Bikes is the largest production manufacturer of bicycles in the US. The company cuts, shapes, welds and assembles all bicycle frames in-house at a 50,000 square foot factory on Detroit's west side. The company was established in 2012 and supplies 24 different bicycle models to a wide range of customers. With a focus on urban markets, these high quality bicycles provide the form and function that daily riders need.

As part of the current machining process, a slot is manually cut in the seat tube using a Bridgeport mill and cumbersome fixtures. Not only does this process tie up a valuable machine, but it also causes inconsistency in the placement of the slot. The slot needs to align perfectly on the centerline of the tube for aesthetic purposes, something that does not always happen with the current tools.

Our team was asked to speed up operations of the slotting process while minimizing the use of the mill. This was to be accomplished through the design of a new machine or through modification of the current machining process. Additionally, a fixture was to be incorporated into the design that would eliminate the opportunity to misalign the slot, while keeping it perpendicular to the bottom bracket.

DETROIT BIKES

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General Motors
Baja SAE CVT Dynamometer

Baja SAE is a collegiate design series where teams design, manufacture, and race off-road vehicles. These teams compete each year in SAE organized events across the country. Competitions are four-day long events requiring the team to balance cost, marketing, innovative design, and performance throughout a series of static and dynamic events. Previously Michigan State has used Continuously Variable Transmissions designed for snowmobiles. However, this year the team will be using a Gaged CVT, which is designed specifically for Mini Baja vehicles.

In light of this change, the Michigan State Baja team has been given the opportunity to team with General Motors in order to design and manufacture a CVT dynamometer. The dynamometer will replicate driving conditions experienced by the CVT during an event and allow for faster tuning and testing. The project will also give the team a better understanding of CVT tuning setups and allow for driveline optimization for the conditions of each event. In the future, the design team hopes that the dynamometer will be used to develop and manufacture a custom CVT.

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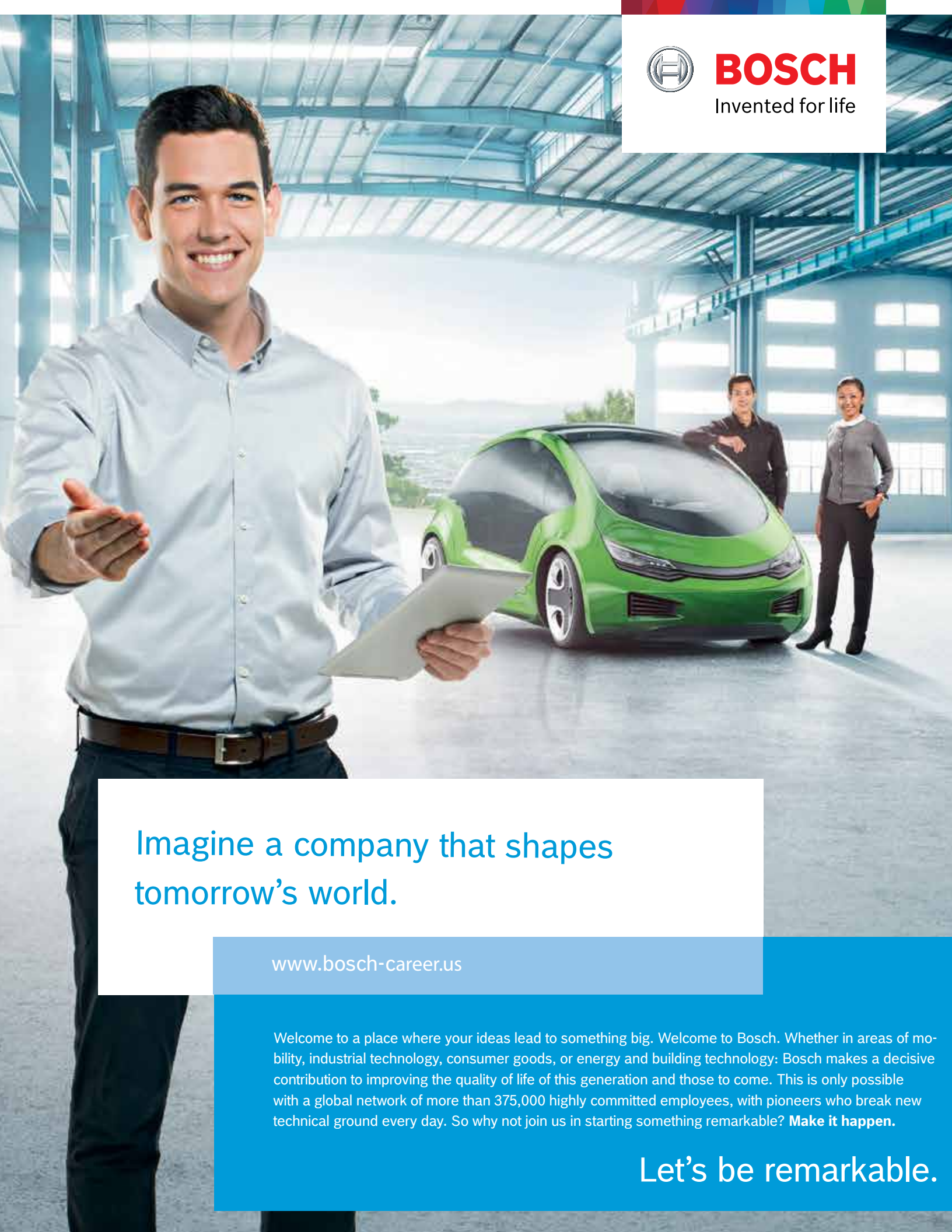
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Invented for life
Imagine a company that shapes tomorrow's world.
www.bosch-career.us
Welcome to a place where your ideas lead to something big. Welcome to Bosch. Whether in areas of mobility, industrial technology, consumer goods, or energy and building technology: Bosch makes a decisive contribution to improving the quality of life of this generation and those to come. This is only possible with a global network of more than 375,000 highly committed employees, with pioneers who break new technical ground every day. So why not join us in starting something remarkable? **Make it happen.**
Let's be remarkable.

The Capstone Projects

Dr. William Resh
Professor of
Mechanical Engineering

Presentation Schedule – Engineering Building, Room 1220

Time	Team Sponsor	Project Title
7:30 a.m.	MSU Sailing Center	Portable Mechanical Sailing Dinghy Simulator
8:00 a.m.	Hitachi	Water Pump Durability Test Stand
8:30 a.m.	Packsize	Variable Corrugate Box Stacker
9:00 a.m.	Fiat Chrysler	Effect of Drive Patterns on Transmission Design
9:30 a.m.	Ford	Dynamic Joint Friction - Driveshaft Applications
10:00 a.m.	Fiat Chrysler	Flexible Interior Storage
10:30 a.m.	Whirlpool	Refrigerator Door Design - Storage Flexibility
11:00 a.m.	ArcelorMittal	Sampling Sleeve Disposal for Molten Steel
11:30 a.m.	ArcelorMittal	Sampling Sleeve Disposal for Molten Steel

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.

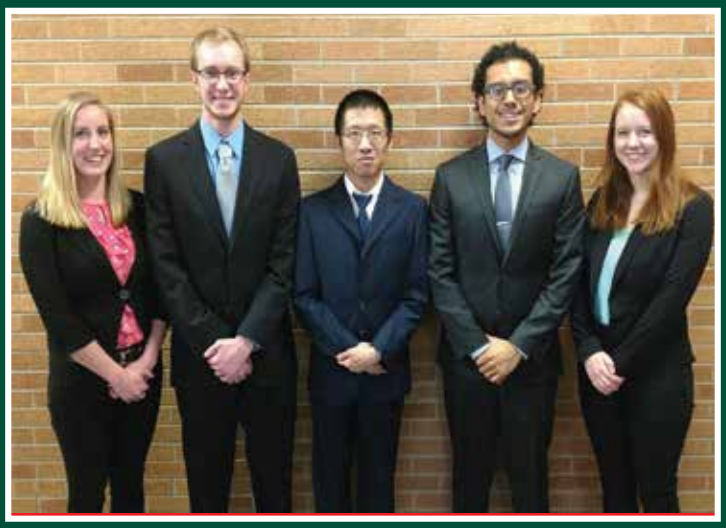
The ME faculty who supervised ME 481 design teams this semester are: Seungik Baek, Andre Bénard, Giles Brereton, Brian Feeny, Patrick Kwon, Al Loos, Norbert Mueller, Ahmed Naguib, Thomas Pence, Tamara Reid-Bush, Dan Segalman, Rod Tabaczynski, Brian Thompson, Yuping Wang, Indrek Wichman, Neil Wright, Sharon Xiao, Junghoon Yeom, and Guoming Zhu.

Michigan State University Sailing Center
Portable Mechanical Sailing Dinghy Simulator

Michigan State University's Sailing Center aids not only the university, but also the Lansing community in sailing instruction and recreation. The center has taught a multitude of people from all ages to sail using its "Learn to Sail" program. In the current teaching methodology used by the sailing center, verbal and visual explanation is available but it lacks tactile input, which makes it difficult to enable students to comprehend sailing in its entirety before entering the water. Due to the lack of tactile input, the Sailing Center has often found that students do not fully grasp the methodology of sailing, therefore causing the students' exposure to injury.

Our team was asked to create a learn-to-sail simulator that can be placed on land to effectively teach students before being taught in the water. A sailboat will be placed on the simulator and students will be allowed on the boat to improve the efficiency, quality, and safety of sailing instruction. Ultimately, the team and sponsor believe it will not only improve instruction but also improve the safety of anyone who receives lessons at the Sailing Center.

RECREATIONAL SPORTS AND FITNESS SERVICES



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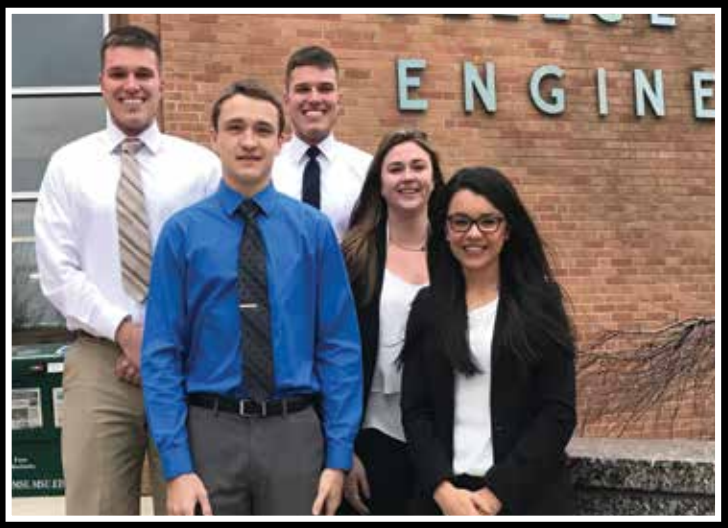
Hitachi Automotive Systems Americas, Inc.
Water Pump Durability Test Stand

Hitachi Automotive Systems Americas, Inc., is a leading global Tier 1 automotive supplier of water pumps with over 40 years of water pump design, testing, and production experience. Our team is tasked to develop a water pump durability test stand for Hitachi's Farmington Hills, Michigan location. This test stand will expand Hitachi's testing capabilities and provide faster testing support to their customers. Water pump durability testing is needed to verify that the pump design meets durability requirements. Hitachi's water pump durability testing is currently located in Japan. However, testing capability is needed at their Farmington Hills, Michigan location. The objective of this project is to design a water pump durability test stand capable of testing various water pump designs. The test stand requirements are:

- Belt driven via electric motor,
- Capable of testing two pumps at the same time, and
- Programmable control of RPM, system pressure, coolant temperature, and inlet and discharge restriction.

Our team has been asked to include a 3D model of the test stand design and Statement of Requirements that Hitachi can use to have the test stand manufactured.

HITACHI
Inspire the Next



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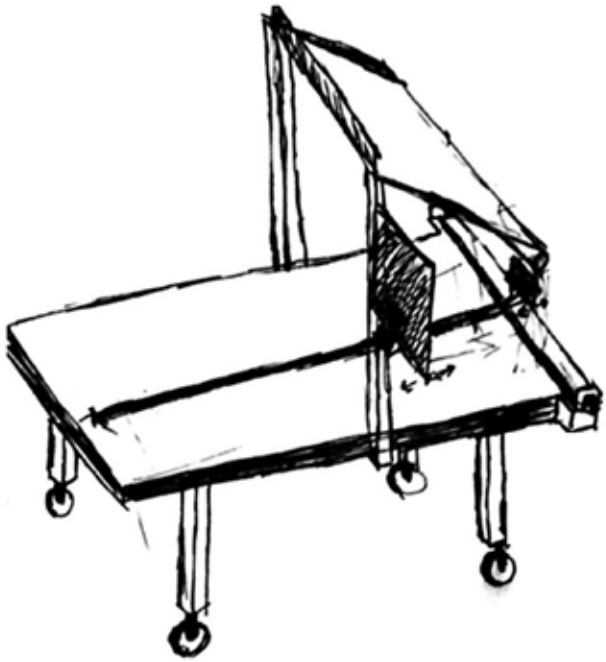
Packsize
Variable Corrugate Box Stacker

Packsize is a packaging company that provides On-Demand Packaging (ODP) solutions for businesses with complex corrugated packaging needs. The business is headquartered in Salt Lake City, Utah and has operations in North America, Europe and Australia.

Packsize produces custom box-making technology, which allows Packsize to ship right-sized boxes in both production and distribution packaging environments. ODP replaces the traditional method of purchasing and warehousing boxes. ODP is a solution that includes an expert mix of machinery, software, accessories, consumables and services. The ODP solution reduces shipping costs and corrugated cardboard consumption by up to 40%. With Packsize On Demand Packaging®, companies receive a solution that provides them the ability to ship their products in the right sized box every time.

Our team was tasked with developing two distinctly different prototypes to support the newest Packsize product, the X4.The X4 utilizes automation to produce a box that has been cut, creased, folded, glued and labeled. The X4 reduces labor up to 66% compared to existing Packsize machines. These prototypes will provide effective and ergonomic box stacking and collection methods, which reduce labor and downtime in the box making process. The X4 is the most advanced and automated product in the current Packsize product portfolio.



PACKSIZE®
ON DEMAND PACKAGING

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Fiat Chrysler Automobiles

Effect of Drive Patterns on Transmission Design

Fiat Chrysler Automobiles (FCA), one of the largest car manufacturers in the USA, sells roughly 2 million vehicles per year. In order to keep pace with the upgrade cycle present in the auto industry, FCA US needs to create prototypes as a method of vetting designs. However, with the extremely high capital investment required for prototype vehicles, only a limited number of prototypes can be made for a given vehicle. As such, there is a growing interest in avoiding physical prototypes in favor of virtual prototypes, especially for critical subsystems like the drivetrain. Previous FCA US sponsored capstone groups at MSU have developed a MATLAB program capable of compiling real-world GPS data for vehicles into stress estimations for the drivetrain.

The goal of this semester's project is to take these existing calculations up through the transmission to determine the time spent in each gear for a given transmission. The success of this project could have a significant impact on transmission design for future FCA US vehicles as it will enable engineers to determine how long the average consumer will spend in higher gears (7th, 8th, etc), as well as the duty cycle each gear will see.

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FIAT CHRYSLER AUTOMOBILES

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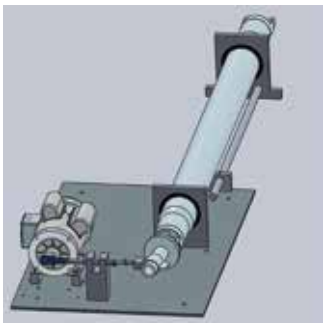
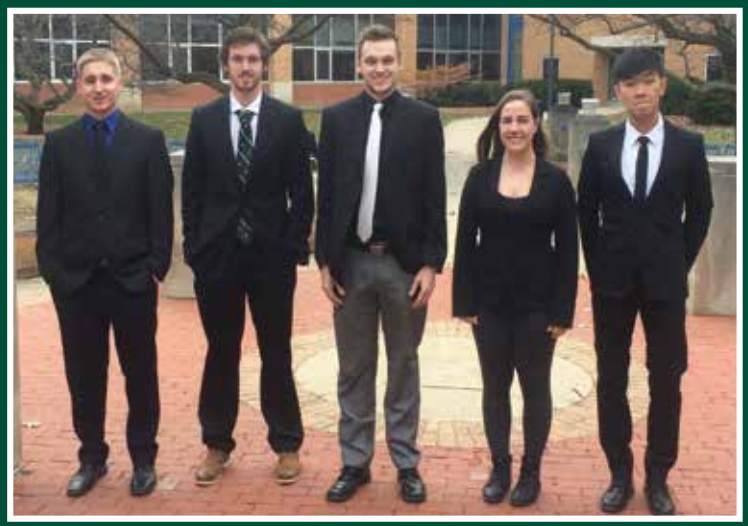
Ford Motor Company

Dynamic Joint Friction—Driveshaft Applications

All OEM's are actively looking for ways to reduce the noise, vibration and harshness (NVH) that occur in daily driving of vehicles. NVH contributes to continued degradation of important vehicle components due to added stresses and forces that are hard to measure due to their complexity. Ford has identified a large percentage of NVH in their vehicles, especially trucks, due to the forces in the driveshaft, specifically in the universal joint (U-joint) that connects the driveshaft to the other drivetrain components. In order to model the NVH of new designs, Ford has used computer-aided engineering (CAE) to minimize prototyping costs. To create an accurate model of forces in the driveshaft, the frictional force in the U-joint must be known. Internal frictional forces in the U-joint must be experimentally determined in order to use CAE modeling for an approximation of NVH in new designs. For this reason, a previous capstone team had built an experimental test rig. The rig consists of a drive motor, a translational slider between the motor and driveshaft, two halves of a driveshaft with a U-joint connection, and force transducers, together with other sensors that help to determine the internal joint forces. Based on the data of three previous capstone teams, a correlation has been noticed but not quantified and not yet fully proven. In order to determine a relationship between internal friction and rotational frequency, data will be captured and used to prove or disprove a relationship between U-joint friction, internal forces, and frequency, with the goal of creating an accurate CAE model.





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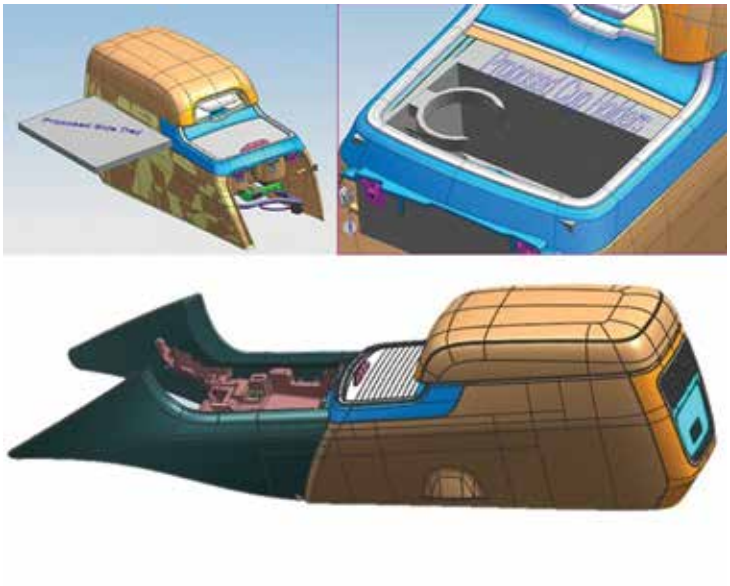
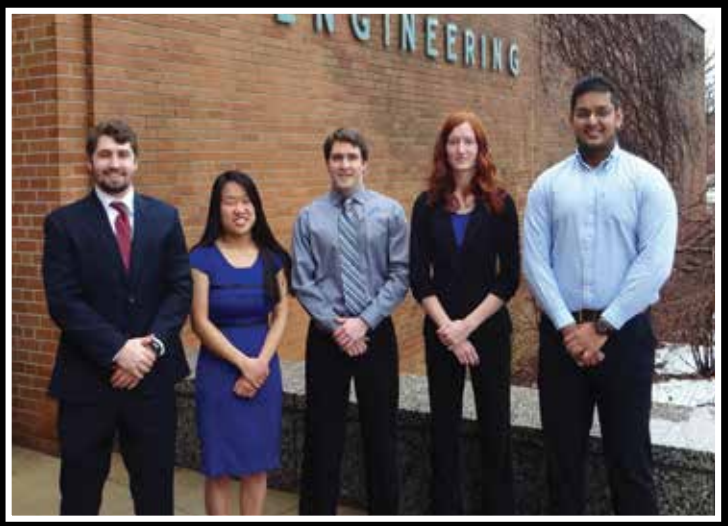
Fiat Chrysler Automobiles
Flexible Interior Storage

Fiat Chrysler Automobiles (FCA) has tasked our team with increasing the flexibility of the existing interior storage in their vehicles, with the focus being the front cabin area. The new storage space designs need to improve upon existing features to increase functionality, versatility, and accessibility. The proposed features have been modeled to fit the next generation Dodge Charger.

The improved designs focus on revamping the cup holders and center console area. The redesigned cup holders add versatility, which allows for different sized cups to fit within the existing area. The design features a sliding mechanism, allowing them to be flipped down when they are not in use. The center console is designed for more functionality, and additional features have been added to the inside and outside of the middle console, aiming to improve its capabilities. A shelving feature will be added to the inside of the center console to allow the user to better organize their belongings while a folding tray on the outside will provide more user-friendly storage space. This tray will be stored between the center console and passenger seat and will be deployed manually. These improved features will provide the consumer with a pleasant and more efficient driving experience.



FCA
FIAT CHRYSLER AUTOMOBILES



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ME 481 Room 1220 | First Floor **10:30 a.m.**

Whirlpool Corporation

Refrigerator Door Design - Storage Flexibility

The Whirlpool Corporation is a multinational manufacturer of home appliances. Its refrigeration sector is located in Benton Harbor, Michigan, and specializes in the design and development of its newest refrigerator technologies, including the 3X French Door model. This model is marketed as one of the most spacious refrigerators commercially available in the United States. Whirlpool is continuing to push the limits of refrigerator storage by expanding on the in-door storage capabilities of the 3X Model.

Our team has been tasked with the challenge of developing a new door storage system. This system is expected to have 20% more door storage space as well as a modular approach for consumer customization. All proposed solutions must be easily manufactured and cost-effective, without compromising airflow and cooling. The final designs have passed cyclic loading simulations in the Whirlpool Structures Lab and have achieved high usability rankings from Whirlpool personnel.

Whirlpool CORPORATION

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ArcelorMittal USA
Sampling Sleeve Disposal for Molten Steel

ArcelorMittal is a world leading steel and mining company present in 60 countries. The second largest USA facility is a fully integrated steelmaking facility located on Lake Michigan in Burns Harbor, Indiana. This plant operates two blast furnaces and is capable of producing five million tons of raw steel annually.

During the steelmaking process, different properties can be produced by chemical composition. These properties include ductility, formability and hardness. In order to ensure the correct alloying of the given steel, sampling is completed during processing. A sample sleeve connected to a telescoping probe that submerges it into the molten steel takes these samples. After the sleeve is submerged, the sample is retrieved and the empty sample sleeve is discarded.

Currently, sampling sleeves are disposed of on the ground where other recyclable materials exist; this violates environmental and recycling policies. Because these materials are not separated at time of disposal, there is an extra cost to separate recyclable materials from the non-recyclable materials.

ArcelorMittal is seeking implementation of a new process to dispose of these sleeves. This solution is both environmentally friendly and works around the current operation and layout constraints. The improved process allows disposal of sampling sleeves in a safe and effective manner.

ArcelorMittal

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Giles Brereton
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ArcelorMittal USA
Sampling Sleeve Disposal for Molten Steel

ArcelorMittal is a world class steel producer with an annual production capacity of around 114 million tons of crude steel. ArcelorMittal is a multinational company with an industrial presence in 19 countries and a leader in all major steel markets including automotive, construction, household appliances, and packaging. During the steelmaking process, many temperature samples of the molten steel are required for analysis in order to maintain a certain set of properties for each batch. In a twenty-four hour period, over five hundred sampling sleeves are used and discarded. Currently, the disposal sleeves are thrown into a pit below large ladles transporting molten steel. In this pit, they are mixed with excess slag, inhibiting the ability to easily separate the sleeves to be recycled.

Our team was approached to develop a solution for the waste created by these sampling sleeves. A disposal system will be designed for the sampling sleeves to provide a way for them to be separated and recycled. This solution must be both environmentally and user friendly. It must be able to withstand the harsh conditions of a steel mill. An effective solution to the disposal of the sampling sleeves will greatly reduce the amount of waste created by the mill on a daily basis.

ArcelorMittal

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The Capstone Projects

Dr. William Resh
Professor of
Mechanical Engineering

Presentation Schedule – Room 1300

Time	Team Sponsor	Project Title
7:30 a.m.	Peckham	Seam Sealing Assistive Device
8:00 a.m.	Heartwood School	Therapeutic Mechanical Pony
8:30 a.m.	Heartwood School	A Variety of Aids for Impaired Children
9:00 a.m.	Michigan AgrAbility	Adjustable Hand Lever
9:30 a.m.	Whirlpool	Under Counter Icemaker
10:00 a.m.	Whirlpool	Under Counter Icemaker
10:30 a.m.	MSU Adaptive Sports & Recreation Club	Hand-Cycle Propulsion Adapter
11:00 a.m.	Bosch	Welding Fixture for Turbo Wastegate Lever
11:30 a.m.	Fiat Chrysler	Composite Low Cost/Low Weight Jack

Mechanical Engineering Design Program Awards

he Mechanical Engineering Design Program presents three project awards 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. This award considers the team's performance over the duration of the project, their presentations, the project solution, and prototype quality.

A second ME 481 Capstone 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 ME Design Program also presents the Leonardo da Vinci Machine Design Award to the winners of its ME 471 Machine Design competition. The specific design problem and criteria for this competition change from semester to semester.

Peckham, Inc.
Seam Sealing Assistive Device

Peckham, Inc. is a nonprofit vocational rehabilitation organization that provides employment and upward mobility for people with disabilities. At Peckham, high performance fleece and extreme cold weather clothing are manufactured for the military, together with other clothing through commercial contracts. Within the past year Peckham has begun to use seam sealing for waterproof and lightweight garments. Seam sealing is performed with a machine that applies sealing tape to the seam of a garment by heating the tape with hot air and then pressing the tape to the seam by running it between two rollers. During the seam sealing process, two operators are generally used to properly seal longer and more complex seams on the garments.

Our team is tasked by Peckham to create an assistive device to replace the second operator for the seam sealing process. The team will develop a device that will adapt to multiple types of seams, fabrics, and tapes. This device will be easy to use for the remaining seam sealer operator and will increase the time and efficiency of the seam sealing process.

PECKHAM
QUALITY • DIVERSITY • PERFORMANCE

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Peckham Inc.
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Yuping Wang
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Heartwood School
Therapeutic Mechanical Pony

Hippotherapy, or therapeutic horseback riding, provides exercise that is designed to benefit those who have a physical or emotional limitation. Though not a well-defined, measureable science, testimonies of many show the impact that horse therapy can have. Heartwood School wishes to embrace this world of hippotherapy through the development of their own mechanical pony.

Heartwood School adheres to the MOVE program philosophy, which stresses the influence that physical activity can have in improving the lives of their students. In light of this, our team strived to provide Heartwood with an opportunity to engage their students in an activity that is both physically beneficial and fun. The mechanical pony acts as a three-degree-of-freedom system which introduces movements that activate core and lumbar muscles, which are crucial for stability and motor control. Maintaining the aesthetics of an actual horse provides an emotional connection that captures the students' imagination and makes it feel as if they are going for an actual horse ride rather than performing routine exercise. The addition of a visually engaging system of riding videos and horse sounds further enhances the simulation of a real pony.

Ultimately, our team was able to implement a well-rounded design process to develop a piece of physical therapy equipment that aligns both with hippotherapy and Heartwood School's principles. The mechanical pony demonstrates that despite the students' limitations, they are only disabled when we deny them an opportunity.

Ingham Intermediate School District
Heartwood School

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Stacy Lantzy
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Mason, Michigan

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East Lansing, Michigan

Heartwood School
A Variety of Aids for Impaired Children

Heartwood School located in Mason, Michigan, is a part of the Ingham Intermediate School District. The school specializes in care for students with moderate to severe physical and cognitive impairments, between the ages of 3 and 26. Because of these impairments, students require continual help and support from the staff members of Heartwood. These staff members strive to enhance the ability of students to walk, and they believe each student should be given the chance to learn and succeed.

Our team was given the task of creating a guidebar for young children to be used for gait training. Another product will be created that aids staff members in the guidance of small wheelchairs and walkers so that caregivers will not have to bend or squat down to guide students. These devices, designed and created by the team, will adapt to previous methods of equipment usage at the Heartwood School. This system will allow students to learn how to make decisions on navigation, steering, and changes in direction, thereby providing increased student independence and self-confidence.

Ingham Intermediate School District
Heartwood School

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Michigan AgrAbility
Adjustable Hand Lever

Michigan AgrAbility provides critical assistance to enable people in the agricultural industry to continue working with an injury, illness or disability. Farmworkers with physical limitations to their legs have a very difficult time operating the foot pedals, which must be engaged numerous times daily, on farm machinery in order to feed livestock, work fields, clean barns and haul loads, as well as a multitude of other tasks.

In order to actuate the foot pedals safely, a considerable amount of force must be applied quickly over a relatively large range of motion. Currently, hand levers attached to the foot pedals allow workers with physical limitations to operate the agricultural machinery entirely with their hands. However, these hand levers require custom fitting for the specific farmworker because of the individual's arm length and strength. In addition, the custom shaping of each lever for each specific tractor is required.

Michigan AgrAbility wishes to develop an adjustable-shaped lever that is modifiable in the field. Our team collaborated with a vegetable grower from Munith, Michigan, who has lost the use of his right leg due to a rare infection. A system was developed that is easily assembled and modified to significantly improve Michigan AgrAbility's ability to help individuals with physical limitations and permit them to continue farming unhindered, thereby contributing to the public good.

AgrAbility
easterseals MICHIGAN STATE UNIVERSITY Extension

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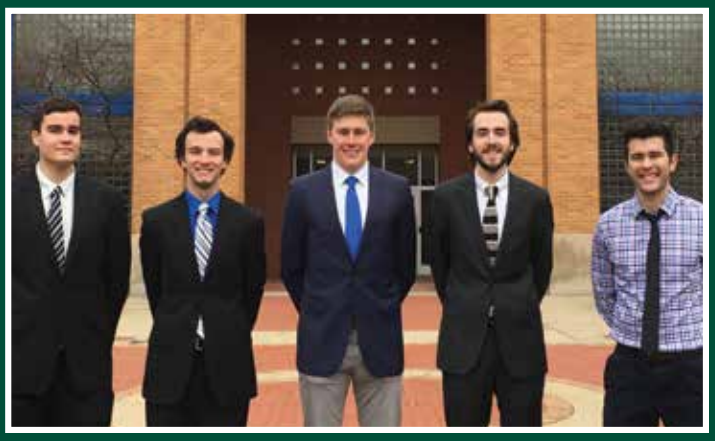
Whirlpool Corporation
Under Counter Icemaker

Whirlpool Corporation, headquartered in Benton Harbor, Michigan, is a worldwide leader in the production of large home appliances. Under familiar brand names including Maytag, KitchenAid, and Jenn-Air; Whirlpool manufactures everything in the household appliance sector from refrigerators to washing machines and even cooking surfaces. Whirlpool also dominates the residential under counter icemaker market, with 15" and 18" width models that produce 40 to 50 lbs. of ice in 24 hours. These products utilize a unique method of forming ice sheets by flowing water over a cooled plate, creating ice cubes that are both visibly clear and free of sediments. However, this special process currently requires more water than traditional methods such as freezing ice in trays. Whirlpool is seeking refinements to their system that curb water usage while ensuring that the ice stays clear and mineral-free and does not clump.

Our team has been tasked with reducing the water usage of the product while maintaining the quality and quantity of ice that customers expect, and has proposed solutions that must fit within the existing structure of the appliance. Successful designs could be implemented into future iterations of the icemaker. With a more efficient product, Whirlpool can ensure that its customers are saving money and reducing their environmental impact.



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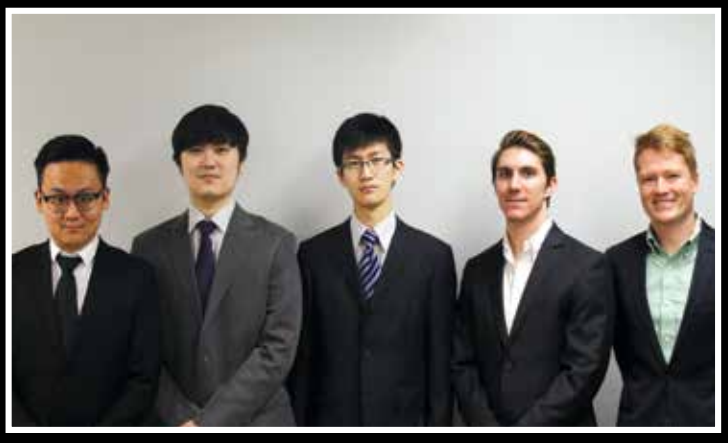
Whirlpool Corporation
Under Counter Icemaker #2

Whirlpool Corporation is the leading major appliance manufacturer in the world, designing in-home solutions that help make a difference in our everyday lives. The under counter icemaker produces up to 50 lbs. of clear ice per day, free of impurities and unwanted minerals. It operates by constantly circulating water over a freezing plate. As the water freezes into ice, the minerals in the water are rejected, producing a sheet of pure, clean ice. When the sheet reaches the desired thickness, it slides onto a grid that divides the sheet into individual cubes. The water containing the discarded minerals is drained after each freezing cycle.

Our team is working to provide a method to reduce the overall water consumption in the existing product. A prototype design will be compatible with the current general structure of the existing icemakers and will maintain the production of high-quality ice.



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MSU Adaptive Sports and Recreation Club
Hand-Cycle Propulsion Adapter

The MSU Adaptive Sports and Recreation Club has a current hand-cycle, the Pacific Handy Upright Hand-Cycle that, while useful to many of their athletes, is unable to provide a cycling experience to club members with more limited ranges of motion. The propulsion system on the hand-cycle is an in-phase dual crank, which requires the users to extend their arms to move the handlebars in a circle in order to rotate the gears. This motion, combined with an inability to adjust the seat position closer or further from the handlebars, results in a hand-cycle that is exclusive to those who have strong control over their torso and adequate upper body strength.

In order to provide a permanent solution for the Adaptive Sports and Recreation Club, our team has decided that the best course of action is to provide the club with an entirely new hand-cycle that will facilitate a cycling experience for athletes with limited ranges of motion. Input from Industrial Advisors (Piotr Pasik and Stephen Blosser) will be considered to ensure that the following criteria are met: the hand-cycle is designed with regard to the athletes that will be using it, and that it will be a long-lasting solution for the club.

MSU Adaptive Sports and Recreation Club

Michigan State University
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Karl Fischer
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MSU Adaptive Sports & Recreation Center
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ME Faculty Advisor

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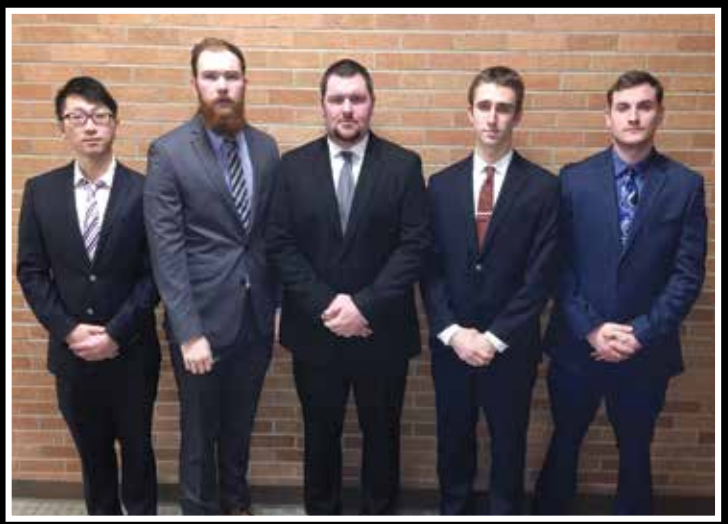
Bosch
Welding Fixture for Turbo Wastegate Lever

Bosch Mahle Turbo Systems (BMTS) develops and produces tailor-made, exhaust-gas turbochargers for passenger cars and commercial vehicles. With the current demand for more efficient and higher powered engines, turbocharger systems have become more popular on a wide range of vehicles. Turbocharging can increase the power and efficiency of an engine without increasing the size. Wastegates are a critical sub-system of turbochargers. They release the backpressure of the exhaust gasses when reducing engine load.

Currently BMTS North America relies on BMTS Headquarters in Germany for turbo-system prototyping. Without support from Germany, North American sample parts often get pushed back or not finished in a timely matter. A solution to this is to make the sample shop located in Farmington Hills, Michigan more capable of producing prototypes.

Our team is tasked to design a fixture and welding apparatus to complete the turbo assembly process. This would allow setting and welding of the wastegate actuator lever to the wastegate spindle. The fixture and welding apparatus will accommodate two turbo assemblies, one with a pneumatically actuated wastegate and one with an electronically actuated wastegate. A successful design will have a low processing time and accuracy of desired specifications which include actuator set specs, weld quality specs, and lever position specs. The completed project will save time and money for the BMTS North American branch, while reducing workload for the BMTS Headquarters in Germany.



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

Fiat Chrysler Automobiles
Composite Low Cost/Low Weight Jack

Fiat Chrysler Automobiles (FCA) is the world's seventh largest automaker. FCA brands are Chrysler, Dodge, Jeep, Ram, FIAT, Alfa Romeo, Maserati, Lancia, and Abarth. As with all automakers, FCA must meet impending emission standards around the world, including the United States' Corporate Average Fuel Economy standards. One way to meet these is to reduce the weight of the car, however the cost of a component ideally should not increase as its weight decreases. Recent technological advancements allow incorporation of composite materials in place of metals in automobiles. Use of composites can decrease the weight of components and allows for alternative manufacturing methods.

FCA has requested the redesign of the metal scissor jack included in its vehicles. The result of the redesign is a lower weight, affordable jack capable of production in volumes of up to one million units annually. The redesigned jack incorporates composites for major structural components in place of steel. The price of the jack was minimized throughout the design by optimizing the amount and type of material used. The composite jack meets the same testing requirements and has or will complete the same tests as the steel jack. All packaging constraints are met, including fitting within the spare tire compartment of the Chrysler 200.

FCA
FIAT CHRYSLER AUTOMOBILES

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THE MSU COLLEGE OF ENGINEERING

DESIGN DAY SPRING 2017

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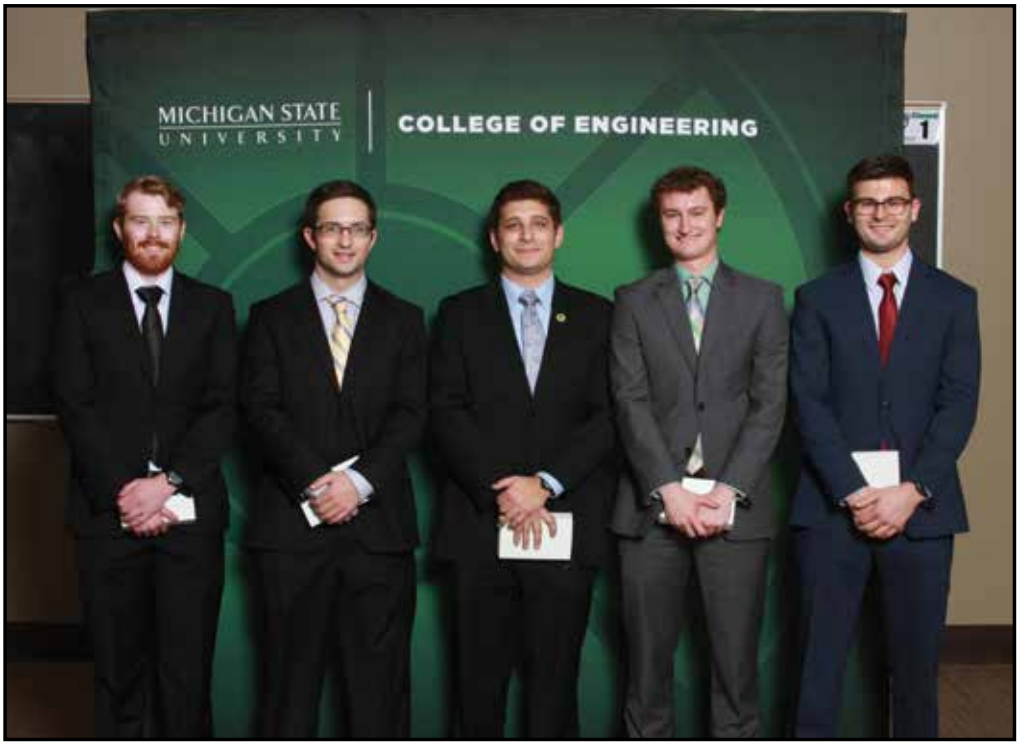
Design Day Awards

ME 481 Thomas Alva Edison Undergraduate Design Award



Left to right: Erik McGuire, Christopher Churay, Jonathan Bianchi, Cody Bradford, Daniel Riggs

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 developed a carbon fiber suspension system for the Formula SAE vehicle. The team was supervised by Prof. Gary Cloud. The winning Edison Scholars were Jonathan Bianchi, Cody Bradford, Christopher Churay, Erik McGuire, and Daniel Riggs.

Fall 2016

ME 481 Project Presentation Award:

The ME 481 Project Presentation Award for the best presentation of a design project was awarded to the team that designed an interchangeable grid for ice cube cutting. The team was supervised by Prof. Brian Thompson. Last semester's winners were Alexander Caine, Abigail Livingston, Darby Spiegel, Morgan Weber, and Abigail Wulf.

Left to right: Darby Spiegel, Abigail Wulf, Alexander Caine, Abigail Livingston, Morgan Weber

ME 471 Machine Design Award: The Leonardo da Vinci Award

The Leonardo da Vinci Award was presented to the team with the best design of a deployable bridge, supervised by Prof. Patrick Kwon.The winning team was Troy Baertson, Elizabeth Davidson, Devon Leasher, Jacob Overla, and Yuanyuan Wang.

Left to right: Jacob Overla, Devon Leasher, Yuanyuan Wang
Not Pictured: Troy Baertson, Elizabeth Davidson


ME 491

APPLIED ENGINEERING SCIENCES PROUDLY ANNOUNCES

The Mike Sadler Competitive Edge Award

As punter for Michigan State University's football team, Mike Sadler was well known for giving his team a competitive edge by flipping the field with perfect punts that pinned the opponents back near their own end zone.

In addition to being well known as an outstanding punter, Mike was also well known for being an outstanding scholar, exemplifying what it means to be a true student-athlete.

Mike was the first football player in Spartan history to earn Academic All-America honors four times. He was a two-time first-team Academic All-American, a National Football Foundation Scholar-Athlete, and a William V. Campbell trophy finalist.

Mike completed an undergraduate degree in Applied Engineering Sciences in just three years and then went on to earn a master's degree in Public Policy. After graduating from MSU in 2015, he was excited to begin Stanford Law School.

The Mike Sadler Competitive Edge Award will be presented annually to the Applied Engineering Sciences capstone team that strives to achieve the highest possible outcome in order to attain the next level of success. The winning project will be considered to have "flipped the field" with an innovative and creative solution that results in a competitive edge that not only solves the problem but distances itself from the competition.

"I am very proud to call myself an Applied Engineering Sciences alumnus. The program has fostered within me maturity, discipline, leadership, and a worldy sense of systems thinking."

- Mike Sadler

Applied Engineering Sciences
Proudly Announces
The Mike Sadler Competitive Edge Award

For information on sponsoring Design Day and design projects, contact

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