

# MECHANICAL ENGINEERING UNDERGRADUATE SYMPOSIUM

DECEMBER 8, 2016

# MEES



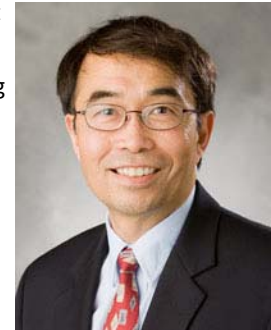
COLLEGE OF ENGINEERING  
MECHANICAL ENGINEERING  
UNIVERSITY OF MICHIGAN

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# Welcome

On behalf of the Mechanical Engineering Department at the University of Michigan, we would like to welcome you to the Fall 2016 Mechanical Engineering Undergraduate Symposium (MEUS).



MEUS provides a venue for our exceptional undergraduate students to showcase their projects from RISE (Research, Innovation, Service and Entrepreneurship) as well as their Design and Manufacturing X50 and X55 courses.

In RISE, our undergraduate students leverage our state-of-the-art facilities working side-by-side with internationally-renowned faculty to tackle cutting edge projects that impact our society. Projects range from transportation systems to mechanical system design and manufacturing, robotic systems, biological and fluidic systems, manufacturing processes and systems, and mechanical art!

Running concurrent to the MEUS poster and presentation sessions is Design Expo. Have an exciting day cheering for the ME 250 teams in their project competition, view the ME 350 four-bar linkage that automatically positions a cup to catch falling balls, and engage with our seniors as they display their ME 450 / ME 455 capstone design projects.

The goal of MEUS is to provide an intimate forum for a vibrant exchange of ideas and results within our University of Michigan ME Community. We are thrilled with the exceptional response. Our sincere appreciation goes to all the students and their RISE/X50/X55 mentors for choosing to share their very best work at MEUS. The planning of MEUS has been a significant team effort of faculty, staff and students. Our thanks go to them for assembling such an outstanding event.

Kon-Well Wang, PhD  
Tim Manganello/BorgWarner Department Chair and  
Stephen P. Timoshenko Collegiate Professor of Mechanical Engineering

# MEUS Planning Committee

## MEUS Technical Planning Committee

Diann Brei	MEUS Co-Chair
Claus Borgnakke	Poster Judge
David Dowling	Session Chair
Amy Hortop	ME 450 Course Coordinator
Chinedum Okwudire	MEUS Co-Chair / Session Chair / Poster Judge
Kenn Oldham	Session Chair
Gabor Orosz	Session Chair
Jwo Pan	Poster Judge
Noel Perkins	Session Chair
Mike Umbriac	ME 250 Course Coordinator / ME 350 Course Coordinator
Alan Wineman	Poster Judge

## MEUS / RISE Organizers

Ken Arbogast-Wilson	Tim Moore
Kristel Briney	Katie Morningstar
Rachel Casanova	Lisa Rogers
Grey Cichy	Nikki Taylor-Vargo
Michele Goci	Angela Wegrecki
Jacob Hayward	

## Graduate Student Judges

Ali Attari	Dian-Ru Li	Mehdi Sadeghpour
Robert Chisena	Yang Liu	Daniel Sullivan
Molong Duan	Neda Maghsoodi	Emma Treadway
Amin Ghadami	Ahmet Mazacioglu	Angela Wu
Saeed Kazemiabnavi	Christopher Pannier	Tong Xie
Narayanan Kidambi	Jeff Plott	Deokkyun Yoon
Justin Koczak	Keval Ramani	

# RISE: Research, Innovation, Service, and Entrepreneurship

Through the RISE program, mechanical engineering undergraduate students leverage our state-of-the-art facilities working alongside internationally-renowned faculty to tackle cutting edge projects that impact our society. The Mechanical Engineering Undergraduate Symposium (MEUS) is the accumulation of the students' work.



During the day, seniors in ME 490 will present their RISE projects in 20 minute presentations. Everyone is welcome to attend these sessions and ask probing questions!

Sophomores and juniors conclude their projects with a poster session during the evening reception, where students will be available to discuss their projects in detail. The posters will also be on display during the day, if you are unable to attend the reception.

The public is invited to peruse the posters, attend presentations, and interact with the students throughout the day.

# Schedule at a Glance

December 8, 2016

## Session 1: Transportation Systems

Room: 1642 GGB

9:20am-10:20am

## Session 2: Mechanical System Design and Manufacturing

Room: 2636 GGB

10:20am-11:40am

## Session 3: Robotic Systems

Room: 2540 GGB

10:40am-12:00pm

## Session 4: Biological and Fluidic Systems

Room: 2636 GGB

12:20pm-1:20pm

## Session 5. Manufacturing Processes and Systems

Room: 2636 GGB

1:40pm-3:20pm

## Session 6: Mechanical Art: Giant Rubik's Cube

Room: 2540 GGB

3:20pm-4:20pm

## Poster Session and ME Reception

BorgWarner Galleria

4:30pm-5:30pm

Reception open to ME students participating in Design Expo or MEUS.

## Session 1: Transportation Systems

Session Chair: Gabor Orosz

1642 GGB

9:20 AM

### Optimization for Maintenance of High-Speed Trains

Student: Zhiyi Chen

Instructor: Jun Ni

9:40 AM

### Tip in Water Injection for Diesel NOx Reduction

Student: Matthew McNamara

Instructor: Andre Boehman

10:00 AM

### Explore Knitting of Smart Materials to Create Changeable and Interactive Product Surfaces

Student: Lucy Zhuang

Instructor: Diann Brei

Co-Instructor: Jonathan Luntz

## Session 2: Mechanical System Design & Manufacturing

Session Chair: David Dowling  
2636 GGB

- 10:20 AM **Secure Cloud Manufacturing**  
Student: Dan Xu  
Instructor: Kira Barton
- 10:40 AM **ElectriFit**  
Student: Brandon Hazelton  
Instructor: Michael Thouless
- 11:00 AM **Scent Release Mechanism**  
Student: Arianna Carley  
Instructor: Karl Grosh
- 11:20 AM **Utility of Design Heuristics in Novice Designer  
Idea Generation**  
Student: Laura Murphy  
Instructor: Shanna Daly

## Session 3: Robotic Systems

Session Chair: Kenn Oldham  
2540 GGB

- 10:40 AM **Improving the Functionality of the E-Nable  
Raptor Reloaded Hand Through Redesign and  
Validation**  
Student: Jane Modes  
Instructor: C. David Remy
- 11:00 AM **Effect of an Articulated Spinal Joint on the Gait  
Dynamics of Quadrupeds**  
Student: William Yang  
Instructor: C. David Remy
- 11:20 AM **Design and Modeling of a Highly-Compliant  
Micro-Robot**  
Student: Yudong Chen  
Instructor: Kenn Oldham
- 11:40 AM **A Scaled Connected Vehicle Experiment Using  
Ground Robots**  
Student: Weilun Peng  
Instructor: Gabor Orosz

## Session 4: Biological and Fluidic Systems

Session Chair: David Dowling  
2636 GGB

12:20 PM **Stress/Strain Testing on Patient Ovarian Cancer Cells**

Student: John Bohenic  
Instructor: Krishna Garikipati

12:40 PM **Microfluidic Mechanical Cell Lysis**

Student: Joshua LeVay  
Instructor: Katsuo Kurabayashi

1:00 PM **Sake Bomb Entry Fluid Dynamics**

Student: Alexander Coryell  
Instructor: Eric Johnsen

## Session 5: Manufacturing Processes and Systems

Session Chair: Chinedum Okwudire  
2636 GGB

1:40 PM **Design and Fabrication of a Step Stage for Wafer Scanners**

Student: Bowen Zeng  
Instructor: Chinedum Okwudire

2:00 PM **Nano-Fabrication of MoS<sub>2</sub> Biosensor with Cycle-Wise Examination**

Student: Joseph Oh  
Instructor: Xiaogan Liang

2:20 PM **Spatial Atomic Layer Deposition Station**

Student: Andre Brooks  
Instructor: Neil Dasgupta

2:40 PM **Design of a Gas Delivery System for a Spatial Atomic Layer Deposition Station**

Student: Ezinwo Weli  
Instructor: Neil Dasgupta

3:00 PM **Ball Milling Then Hot Pressing as a Candidate Synthesis Method for Chalcogenide Perovskites**

Student: Christopher Bauer  
Instructor: Jeff Sakamoto

## Session 6: Mechanical Art: Giant Rubik's Cube

Session Chair: Noel Perkins  
2540 GGB

### 3:20 PM **Mechanical Art: Giant Rubik's Cube**

Student: Ryan Kuhn  
Instructor: Noel Perkins

### 3:40 PM **Mechanical Art: Giant Rubik's Cube**

Student: Douglas Nordman  
Instructor: Noel Perkins

### 4:00 PM **Mechanical Art: Giant Rubik's Cube**

Student: Jason Hoving  
Instructor: Noel Perkins

## Poster Session and ME Reception

BorgWarner Galleria  
4:30 PM - 5:30 PM

Mechanical Engineering is pleased to conclude the day's activities with a reception to celebrate a successful semester for the ME Community and to announce the RISE and X50 Award winners.

### ME 390 Posters

#### **Redesign of Compliant Joint for Improved Precision and Speed in Nanopositioning Stages**

Student: Xingjian Liu Instructor: Chinedum Okwudire

#### **Inflatable Devices for Automotive Applications**

Student: Xiangyi Ye Instructor: Diann Brei  
Co-Instructor: Jonathan Luntz

#### **Properties of the E-Jet Process at Various Environmental Conditions**

Student: Ryan Tepper Instructor: Kira Barton

#### **Pneumatically Controlled Digital Microfluidics**

Student: Parker Haffey Instructor: Jianping Fu

#### **Solar-Powered Electric Bicycle Trailer**

Student: Maria Roma Instructor: Kazu Saitou

#### **Splint Design for a Piezoelectric Cardiovascular Sensor for Detecting Intradialytic Hypotension**

Student: Danielle Park Instructor: Kenn Oldham

#### **Inflatable Devices for Automotive Applications**

Student: Varghese Vadakumcherry Instructor: Diann Brei  
Co-Instructor: Jonathan Luntz

# RISE Awards

We are pleased to hold three competitions for the Mechanical Engineering Undergraduate Symposium: Best Poster, Best Session, and Best Paper.

## **Best Poster Award**

All RISE ME 290 and ME 390 students will automatically be entered to compete for the Best Poster Award. The best poster will be judged by faculty and graduate students based upon quality of the project work, the poster, and the presentation of the work.

Winners of the award will be honored at the reception with a certificate and monetary award.

## **Best Session Award**

All RISE ME 490 students that present at MEUS will be automatically entered to compete for the Best Session Award. Judges will attend the presentations and will select the best of each session based upon the quality of the presentation and the project work.

Winners of each award will be honored with a certificate.

## **Best Paper Award**

The top RISE award is the Best Paper Award. The judges will review the final papers from the winners of the Best Session Award to select the best overall project based upon the quality of the project work and the presentation in both oral and written forms.

The winner of the Best Paper Award will be honored with a certificate and monetary award.

# Collaborating Programs and Student Organizations

We are very grateful for the assistance of our collaborating programs and student organizations in promoting RISE and helping to plan and execute MEUS.

The ME Graduate Council (MEGC) contributed as judges for our RISE awards. ASME and PTS were instrumental in the “retro video game” reception theme and activities. Please make sure to stop by during the reception to play a variety of retro video games.

## **ASME (American Society of Mechanical Engineers)**

ASME is an organization devoted to the enrichment of the UM Mechanical Engineering experience. Through seminars with professors, corporate information sessions, and visits to companies, ASME allows students to see the applications of classroom learning in the real world. Additionally, ASME works to create a community within the Mechanical Engineering Department by helping with events such as the ME Pancake Breakfast, Halloween Bash, and the ME T-shirt Contest. ASME provides an opportunity for students to meet and network through various social events, intramural sports, and community service. To learn more about our chapter, visit our website at <http://www.umich.edu/~asme/>.

## **PTS (Pi Tau Sigma)**

Pi Tau Sigma is the international mechanical engineering honor society. Juniors and seniors are invited to join based on their academic achievements, and are initiated after showing desired involvement with the society, department, and college. You can see PTS members around campus grilling brats in the warm weather, tutoring in the FLC, hosting corporate info sessions, volunteering at department events such as the Halloween Bash and Pancake Breakfast, and on the ice for IM broomball. To learn more about our chapter, visit our website at <http://www.umich.edu/~ptsme/>.



# Collaborating Programs and Student Organizations

## **MEGC (ME Graduate Council)**

MEGC serves as a liaison to voice the opinions, problems and issues of the graduate students in the Department of Mechanical Engineering. The council engages in organizing student-led research seminars, technical workshops, professional development events, outreach, mentorship, and social activities. Additionally, MEGC aids the department in activities such as recruiting weekends, new student orientation, etc. Visit our website at <http://me.engin.umich.edu/Gradcncl/index.html>.

## **College of Engineering Honors Program**

The College of Engineering Honors Program provides a unique opportunity for highly-motivated students to reach their full potential, both inside and outside of the classroom. Specialized academic requirements create an enriched learning environment that caters to the various disciplines of the College of Engineering. Honors students work closely with faculty and student mentors, facilitating strong intellectual bonds and personal growth, culminating in the creation of an Honors Capstone project. Students from Engineering Honors will be presenting their Honors Capstone project at the MEUS in December 2016. Visit our website at <http://honors.engin.umich.edu/>.

## **Multidisciplinary Design Program (MDP)**

The College of Engineering MDP offers students a wide variety of long-term, team-based experiential learning opportunities. We partner with research faculty and industry leaders to bridge the gap between the classroom and professional experience. Additionally, MDP pilots new models for experiential learning and conducts educational methods research to improve the quality of the experiential learning opportunities we offer. Students participate in MDP by joining a Faculty Research or externally-sponsored project, earning academic credit through a student competition team, or attending a technical workshop. The program is focused on engineering projects but is open to students from over eleven different schools and colleges across campus. To learn more about our program and academic minor, visit our website at <http://mdp.engin.umich.edu>.

# ME X50 and X55 Projects

The Michigan Engineering Design Expo is held concurrently with the Mechanical Engineering Undergraduate Symposium (MEUS).

The Design Expo showcases the achievements of our students in engineering design and prototyping, and demonstrates applications of their studies that solve real-world problems.

Students in mechanical engineering design and manufacturing courses (ME 250, 350, 450, and 455), will present their projects for the Design Expo during the ME Undergraduate Symposium.

## ME 250 Design and Manufacturing I

BorgWarner Galleria  
1:00 PM - 3:00 PM

In ME 250, the students learn engineering drawing; CAD and solid modeling; use of mechanical elements such as bearings, gears, and springs; engineering analysis; and manufacturing processes. They get hands-on experience using machine tools such as a milling machine, lathe, laser cutter, and water jet cutting machine, as well as a 3D printer.

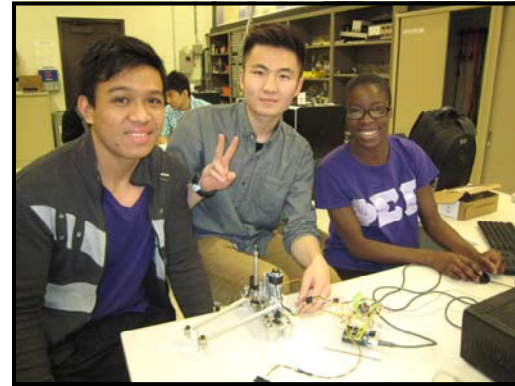
In the course project, the students put their knowledge to use. They work in teams of four to design and build a remote-controlled machine that must compete to move objects in an arena. The students learn to choose a strategy, generate concepts for the design, perform analysis on their concept, and then design the individual components. They are given a kit of materials which they

can use to manufacture the components using the student machine shop. They test and validate their designs before the competition, which is held during the MEUS.



## ME 350 Design and Manufacturing II

BorgWarner Galleria  
1:00 PM - 3:00 PM



In ME 350, the emphasis is on the model-based design of mechanical and mechatronic systems. The students learn the design of mechanisms, the design of mechanical elements for strength, and mechatronics. Mechatronics is the synergistic integration of mechanics, electronics, control theory, and computer science within product design and manufacturing, in order to improve and/or optimize its functionality.

In the course project, students work in teams of four to design, build, and test a four-bar linkage to automatically position a cup to catch falling balls. The students use a motor and transmission to move the linkage, limit switches to calibrate the linkage position, and an encoder to keep track of the position. The students learn to program an Arduino microcontroller board (running a PID controller) to receive the signals from the sensors and make decisions based on these signals, and send the output to the motor driver to position the cup to catch the balls. The Arduino also reads a color sensor to decide where to put each ball after it is caught.

## ME 450 Design and Manufacturing III

Mechatronics Lab/Blue Lounge/EECS Building  
12:00 PM - 4:00 PM

ME 450 is the capstone in our unique design and manufacturing sequence. Students are taught to approach open-ended design challenges through processes, to manage and work in collaborative teams, and to synthesize and apply diverse engineering knowledge to the design and manufacturing of real mechanical systems. Teams of 3-5 students work together on a semester-long design problem, typically from industry, or faculty research, and present a working prototype at Design Expo. Students are exposed to the design process from eliciting user needs and generating concepts through to prototype validation.

ME 450 projects can be viewed in the Mechatronics Lab , the Blue Lounge, and the EECS Building as part of the Design Expo from 12:00 pm - 4:00 pm.

## ME 455 / DESCI 501 Analytical Product Design

ME Assembly Room  
12:00 PM - 4:00 PM

In this intense immersive class, students are taught design of technical products from a multidisciplinary perspective that includes engineering, art, psychology, marketing, and economics. Using a decision-making framework, emphasis is placed on quantitative methods through building mathematical models and accounting for interdisciplinary interactions. Students work in teams of 4-6 students to elicit product specification through consumer and market research, generate concepts and engineer a detailed design to meet the product specifications, build and validate a proof-of-concept prototype and develop a business plan with financial analysis. Students reveal their product designs at Design Expo.

# ME Project Sponsors

The Mechanical Engineering Department would like to thank our Fall 2016 ME 250 and 450 project sponsors:

**ME 250**  
Shell



**ME 450**

Professor Mihaela Banu  
Professor Neil Dasgupta  
Mr. Garrick Hu  
Dr. Jacob Joseph  
Professor Kannatey-Asibu  
Dr. Thomas Konney  
Dr. Grant Kruger  
Dr. Ibrahim Mohedas  
Dr. Virginia Nelson

Dr. Samuel Obed  
Professor Johannes Schwank  
Professor Joe Trumpey  
Dr. Cornelius Turpin  
Dr. Benjamin Viglianti  
Ms. Brenda Vyletel  
Ms. Maria Young  
Mr. Robert Weinstein

U-M Orthotics and Prosthetics Center

U-M Global Health Design Initiative

U-M Laboratory for Innovation in Global Health Technology



# Maps

## GG Brown Building - ME 450 Projects

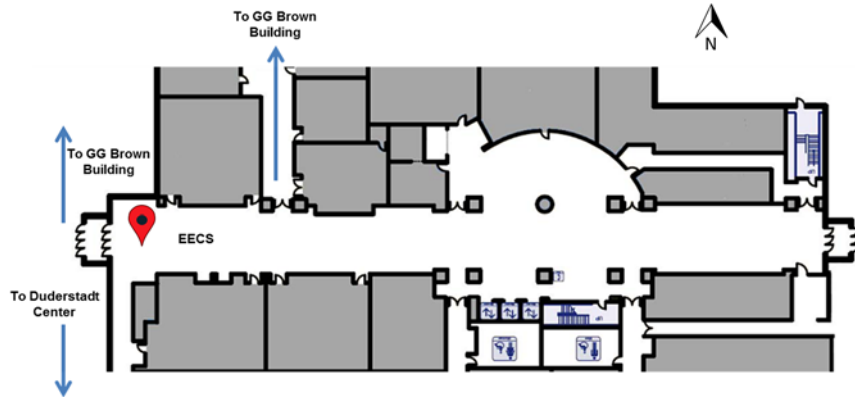


ME 450 Team	Project	Project Sponsor
Team 17	Micro-Actuation System	Dr. Grant Kruger
Team 18	Head-holder for Neurosurgical Procedures	Dr. Jacob Joseph
Team 21	Development of a Reaction Chamber	Dr. Benjamin Viglianti
Team 27	Treating Primary Postpartum Hemorrhage in Low Resource Settings	U-M Global Health Design Initiative
Team 28	Customized Instrumentation to Support Task-Shifting Medical Device Development and Pre-Clinical Trial Assessment	U-M Laboratory for Innovation in Global Health Technology
Team 29	Capturing and Measuring Blood Loss in Low-Resource Settings	U-M Global Health Design Initiative
Team 30	Durable Walking Aid for Use in Rural Low-Resource Settings	U-M Global Health Design Initiative
Team 31	Assistive Device for Removing Subcutaneous Contraceptive Implants in Low-Resource Settings	U-M Laboratory for Innovation in Global Health Technology; University of Michigan Global Health Design Initiative
Team 32	Relieving Pressure Sores in Immobile Patients in Low-Resource Settings	University of Michigan Global Health Design Initiative

ME 450 Team	Project	Project Sponsor
Team 2	Mobility Assist	VA Ann Arbor Healthcare System
Team 4	Redesign of the Telescoping Pogo Pin for Charging	X-Rite
Team 7	Crisp Crust Pizza	Tomatoes Apizza
Team 9	Heating System	White Lotus Farms
Team 10	Hoop House	NiftyHoops
Team 11	Gas Exhaust System for Nanoscale Thin Film Deposition System	Prof. Neil Dasgupta
Team 19	Baby Crib Redesign	Kids in Danger
Team 22	Design of 3D-Printed Custom Below Knee Prosthesis	UM Orthotics and Prosthetics Center
Team 23	Rube Codeberg	Student-Initiated
Team 24	Accessory to Increase Tire Traction to Improve Vehicle Travel in Gabon	REFRESCH
Team 25	Bamboo Bike	Prof. Mihaela Banu
Team 26	Stabilizing Wheels	FatWheels

# Maps

## EECS Building - ME 450 Projects



EECS Atrium (EECS Bldg)

ME 450 Team	Project Title	Project Sponsor
Team 1	Automotive Seating	Adient
Team 3	Development of Micro-PCM for Automotive Interiors	Toyota
Team 5	Corrugate Laser Cutting and Creasing	Packsized
Team 6	Packaging Distribution	Packsized
Team 8	Carbon Capture Canister	EPA
Team 12	Oil Lubrication System	Roush Industries Inc.
Team 13	Broil System	Whirlpool
Team 14	Selection and Testing of a Bearing Material for a Throttle Body Butterfly Valve	GW Lisk
Team 15	Development of System to Monitor, Record, and Display Load and Torsional Windup	Formsprag Clutch
Team 16	Performance Improvement Development	U-M Baja Team

# Maps

## GG Brown Building - ME 455 Projects



Assembly Room (1510 GGB)

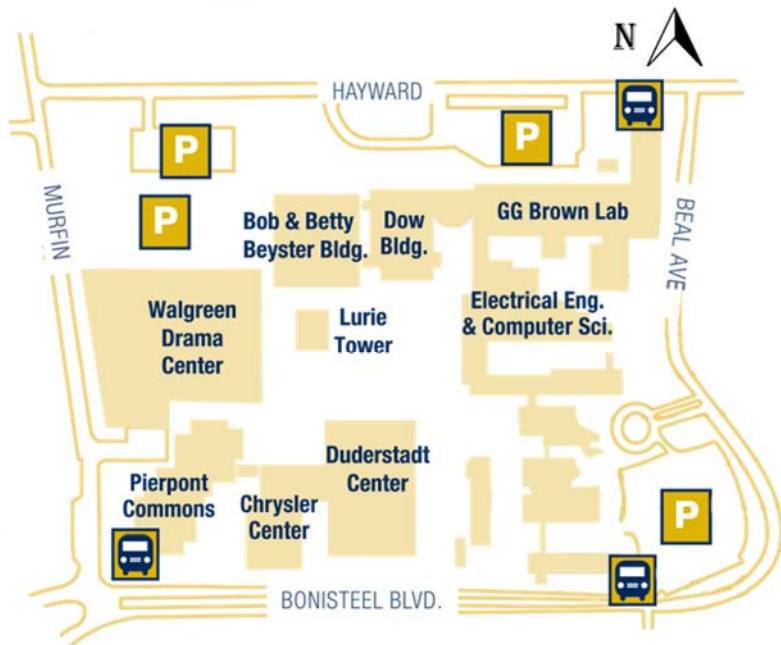
ME 455 Team	Project
Team deTravel Studio	cubo
Team M4U	IndiGO Brake
Team KIT 101	PetFree
Team Get on Up	Get on' Up
Team Funshades	Skyleaf
Team Design Kitchen	Innobrewer
Team Grocery Techs	QuickLift
Team Earbuddies	The Earbuddy
Team R^3	All-in-One Home Waste Disposal System
Team Awesome	The Trash Buggy

# Maps

## Borg Warner Galleria



## U of M North Campus



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